

**“Pushing myself is easier when physical activity is fun”  
Children and adolescents with asthma and their  
perceptions of participation in physical activity**



Thomas Westergren

“Pushing myself is easier when physical  
activity is fun”

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participation in physical activity

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## SUMMARY

*Background:* Physical activity (PA) in childhood and adolescence is associated with numerous short- and long-term health benefits, social inclusion, growth, and development. Asthma is common with a prevalence of 10-20% among children and adolescents, and may challenge participation in PA. Management of asthma includes control of the disease by medical treatment, and increased fitness and health through PA. Physical activity is influenced by a range of individual biological and psychological, interpersonal, and environmental factors, and knowledge about barriers and facilitators of PA in children and adolescents with asthma is needed.

*Aim:* The overall aim of the present thesis was to identify barriers and facilitators for participation in PA among children and adolescents with asthma including; (i) whether asthma related pathophysiological factors, asthma severity, socioeconomic factors, and PA were associated with perceived exercise limitation, (ii) whether psychosocial and socioeconomic factors were associated with level of PA, (iii) whether an active play exercise intervention was feasible, and how children perceived their participation in an active play exercise intervention.

*Design and methods:* From the Environment and Childhood Asthma birth cohort study, 302 children with asthma at 10 years, and 174 adolescents with (n=95) and without (n=79) asthma at 13 years participated in the study. Subsequently, six 10-12-year-old children with asthma were recruited to a six week active play exercise intervention pilot, which was a mixed-methods study. A literature review study was also conducted, consisting of 34 studies including 4-19-year-old participants with asthma. Lung function was assessed with flow volume loops and overweight was assessed by age and sex adjusted body mass index according to international standards. At 10 years, a treadmill-running exercise-test and a methacholine bronchial challenge were performed, and at 13 years and in the intervention pilot study, cardiorespiratory fitness testing and objective recordings of PA were conducted according to standardized procedures. Asthma severity was assessed based on dose of inhaled corticosteroids, use of  $\beta_2$ -agonists and/or leukotriene antagonists, and exacerbations in the last 12 months. Children's perceptions were collected by structured interview of parents and children and paper based self-administered questionnaires. In the intervention pilot, semi-structured focus group interviews and field observations were additionally conducted. Studies in the review were identified

by a systematic database search, and psychosocial and socioeconomic factors and issues in relation to PA level were extracted and charted.

*Findings:* Overweight was associated with a two-fold increase in the probability of reporting exercise limitation irrespectively of asthma severity, allergy, low household income, prenatal smoking or PA. Allergic rhinitis, comorbidity of allergic rhinitis and atopic eczema, severe bronchial hyperresponsiveness (provocation dose of  $\leq 1 \mu\text{mol}$  methacholine causing a decrease of  $\geq 20\%$  in forced expiratory volume at 1 second (FEV<sub>1</sub>)), maximal reduction in FEV<sub>1</sub> post exercise, and asthma severity were associated with perceived exercise limitation. Socioeconomic factors and self-reported PA were not associated with perceived exercise limitation.

Perceived competence-enjoyment and peer support were positively associated with vigorous intensity PA. In the systematic review, enjoyment (5/5 studies), physical self-concept (4/5 studies), self-efficacy (2/3 studies), attitudes and beliefs about PA and health (4/7 studies), psychological distress (3/4 studies), health-related quality of life (HRQoL) (2/3 studies), and social support (5/7 studies) were associated with PA level. Capability and being similar to peers in relation to PA were the most commonly reported issues by children with asthma in qualitative studies.

The active play exercise intervention pilot included attendance of 90%, no drop-out, exercise intensity  $\geq 80\%$  of maximal heart rate for two thirds of the time in endurance-type activities, no reports of asthma related exercise limitation or severe asthma attacks, easy-to-master activities, an inclusive atmosphere, humor, and mutual participation. Participating children reported satisfaction and enjoyment, appreciated being acknowledged as competent and normal, and experienced improved fitness and asthma post intervention compared with baseline.

*Conclusion:* Perception of exercise limitation was related to asthma related pathophysiological factors and severity of asthma. Increased PA level was associated with perceived enjoyment, competence/physical self-concept, self-efficacy, attitudes and beliefs about PA and health, HRQoL, and peer/social support. Capability and desire to be like peers were central issues in children's experiences with PA, and perceived every-day limitation could be changed into enjoyment, satisfaction, and experience of improved health in an active play exercise intervention acknowledging the competent and normal child.

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## LIST OF PAPERS

### Paper 1

Westergren, T., Berntsen, S., Lødrup Carlsen, K. C., Mowinckel, P., Håland, G., Fegran, L., & Carlsen, K-H. (2016). *Perceived exercise limitation in asthma: the role of disease severity, overweight and physical activity in children*. *Pediatric Allergy and Immunology*, Early Online 11 NOV 2016; DOI 10.1111/pai.12670.

### Paper 2

Westergren, T., Ommundsen, Y., Lødrup Carlsen, K. C., Carlsen, K-H., Mowinckel, P., Fegran, L., & Berntsen, S. (2015). *A nested case-control study: personal, social and environmental correlates of vigorous physical activity in adolescents with asthma*. *Journal of Asthma*, 52(2), 155-161.

### Paper 3

Westergren T., Berntsen S., Ludvigsen M. S., Aagaard H., Hall E. O. C., Ommundsen Y., Uhrenfeldt L., Fegran L. (2016). *Relationships between physical activity level and psychosocial and socioeconomic factors and issues in children and adolescents with asthma: a scoping review*. (Submitted 14<sup>th</sup> of December 2016 to JBI Database of Systematic Reviews and Implementation Reports - protocol was accepted for publication the 24<sup>th</sup> of October 2016)

### Paper 4

Westergren, T., Fegran, L., Nilsen, T., Haraldstad, K., Kittang, O-B., & Berntsen, S. (2016). *Active play exercise intervention in children with asthma: a PILOT STUDY*. *BMJ Open*, 6: e009721.

## ABBREVIATIONS

|                      |  |
|----------------------|--|
| BHR                  | bronchial hyperresponsiveness                    |
| BMI                  | body mass index                                  |
| EIB                  | exercise-induced bronchoconstriction             |
| ECA                  | the Environment and Childhood Asthma study       |
| FEF <sub>25-75</sub> | forced expiratory flow at 25-75% of FVC          |
| FEF <sub>50</sub>    | forced expiratory flow at 50% of FVC             |
| FEV <sub>1</sub>     | forced expiratory volume at 1 second             |
| FVC                  | forced vital capacity                            |
| HR                   | heart rate                                       |
| HRQoL                | health-related quality of life                   |
| ICS                  | inhaled corticosteroids                          |
| MET                  | metabolic equivalent                             |
| MPA                  | moderate intensity physical activity             |
| MVPA                 | moderate-to-vigorous intensity physical activity |
| PA                   | physical activity                                |
| PCC                  | Participants, concept and context                |
| V $\dot{O}_{2max}$   | maximal oxygen uptake                            |
| VPA                  | vigorous intensity physical activity             |



## 1.0 INTRODUCTION

Physical activity (PA) in childhood and adolescence is associated with numerous short- and long-term health benefits (1-3). Children and adolescents participating in higher levels of PA develop enhanced musculoskeletal health and motor skills, increased aerobic fitness, endurance, and bone mineral density (1-3). Moreover, children and adolescents with higher PA levels experience lesser symptoms of anxiety and depression, and develop a more positive physical self-concept (1-3). Academic performance is also reported to increase by PA level, and more physically active children and adolescents report increased pro-social behavior, well-being and quality of life (1, 3). Furthermore, increased PA levels are associated with reduced overweight/obesity/adiposity, reduced cholesterol, reduced inflammatory markers, reduced blood pressure, and improvement of cardiometabolic biomarkers (1-3). The higher PA level and intensity, the greater health benefits are reported (1-3). In addition to health benefits and reduced non-communicable diseases manifested in child- and adulthood (1), PA in childhood and adolescence provides an opportunity to develop competence of a healthier and more physically active life-course (4).

International evidence based recommendations for PA are at least 60 min per day of moderate-to-vigorous intensity PA (MVPA) including muscle- and skeletal strengthening activities (1-3), which is similar to the recommendation given by the Norwegian Directorate of Health (5). Physical activity as a behavior per se, and arenas of physical education, active play, and sports are important for physical, psychological, and social development and for social inclusion (4, 6-8). Adolescents who continue to participate in organized sports with increased age, report that participation is an opportunity for enjoyment, belonging with peers, and development in community with others (9).

Asthma is a chronic disease including airflow inflammation and limitation, shortness of breath, chest tightness, and cough (10) that challenges participation in PA (11). Prevalence of current asthma symptoms ranges from 12% in 6 to 7-year-old to 14% in 13 to 14-year-old children, globally (12). In Oslo, Norway, a prevalence of current asthma of 11% at 10 years (13), and of 18% at 16 years (14) has been reported from the similar birth cohort. In northern Norway, a prevalence of current asthma of 10% in age 7 to 14 has been reported (15). We may hence assume children with asthma are represented in most arenas where children and adolescents are present. Bronchoconstrictive response triggered by exercise is a common feature of asthma,

particularly in children and adolescents (16), reported in 37% of children with current asthma at 10 years (13). Thus, children with asthma may have specific challenges in meeting the recommended amount of PA, with possible negative consequences on their general health, development, and social inclusion (11). Moreover, PA is reported to positively influence cardiorespiratory fitness (17-19), and health-related quality of life (HRQoL)(17, 18, 20), and reduce bronchial hyperresponsiveness (BHR)(18), exercise-induced bronchoconstriction (EIB)(17, 18), and asthma symptoms (17, 18), while a small (18) or no effect on lung function is reported (19).

Rehabilitation of children with asthma has been guided by clinical multidisciplinary practice at special hospitals including improved mastering of physical activity with increased fitness and health through exercise, detailed history of symptoms and triggers, and increased control of the disease by medical treatment (21-23). Such practice and rehabilitation is in line with international evidence and recommendations (24), and the Merem Asthma Center in Netherlands/Switzerland, and Voksentoppen and Geilomo in Norway represent such institutions. To reduce asthma symptoms induced by PA, appropriate control of the disease by inhaled corticosteroids (ICS), and pre-treatment with short acting  $\beta_2$ -agonists before PA are recommended (16). In addition, long acting  $\beta_2$ -agonists and leukotriene antagonists may be added when needed (16). Nasal breathing, pre-exercise warm-ups, and post exercise warm-downs are also recommended along with anti-cold masks for PA in cold environments (16).

In the last decades, earlier identification and phenotyping of the asthma diagnosis in individuals along with better and more targeted treatment options have improved possibilities for well-controlled asthma (25). Nevertheless, non-optimally treated asthma may limit possibilities for PA (16). Children and parents may believe PA in asthma is unfavorable (11, 26), and avoidance of symptoms through reduced participation in PA has also been reported (27). The unfavorable coincidence of reduced health and inactivity in asthma is supported by reported associations between aerobic fitness and psychological functioning (28), as well as perceived physical competence (29). Barriers to PA experienced by children with asthma may be further understood through reports of perceived stigma of experiencing symptoms publicly during PA, and of using medications in public (30). Recently, following the focus on asthma and doping in elite athletes, reports in media of children not using their medication in fear of being accused of doping (31) may illustrate novel challenges of

children with asthma concerning participation in PA. Therefore, the present thesis focuses on barriers and facilitators of PA among children and adolescents with asthma.

## **2.0 BACKGROUND**

### **2.1 Definitions**

#### **2.1.1 Assessment of physical activity level**

Physical activity is defined as any bodily movement such as play, exercise, or daily activities produced by the contraction of skeletal muscles that increases energy expenditure above resting levels (32). Energy expenditure may be measured directly by heat production, indirectly by oxygen consumption, and estimated by objective measures of steps per day, accelerometer counts per minute, or heart rate (33). Energy expenditure may also be estimated by subjective reports of exhaustion, and by observation or self-reports of activities conducted related to estimated energy costs of certain activities (33). Resting levels of energy expenditure are generally referred to as one metabolic equivalent (MET) defined as an oxygen consumption of 3.5ml/kg body weight/min (34). Level of PA is hence commonly assessed by a measure or estimate of energy expenditure expressed by METs in a given time span, or more specific by the intensity (of PA) related to the duration e.g. METs minutes or time spent in PA at a given intensity cut-off such as e.g.  $\geq 3$  METs. Intensity measured by energy expenditure is essentially a continuum of rates of energy expenditure across any bodily movement (34). Intensity of PA, and categorization or grouping of PA level varies in the literature, both depending on descriptive terms of intensity and cut-offs used, and whether intensity is expressed with absolute levels of energy expenditure or relative levels of energy expenditure related to aerobic fitness levels (maximal oxygen uptake;  $\dot{V}O_{2max}$  expressed as ml/min/kg body weight) as illustrated in Figure 1 (34). Cut off points defining categories of PA are in the present thesis based on MET values (34). Light intensity PA corresponds to  $1.6 \leq 2.9$  METs which does not normally cause a noticeable change in respiratory rate or body temperature. Moderate intensity PA (MPA) corresponds to  $3 \leq 5.9$  METs and activities accompanied by an increase in respiratory rate whilst participants can still maintain a conversation uninterrupted. Vigorous intensity PA (VPA) corresponds to  $\geq 6$  METs and a respiratory rate whereas a conversation generally cannot be maintained uninterrupted. When self-reported measures are included, PA is categorized by time spent in defined intensity zones, or by time spent in specified activities which is then used to calculate energy expenditure as METs minutes (35). Level of PA may, in addition to assessment and expression of intensity and duration, also be assessed by frequency, type and mode (33), either with or without estimation of energy expenditure or expression of METs.

| Intensity category | Objective measures  | Subjective measures              | Descriptive measures   |
|--------------------|---|----------------------------------|--|
| <b>SEDENTARY</b>   | < 1.6 METs<br>< 40% HR <sub>max</sub><br>< 20% HRR<br>< 20% VO <sub>2max</sub>            | RPE (C): < 8<br>RPE (C-R): < 1   | <ul style="list-style-type: none"> <li>activities that usually involve sitting or lying and that have little additional movement and a low energy requirement</li> </ul>   |
| <b>LIGHT</b>       | 1.6 < 3 METs<br>40 < 55% HR <sub>max</sub><br>20 < 40% HRR<br>20 < 40% VO <sub>2max</sub> | RPE (C): 8-10<br>RPE (C-R): 1-2  | <ul style="list-style-type: none"> <li>an aerobic activity that does not cause a noticeable change in breathing rate</li> <li>an intensity that can be sustained for at least 60 minutes</li> </ul>              |
| <b>MODERATE</b>    | 3 < 6 METs<br>55 < 70% HR <sub>max</sub><br>40 < 60% HRR<br>40 < 60% VO <sub>2max</sub>   | RPE (C): 11-13<br>RPE (C-R): 3-4 | <ul style="list-style-type: none"> <li>an aerobic activity that is able to be conducted whilst maintaining a conversation uninterrupted</li> <li>an intensity that may last between 30 and 60 minutes</li> </ul> |
| <b>VIGOROUS</b>    | 6 < 9 METs<br>70 < 90% HR <sub>max</sub><br>60 < 85% HRR<br>60 < 85% VO <sub>2max</sub>   | RPE (C): 14-16<br>RPE (C-R): 5-6 | <ul style="list-style-type: none"> <li>an aerobic activity in which a conversation generally cannot be maintained uninterrupted</li> <li>an intensity that may last up to about 30 minutes</li> </ul>            |
| <b>HIGH</b>        | ≥ 9 METs<br>≥ 90% HR <sub>max</sub><br>≥ 85% HRR<br>≥ 85% VO <sub>2max</sub>              | RPE (C): ≥ 17<br>RPE (C-R): ≥ 7  | <ul style="list-style-type: none"> <li>an intensity that generally cannot be sustained for longer than about 10 minutes</li> </ul>   |

**Figure 1** Absolute and relative intensity ratings of PA © Norton et al. 2000.<sup>1</sup>

Abbreviations: METs; metabolic equivalents, HR<sub>max</sub>; maximal heart rate, HRR; heart rate reserve, VO<sub>2max</sub>; maximal oxygen uptake, RPE; rating of perceived exertion, C; category scale (6-20), and C-R; category-ratio scale (0-10).

### 2.1.2 Psychosocial correlates of physical activity

Psychosocial correlates of PA concern factors that contribute to, or are barriers to participation in PA. According to Bauman et al. (36, 37), such factors are in the present thesis defined as perceptions or cognitions measured individually and reported by participants themselves. Factors are sorted as intrapersonal (motivation, beliefs, and cognition), interpersonal (support from others, and cultural norms and practices) or environmental (social, built and natural environment), and have been reported to connect with none, one or several specific behavioral theories and models, as described elsewhere (37).

<sup>1</sup> Reprinted from Journal of Science and Medicine in Sport, 13 /5, Norton K, Norton L, Sadgrove D., Position statement on physical activity and exercise intensity terminology , 496-502., Copyright (2010), with permission from Elsevier

### 2.1.3 Socioeconomic factors

The term ‘socioeconomic factors’ relates to a multidimensional concept comprising educational level, income, occupation, and/or other indicative composite measures such as car ownership, unshared bedrooms, and internet access (38-40). Measures may be assessed at an individual level, or by a household or neighborhood level (40). Neither of those features of socioeconomic measures are interchangeable, and use of such factors rely on the context and the instruments used (40). Measures need to be refined according to economic, technological and societal changes in a given society (39).

### 2.1.4 Asthma, severity and control

*“Asthma is a chronic inflammatory disorder associated with variable airway obstruction and bronchial hyperresponsiveness. It presents with recurrent episodes of wheeze, cough, shortness of breath, and chest tightness.”*(25,p.978). In primary care the diagnosis often relies on symptoms only which are not specific to asthma and overlap with other conditions although confirmation by objective measures, such as reversibility to bronchodilators or BHR is recommended (10). Asthma has been identified as a heterogeneous disease for decades (41), and different phenotypes have been described: allergic asthma, non-allergic asthma, late-onset asthma, asthma with fixed airflow limitation, asthma with obesity (42), or virus-, allergen-, exercise-, or multi-trigger-induced, unresolved, or obesity asthma (25). Recently, a sports asthma phenotype has been suggested, particularly identified in water- and winter-sport athletes (43).

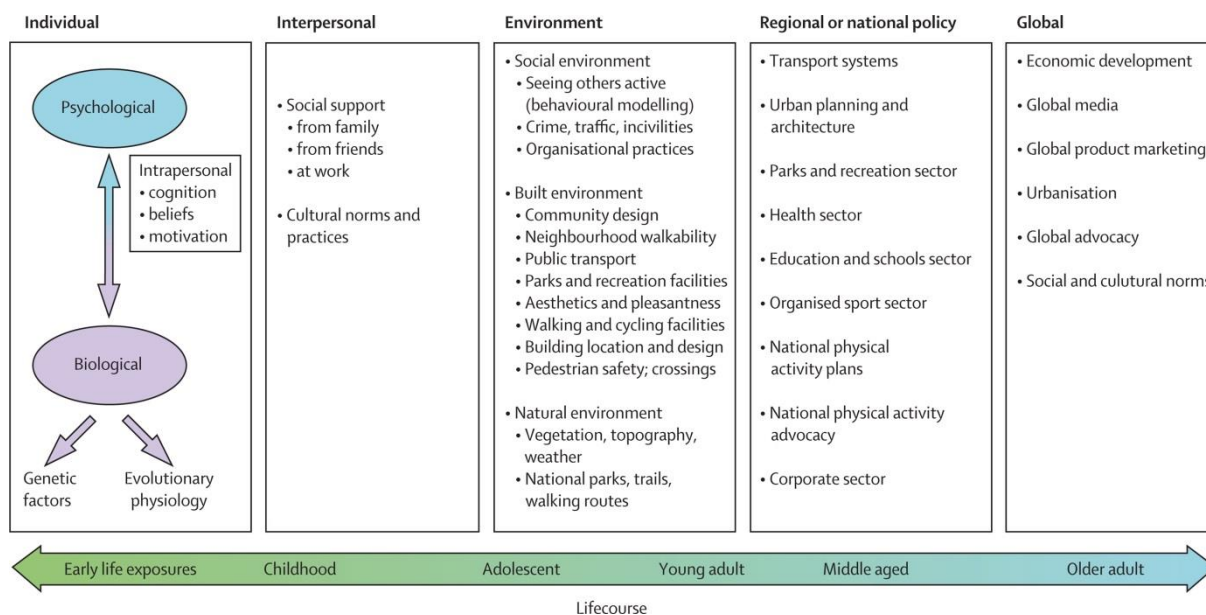
Asthma control *“refers to the extent of which the manifestations of asthma have been reduced or removed by treatment. Its assessment should incorporate the dual components of current clinical control (e.g. symptoms, reliever use and lung function) and future risk (e.g. exacerbations and lung function decline)”*(10,p.545). Asthma severity may refer to the intensity of the respiratory distress (dyspnea), the speed of onset and the degree of disability, the amount of treatment required to maintain control, the degree of loss of lung function, the level of response to challenge agents, and the degree of inflammation (10). Disease severity may be classified as intermittent, mild, moderate and severe based on treatment required to control symptoms (10, 25). Assessing severity based on prescribed controller medication; however, may cause confusions as it is based on the assumption that patients are

prescribed and use the appropriate medication (10, 25, 42). Furthermore, issues of compliance to treatment, comorbidities, exposure to environmental agents, and psychosocial influence may confuse the assessment of severity by treatment required to control symptoms, and severity and control may be difficult to distinguish (42). Due to treatment and environmental exposure, symptoms, airway obstruction measured by spirometry, and airway inflammation may change rapidly (10, 44, 45), while airway remodeling and bronchial responsiveness change comparatively slowly (10). Clinical manifestations and measures of underlying disease mechanisms may hence not correspond well (10).

Asthma severity is hence defined as *“the intensity of treatment required to achieve good asthma control, i.e. severity is assessed during treatment. Severe asthma is defined as the requirement for (not necessarily just prescription or use of) high intensity treatment. Asthma severity may be influenced by the underlying disease activity and by the patient’s phenotype, both of which may be further described using pathological and physiological markers. These markers can also act as surrogate measures for future risk.”* (10,p.545)

## **2.2 Determinants and correlates of physical activity level in children and adolescents**

In order to understand why people are physically active or inactive, attention to influencing factors is needed. Moreover, a variety of factors underpinned by different theories and models ranging from individual to global may influence PA level during the life-course (36). Such factors may be integrated in an ecological model to guide an improved understanding of combination and interaction of factors related to PA level. Figure 2 is a visualization of an ecological model including the complexity of elements influencing PA during the life-course (36). Most studies investigating why some people are active and others inactive are based on cross-sectional measures indicating correlates of PA. Determinants of PA are used to describe association between influencing factors and PA level in studies based on longitudinal or experimental designs assuming casual relationships (36).



**Figure 2** Adapted ecological model from the Lancet Physical Activity Series Group © (Bauman et al. 2012).<sup>2</sup>

There is a large body of evidence related to factors influencing PA level (36, 46). In a review, Bauman et al. (36) reported consistent positive associations between PA level and male sex, self-efficacy, perceived behavioral control, previous PA, and support of PA. In another review, Sterdt et al. (46) reported positive associations between PA level and male sex, younger age, Caucasian ethnicity, perceived competence, self-efficacy, goal orientation/motivation, outcome expectations, less perceived barriers, participation in community sports, parental support, support from significant others, access to sport/recreational facilities, time outdoor, parental education, family income, and socioeconomic status in children and adolescents.

Recently, correlates of objectively recorded VPA from >24,000 5 to 18-year-old participants from ten countries and five continents were reported. Vigorous PA declined yearly, and more in girls vs. boys, white vs. non-white, maternal high school educated vs. college/university educated, and in overweight/obese vs. normal weight (47). Overweight may follow inactivity, but is also reported as a barrier of PA. Higher body-related and social barriers, lower social support, and personal and environmental resources of PA were reported in overweight children and adolescents compared to normal weight subjects. Associations were accentuated in girls compared to boys (48). Moreover, in a review of qualitative studies concerning barriers of PA in overweight

<sup>2</sup> Reprinted from The Lancet, 380. 9838, Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJF, Martin BW, Correlates of physical activity: why are some people physically active and others not?, 258–71., Copyright (2012), with permission from Elsevier.



children, general barriers of PA were reported as exacerbated by weight status. Environmental and interpersonal challenges reinforced intrapersonal barriers to PA and increased vulnerability and victimization, and children with low socioeconomic status or of minority ethnicities were reported as even more vulnerable in relation to PA (49).

In Norway, PA among children and adolescents, aged 9 and 15 is reported to be located in different locations; school commuting, informal school games and play, organized sport, structured exercise, and games and play in leisure time (50). Psychosocial factors may explain 15-55% of the variation in PA level whereas peer support, enjoyment of PA, and perceived competence in PA were associated with PA level in all contexts. Parental support had the strongest association with leisure-time PA, while teacher support was most strongly associated with school located informal games and play. Enjoyment of physical education classes was associated with PA in active school commuting. Physical and social environments were only marginally associated with PA level (50). Bergh et al. (51) recorded PA objectively in 11-year-old children. Authors reported that normal weight compared with overweight/obese children, and children with higher self-efficacy and higher perceived peer support participated more in MVPA. An inverse association between computer/game-use on weekends and MVPA was reported, which was also accentuated in overweight/obese children (51).

Evidence of correlates of PA is reported as a well advanced field of knowledge while there is a need for more longitudinal studies (36). Additionally, more focus on multidimensional approaches related to (socio-)ecologic models, and greater attention to subgroups of children and adolescents is needed (36, 46).

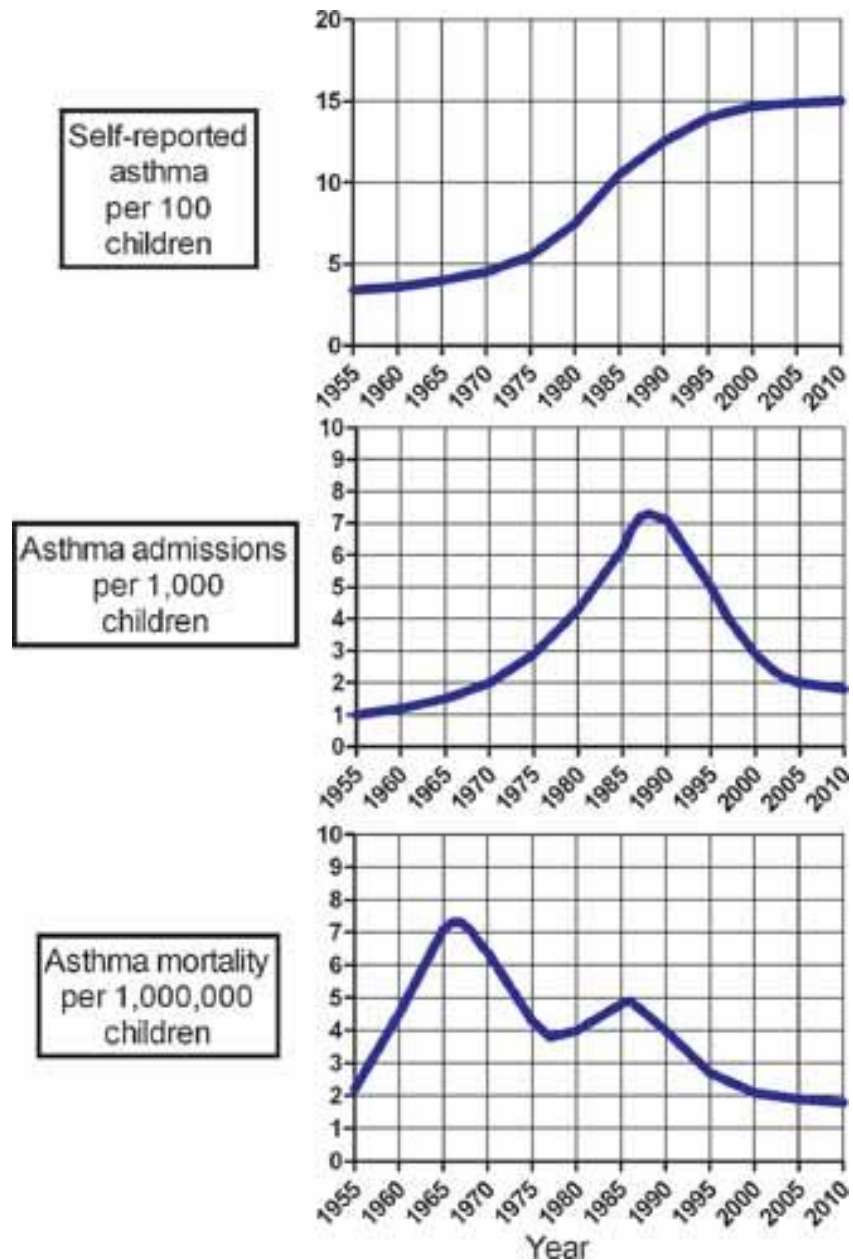
### **2.3 Prevalence of asthma, hospital admissions and mortality**

Three coincidental trends from the 1950s to 2010 in developed countries have been reported; increased self-reported asthma prevalence, decreased hospital admissions from the 90s, and decreased asthma mortality with a peak in the 60s and the 80s (Figure 3)<sup>3</sup> (52).

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<sup>3</sup> Reprinted from *Pediatric Pulmonology*, 47. 3, Chawla J, Seear M, Zhang T, Smith A, Carleton B, Fifty years of pediatric asthma in developed countries: How reliable are the basic data sources?, 211–9., Copyright (2012), with permission from John Wiley and Sons.

**Figure 3** Long-time trends in asthma prevalence, hospital admissions, and asthma mortality © (Chawla et al. 2012).



In 2009, the global prevalence of current asthma was 12% and 14% in 6 to 7-year-old and 13 to 14-year-old children, respectively, with prevalence variation between countries ranging from 1-38% (12). A higher prevalence of asthma in higher income countries, and of severe asthma in lower income countries was reported (12). Prevalence in Western Europe was 10% and 14%, respectively for the two age-groups (12).

In Norway, lifetime prevalence of asthma in 10-year-old children has been reported to be 20% based on a birth cohort in Oslo. Boys more often than girls had current asthma (14 vs. 7%) and wheeze ever (37 vs. 23%) (13). In a more recent report from Northern Norway, asthma (ever) prevalence increased from 7% in 1985 to 18%

in 2008 (21% in boys, 14% in girls) in 7 to 14-year-old children (15). In the 16-year follow-up of the birth cohort in Oslo, prevalence had increased to 37%, whereas 18% had current asthma (14).

A shift from higher prevalence among boys in childhood towards higher prevalence among girls in adolescence has been reported (53, 54). The asthma definition may influence prevalence rates and gender differences between studies according to Henriksen et al. (53), who reported similar prevalence (11%) of doctor diagnosed asthma. Contrary, including wheeze and confirmed BHR, the estimated prevalence of current asthma in 13 to 19-year-old adolescents was 18% in girls and 11% in boys (53). Similar trends were reported in a Swedish cross-sectional study (54).

From 1980-95 admittance rates for acute asthma in 0 to 3-year-old children increased in Oslo (55). Simultaneously with increased first admission rates, readmissions decreased, as did the length of hospitalization. Prophylactic treatment with ICS increased into 1989, while short course use of systemic steroids increased from 1991 (55). A more recent study conducted in Western Norway confirmed those trends, including also a decline in overall hospital admission rates from 1989/90 to 2009/10 in 1 to 13-year-old children with asthma, along with increased treatment of ICS (56).

## **2.4 Risk factors for asthma development**

Several environmental factors have been suggested to partly explain the increase in asthma prevalence during the 20<sup>th</sup> century, including exposure in utero, early childhood, and later in life (57, 58). Risk factors are mainly reported from observational studies, and few factors have been assessed in primary prevention studies (59). Environmental risk factors of asthma include exposure to tobacco smoke, air pollution, allergens, infections, microbial substances in the environment, cold dry air, and diet (16, 57). Overweight and obesity are also reported as risk factors of asthma and morbidity (57, 58). Increased risk of asthma is also reported to be associated with socioeconomic factors (60, 61), and poverty, stress, discrimination, and neighborhood disadvantage (62).

Atopic, or allergic asthma, is the predominant phenotype linking allergic sensitization and subsequent asthma (63). Distinguishing between allergic and non-allergic asthma; however, may denote the importance of asthma phenotypes related to

different risk-factors (59, 64). Environmental exposure was by Janson et al. (64) identified as risk factors primarily in non-allergic asthma, while increased body mass index (BMI) was associated with both allergic and non-allergic asthma.

Exposure to smoking in utero and later (54, 59, 61, 65, 66) is a confirmed risk factor of asthma development. A positive association between asthma and exposure of gas, dust, or fumes confirms that air pollution increases the risk of asthma development (54, 59). Childhood vaccination are reported as a protective factor (61), as well as associated with increased asthma risk (67). Infections before 2 years of age have been identified as risk factors of asthma at 6 years of age (59, 67). Children of obese mother's are also reported to have increased prevalence of respiratory infections and wheeze (68).

Heredity of asthma and allergy is established as a known risk factor of asthma (54, 59, 61, 67). Risk factors interact with underlying pathways which are genetically determined (57, 58). No single gene has been identified as an 'asthma predictor', while there are growing evidence of possible epigenetic pathways induced by environmental exposure, pointing on the interplay of host and environmental risk factors (69). Studies comparing asthma development and risk factors in urban and rural areas might point in the direction of combinations of exposure in favor of exposure to single factors influencing the immune system both in direction of protection of, and development of asthma (70). For instance, children being raised at a farm have lower risk of asthma development (54). In a recent meta-analysis, children exposed to farming environment had 25% lower prevalence of asthma compared to those not exposed (71).

The prevalence of asthma and BHR increases in athletes with increased age, particularly identified in winter-sport athletes and swimmers (16, 72). During PA a subject is exposed to increased environmental agents due to increased ventilation. Hence, PA in cold air, in ice rinks with enhanced levels of nitrogen oxide and ultrafine particles, in chlorinated swimming pools, in seasons or places with high levels of allergens, and in polluted air increases the exposure to irritants (16, 72). Moreover, cooling of airways (vascular / thermal mechanisms) and water loss (airway drying / osmolality) during increased ventilation in PA may cause a combination of smooth muscle constriction and mucosal edema, reduce bronchial lumen, and increase airway resistance, in addition to immune response (16). Thus, PA may potentially induce and aggravate asthma, BHR, and asthma symptoms (16, 72). Increased exhaled nitric oxide has been reported in association with time spent in VPA in healthy adolescents (73),

and the reported sports asthma phenotype (43) confirms intense endurance exercise as a possible risk factor of asthma. Furthermore, exercise induces immune response and increases circulating inflammatory cells (74, 75), whereas the potentially favorable or unfavorable effect on asthma development remains unclear (76, 77).

## **2.5 Benefits of and challenges with PA in asthma**

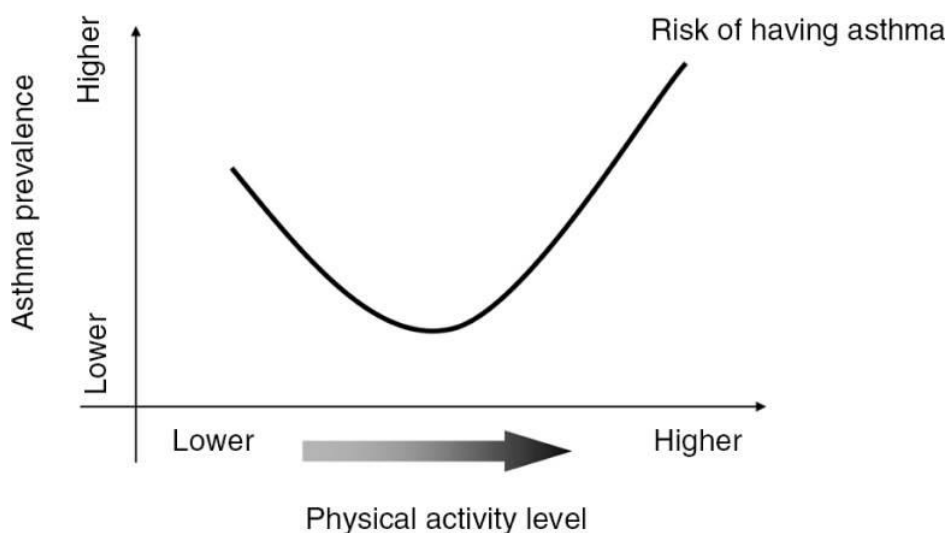
International recommendations of at least 60 min / day in MVPA in childhood and adolescence are based on research linking PA to health benefits (1-3). In addition, arenas of physical activities are also arenas of physical, psychological and social development, and arenas of community with peers (4, 6-8). In addition to health benefits documented in the general child population, health benefits specific to asthma are additionally documented. Cardiorespiratory fitness has been reported to be associated with psychological functioning in children with asthma (28). Flapper et al. (78) reported increased HRQoL including physical, social, emotional, and cognitive functioning, and that children were ‘happier’ after an exercise and education intervention.

Improved cardiorespiratory fitness, HRQoL, and lung function, reduced asthma symptoms, EIB, and BHR by direct bronchoprovocation were reported in a meta-analysis of exercise intervention effects by Eichenberger et al. (18) Carson et al. (19) also reported improvement of cardiorespiratory fitness following exercise in a meta-analysis including 21 studies. In addition, some limited evidence of increased HRQoL were reported (19). Influence of exercise on lung function was; however, not evident (19). In a systematic review including only children with asthma, Wanrooij et al. (17) reported reduced EIB and asthma symptoms, and improved cardiorespiratory fitness and HRQoL (17). Moreover, in none of the abovementioned meta-analyses or systematic reviews, adverse effects of PA were reported, indicating that PA is feasible, safe and can be recommended for children with asthma (17-19).

An observed association between fitness and reduced asthma prevalence has been reported in a longitudinal study (79, 80), as well as between PA level and asthma in two meta-analyses (76, 81). Different mechanisms may; however, be involved. Low physical fitness and PA may appear coincidentally with other lifestyle factors reported as risk factors of asthma such as overweight, allergen exposure, diet, and stress (59, 79).

Physical activity is a potentially harmful trigger of bronchoconstriction, induced by hyperventilation, hyperosmolality, and bronchial heat loss (16). In the general population, a prevalence of EIB of 19% has been reported in 14-year-old adolescents (82), while a prevalence of 37% in 10-year-old children with current asthma and 6% in peers without asthma was reported by Carlsen et al. (13). In addition, PA may take place in cold air, during seasons with increased allergens, and in areas or places with high levels of air pollutants while larger breathing volumes during PA also increases level of environmental exposure (16, 72, 83, 84). Prolonged, intense exercise may also increase the risk of respiratory viral infections (85), and increased BHR may occur by exercising during ongoing respiratory tract infections (84).

Therefore, PA in asthma has been reported as a double-edged sword (83). Intensity of PA is reported as a key issue concerning benefits of, and challenges with PA in asthma, with a ‘U’-shaped dose-response curve between PA and asthma risk (Figure 4) (16). To facilitate PA, control of the disease by ICS, and pre-treatment with short acting  $\beta_2$ -agonists before PA, long acting  $\beta_2$ -agonists, and leukotriene antagonists when needed should be prescribed(16, 84). Moreover, nasal breathing (if possible), pre-exercise warm-ups, post exercise warm-downs, anti-cold masks, pre-cautions regarding cold air, infections, allergens and pollutants are also recommended to limit the possible negative consequences of PA in asthma (16, 84). Individual follow-up of the child with asthma is hence necessary to facilitate PA, active play, and sports (84).



**Figure 4** Suggested dose-response relation between PA and asthma risk © (Stefano R. Giacco et al. 2015).<sup>4</sup>

<sup>4</sup> Reprinted from European Clinical Respiratory Journal, 2. 27984, Del Giacco SR, Firinu D, Bjermer L, Exercise and asthma: an overview., 27984., Copyright (2015), with permission according to the Open Access terms of Creative Commons Attribution 4.0 International License, and with allowance from Dr. André Moreira who co-created the figure with Prof. Luis Delgado at the University of Porto.

## **2.6 Physical activity level in children and adolescents with asthma**

There is some controversy related to whether or not children and adolescents with asthma are less physically active than their healthy peers (86). Similar level of PA (87, 88) and cardiorespiratory fitness (88) in children and adolescents with asthma compared to healthy peers have been reported. Vahlkvist & Pedersen (89); however, reported that children with asthma who were newly diagnosed or had reduced asthma control were less physically active than healthy peers. In a recent meta-analysis based on objective recordings of PA only, authors reported no difference in PA level between children with and without asthma (90).

Similar level of PA in children with asthma and healthy peers do not guarantee appropriate level of PA. In healthy children PA level is reduced with increased age (47, 91-93). As much as 80% of adolescents worldwide do not participate in the internationally recommended level of 60 min / day of MVPA (94). Williams et al. (11) and Nystad et al. (95) also suggested that PA level in children with asthma may be artificially high as already active children are more likely to receive an asthma diagnosis. This may provide explanation of higher PA level reported in asthma in certain studies (96, 97). Moreover, Williams et al. (11) suggested that children may avoid PA to avoid asthma symptoms, which could explain lower level of PA and reduced fitness in undiagnosed asthma (98) or newly diagnosed children with asthma (89).

Lower PA level has been reported in association with more severe or uncontrolled asthma (99-103). Vahlkvist et al. (99) reported increased PA level following increased asthma control in a longitudinal study, and Lang et al. (100) reported lower PA among children with more severe asthma. Firrincieli et al. (101) reported lower level of PA in children with asthma and presentation to the emergency room the last 12 months. Bronchial hyperresponsiveness has also been reported to be associated with reduced PA level in pre-school children (102), and in 6 to 16-year-old children (103). In contrast, Sousa et al. (104) reported no difference in PA level between children without asthma, or with mild, moderate, or severe persistent asthma which was well-controlled. Driessen et al. (105) found no associations between shortness of breath or wheezing and PA level in preschool children.

## **2.7 Factors associated with physical activity level in children with asthma**

Most studies reporting barriers or facilitators of PA in asthma are cross-sectional and thus not designed to distinguish between associations versus possible causal factors. Level of PA in asthma is reported to be associated with, and thereby possibly influenced by age (106), gender (107), and weight status (108-110).

Reduced VPA in overweight children with EIB compared to normal weight peers with or without EIB has been reported (109), as well as lower intensity PA in overweight children with asthma compared to normal weight (110). In the study by Tsai et al. (108), PA level between children with and without asthma did not differ while there was a significant interaction between asthma and BMI on PA level.

A significant interaction between PA level and age has also been reported, suggesting a larger decrease in PA level by age in adolescents with asthma, which was also more pronounced in females (106). Moreover, lower PA level in girls with asthma has been reported, despite no difference between children with and without asthma overall (107).

In children and adolescents with asthma, psychosocial factors may influence PA, and parental asthma-specific beliefs regarding PA (100, 111), self-efficacy (112), neighborhood safety, socioeconomic factors, and health support (113) have been reported to be associated with PA level. Furthermore, perceived competence of PA has been reported to be associated with cardiorespiratory fitness (29), and psychological functioning has been reported as at least as important as the severity of asthma in association with cardiorespiratory fitness (28).

Perceived limitation of PA has been reported independent of PA level (29, 108), indicating further complexity of the association between asthma and PA level. Moreover, limitations of PA reported by children, or reports of exercise-induced symptoms have been reported to poorly correspond with objective measures of EIB (114-116). Quinn et al. (117); however, reported that perceived exercise limitation in asthma was associated with socioeconomic factors.

Williams et al. (11) reported how PA may be influenced by children's and adolescents' desire to meet socially accepted norms, and be 'ordinary' or 'normal', particularly related to gender specific expectations. Similar connections have been reported in several qualitative studies; Rhee et al. (118) and Williams (119) reported on males' 'toughening' and their downplay of asthma in desire to be treated similar as



peers and in construction of masculinities. They also reported on girls' expression of guilt and lowering of expectations concerning PA (118, 119). Walsh et al. (120) reported how children and adolescents with asthma were more concerned by the emotional and social discomfort of being different, than the unpleasantness of asthma symptoms appearing during PA. Moreover, Protudjer et al. (30) reported on children's alternation of social cost of visible medication and visible symptoms in relation to participation in PA. Participation in PA is reported as an integrated part of youths' lives (121), including pleasure and camaraderie (30), and an opportunity to seek normality in front of peers (122). Reported parental interaction with their children concerning participation in PA include overprotection (27), reluctance of restrictions (123) , and support (124).

### **3.0 GAPS OF KNOWLEDGE**

A variety of barriers and facilitators of PA in childhood and adolescence may influence PA level including individual (psychological / biological), social, and environmental factors as described in the ecological model by Bauman et al. (36). In asthma, such barriers and facilitators may be similar as in the general population, or modified and accentuated by a complexity of interrelations physically, psychologically, socially, and environmentally.

Despite an advanced field of knowledge related to correlates of PA in children and adolescents in general, less is known about specific sub-groups like children and adolescents with asthma, including the use of multidimensional approaches (36). Previous research is pointing to a complexity of elements involved, ranging from pathophysiologic mechanisms to social culture and norms. Knowledge on factors associated with perceived exercise limitation in asthma is; however, sparse, as well as about psychosocial factors associated with objectively recorded VPA in asthma compared to controls. Moreover, a mapping of psychosocial factors related to PA level in asthma, and instruments used, is needed. Children's perception of participating in PA together with further knowledge of barriers and facilitators may increase our understanding of how to implement PA into children's daily life.

#### **4.0 AIM OF THE THESIS**

The overall aim of the present thesis was to identify barriers and facilitators for participation in physical activity among children and adolescents with asthma. The aim was addressed by the following specific aims and research questions:

Aim 1: To investigate factors related to perceived exercise limitation (paper 1).

- (1) Are asthma related pathophysiological factors associated with perceived exercise limitation?
- (2) Is asthma severity associated with perceived exercise limitation?
- (3) Are socioeconomic factors associated with perceived exercise limitation?
- (4) Is physical activity associated with perceived exercise limitation?

Aim 2: To investigate to what extent is level of physical activity associated with psychosocial or socioeconomic factors (Paper 2 and 3).

- (5) Are psychosocial factors associated with vigorous intensity physical activity?
- (6) Are psychosocial or socioeconomic factors correlates and/or determinants of physical activity level?

Aim 3: To assess if an active play exercise intervention is feasible in children and how children perceive their participation in the intervention (Paper 4).

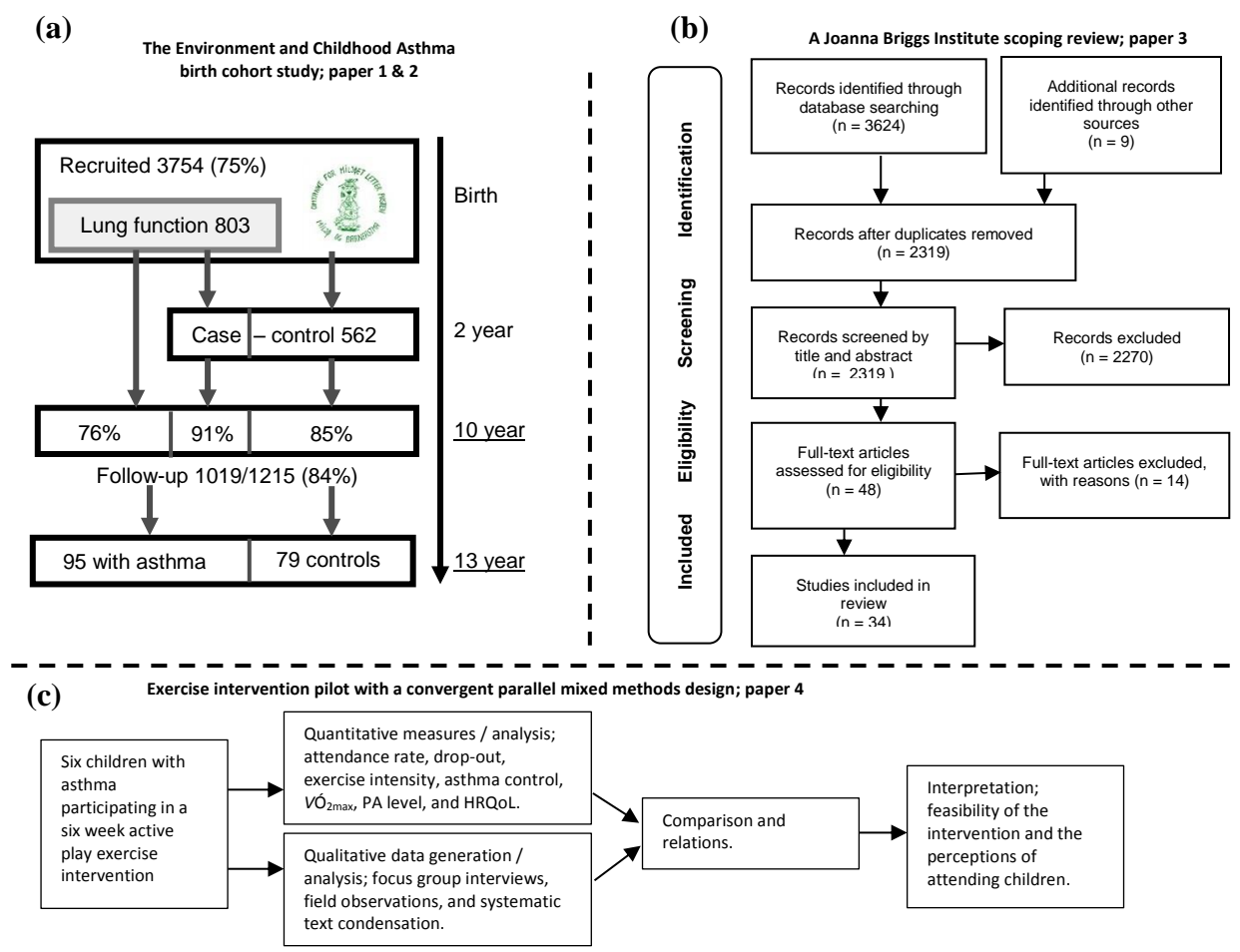
- (7) Is it feasible to intervene with physical exercise based on active play in children and adolescents with asthma?
- (8) How do children and adolescents perceive their participation in an active play exercise intervention?

## 5.0 SUBJECTS AND METHODS

The present thesis is based on the 10- and 13-year follow-up studies of the Environment and Childhood Asthma birth cohort study (ECA) in Oslo (paper 1 and 2), a comprehensive literature review of research reporting psychosocial and socioeconomic factors and issues in relation to PA level in children and adolescents with asthma (paper 3), and an active play exercise intervention pilot study in children with asthma aged 10-12 years (paper 4).

### 5.1 Study design

The study design is visualized in Figure 5.



**Figure 5** Combined design of the study; Paper 1 about perceived exercise limitation was based on the 10-year follow-up study, and paper 2 about psychosocial correlates of physical activity on the 13-year follow-up study of the Environmental Childhood Asthma birth cohort study (a). Paper 3 (b) was a systematic scoping review including 34 studies about psychosocial and socioeconomic factors in relation to physical activity level in 6 to 18-year-old children. Paper 4 (c) was a convergent parallel mixed methods study of an active play exercise intervention pilot.

From the ECA birth cohort study in Oslo established in 1991-92 (Figure 5a), 10- and 13-year follow-up studies were conducted. At 10 year, two clinical examinations with measures of BHR (EIB test and methacholine bronchial challenge on separate days) were performed 2–7 days apart (paper 1). Children who had lung function measured at birth and/or at the 2-year case-control study were invited (attendance 1019/1215 (84%)). The subsequent 13-year follow-up study included one day of clinical examinations including aerobic fitness testing, and four days of objective recordings of PA at home with an activity monitor. Children with current asthma at 10 years (n=143), and the child born closest in time without a history of lower respiratory disease were asked to attend, and 174 (56%) adolescents agreed to participate. In both 10- and 13-year follow-up studies (paper 1 and 2), structured interviews of parents and children were conducted, and anthropometric data and lung function were measured.

The review study (paper 3) was designed as a Joanna Briggs Institute systematic scoping review according to Peters et al. (125). Search strategy and inclusion of studies were designed according to definition of participants, concept, and context (PCC)(125) to ensure a broad comprehensive search including all relevant quantitative and qualitative primary studies written in English language without date limit (Figure 5b). Studies were included by the following criteria; (*Participants*) children with asthma aged 6-18 years as study participants which (*Concept*) investigated or explored psychosocial and socioeconomic factors and issues in relation to level of and participation in PA, and (*Context*) studies including all contexts of PA such as school time, leisure time, time at home, and organized exercise time performed in all countries. Data from studies were extracted and mapped logically according to the objective of the review.

The intervention consisting of six weeks active play exercise (paper 4) had a convergent parallel mixed-methods design (126), meaning that quantitative and qualitative data were analyzed separately before compared and interpreted further (Figure 5c). The study included systematic text condensation of semi-structured focus group interviews and field observations, description of the exercise program and sessions, and analysis of attendance rate, measures of exercise intensity, cardiorespiratory fitness, objectively recorded PA, HRQoL, and asthma control. Participants were recruited from a Norwegian outpatient clinic at a regular follow-up consultation between June and October 2013. Inclusion criteria were: (a) age 10–12 years; (b) a diagnosis of asthma; (c) use of asthma medication ( $\beta_2$ -agonists,

corticosteroids, leukotriene antagonists, and/or combination formulation of long acting  $\beta_2$ -agonists and corticosteroids) during the past month; (d) dyspnea, chest tightness and/or wheezing during the past month; and (e) reversible airflow limitation measured during the past year as measured by a 10% increase in FEV<sub>1</sub> 15 min after inhalation of 0.2 mg salbutamol per 10 kg body mass (maximum 0.8 mg).

## 5.2 Study populations

*Paper 1* included 302 children with asthma from the 10-year follow-up study of the ECA. From the 3754 children included at birth, 1215 children had lung function measured at birth and/or at the 2-year case-control study. In the 10-year follow-up study (paper 1), 1019 of those 1215 (84%) children attended in the nested case-control (Figure 5a). Attending children, compared to not attending did not differ significantly at birth with respect to gender, parental age, parental asthma, eczema or rhinoconjunctivitis, maternal prenatal smoking, pet keeping, parental education, paternal employment rate, household income, or number of siblings. Children with asthma (n=302) included in paper 1 were at 10 years similar to the 717 children without asthma with respect to height, weight, household income, prenatal smoking, and allergic rhinitis or atopic eczema only, but were significantly more often male, younger and overweight, had more often parents with education  $\leq$  13 years of schooling, and comorbidity of allergic rhinitis and atopic eczema. Baseline characteristics of children with and without asthma are given in Table 1.

*Paper 2* included 95 (66 boys) adolescents with asthma, and 79 (41 boys) controls. In the 13-year follow-up study of ECA, 147 children with current asthma at 10 years and the child born closest in time without any lower respiratory disease were invited to participate. One-hundred and seventy four (56%) agreed to participate (Figure 5a). Attendees and those who declined at 13 year were similar at 10 years of age with respect to household income and parental education, BMI, lung function, BHR, use of inhaled corticosteroids or  $\beta_2$ -agonists, prevalence of wheeze, and EIB.

Baseline characteristics are given in Table 2. Adolescents with asthma were more often boys and had reduced lung function compared with adolescents without asthma. Groups were at similar age, height, and weight, and included a similar proportion of overweight participants.

**Table 1** Baseline characteristics of children with asthma included in paper 1 (n=302) compared with excluded children without asthma from the 10-year follow-up of the Environment and Childhood Asthma Study (n=1019<sup>a</sup>). Data are given as counts (%) unless otherwise stated.

|  | Included; children with asthma (n=302) | Excluded; children without asthma (n=717 <sup>a</sup> ) | <i>p</i> -value <sup>b</sup> |
|--|--|---|------------------------------|
| Boys <sup>c, a</sup>   | 193 (64)                               | 351 (50)  | <b>&lt;0.01</b>              |
| Age, mean (min, max) <sup>a</sup>                                  | 10.5 (8.8, 12.5)                       | 10.8 (9.0, 12.5)  | <b>&lt;0.01</b>              |
| Height <sup>d</sup> (cm), mean (SD) <sup>a</sup>                   | 145.6 (6.6)                            | 146.0 (6.5)   | 0.49                         |
| Weight (kg), mean (SD) <sup>a</sup>                                | 38.5 (8.7)                             | 38.8 (7.9)  | 0.69                         |
| BMI <sup>d</sup> (kg/m <sup>2</sup> ), mean (SD) <sup>a</sup>      | 18.4 (2.7)                             | 17.9(2.7)   | <b>0.01</b>                  |
| Overweight   | 68 (23)                                | 101 (14)  | <b>&lt;0.01</b>              |
| Low household income (< 350.000NOK /year) <sup>a</sup>             | 56 (19)                                | 101 (14)  | 0.09                         |
| Low parental education (no education beyond 13 years of schooling) | 114 (38)                               | 173 (25)  | <b>&lt;0.01</b>              |
| Prenatal smoking <sup>a</sup>                                      | 72 (24)                                | 139 (20)  | 0.15                         |
| Allergic rhinitis only <sup>a</sup>                                | 30 (10)                                | 54 (8)  | 0.25                         |
| Atopic eczema only <sup>a</sup>                                    | 80 (27)                                | 171 (24)  | 0.49                         |
| Allergic rhinitis + atopic eczema <sup>a</sup>                     | 68 (23)                                | 41 (6)  | <b>&lt;0.01</b>              |

<sup>a</sup> Missing cases 1-28 in variables; <sup>b</sup> statistical differences between groups in bold. Analysis conducted: categorical variables; Chi-square tests, continuous normally distributed variables; independent t-tests. Statistical significant differences at 5% level are given in bold.; <sup>c</sup> with reference to girls; <sup>d</sup> adjusted for age and gender  
Abbreviations: n; numbers, min; minimum, max; maximum, cm; centimeter, kg; kilograms, SD; standard deviation, BMI; body mass index, m; meter.

**Table 2<sup>5</sup>** Baseline characteristics of participants in paper 2 presented by adolescents with and without asthma. Data are given as mean and standard deviation (SD) in parentheses unless otherwise stated<sup>a</sup>.

|  | Adolescents with asthma (n=95) Mean (SD) | Adolescents without asthma (n=79) Mean (SD) | <i>p</i> -value <sup>b</sup> |
|--|--|---|------------------------------|
| Boys; n(%) <sup>a</sup>  | 67 (71)                                  | 41 (52)                                     | <b>0.01</b>                  |
| Age (yrs); Mean (Min-Max) <sup>a, c</sup>                              | 13.6 (12.8-14.3)                         | 13.6 (12.6-14.3)                            | 0.64                         |
| Height (cm)  | 164 (9)                                  | 162 (7)                                     | 0.16                         |
| Weight (kg)  | 53 (11)                                  | 50 (10)                                     | 0.09                         |
| FEV <sub>1</sub> (% of predicted) <sup>c</sup>                         | 100 (13)                                 | 104 (13)                                    | <b>0.04</b>                  |
| FEV <sub>1</sub> /FVC <sup>c</sup>                                     | 85 (7)                                   | 87 (6)                                      | <b>0.01</b>                  |
| FEF <sub>50</sub> (% of predicted) <sup>c</sup>                        | 86 (21)                                  | 98 (22)                                     | <b>&lt;0.001</b>             |
| Overweight; n(%) <sup>a</sup>  | 15 (16)                                  | 8 (11)                                      | 0.29                         |
| Use of ICS last 14 days; n(%) <sup>a, c</sup>                          | 30 (32)                                  | NA  | -                            |
| Use of β <sub>2</sub> -agonists last 14 days; n(%) <sup>a</sup>        | 35 (37)                                  | NA  | -                            |
| Asthma exacerbations last 14 days; n(%) <sup>a</sup>                   | 11 (12)                                  | NA  | -                            |
| Self-reported exercise induced asthma exacerbations; n(%) <sup>a</sup> | 34 (36)                                  | NA  | -                            |
| Activity limitations due to asthma; n(%) <sup>a</sup>                  | 21 (22)                                  | NA  | -                            |

<sup>b</sup> *P*-values for any differences between groups. Statistic significant differences between groups are given in bold;  
<sup>c</sup> with reference to girls; Abbreviations: Min, minimum; Max, maximum; FEV<sub>1</sub>, forced expiratory volume in 1 s; FVC, forced vital capacity; FEF<sub>50</sub> forced expiratory flow at 50% of FVC; PA, physical activity; IQR, interquartile range; ICS, inhaled corticosteroids; NA, non-applicable.

*Paper 3* included 34 studies reporting psychosocial and socioeconomic factors and issues related to PA level in children with asthma which were published between 1989 and 2015. Quantitative studies (n=21) included 6 to 19-year-old participants.

<sup>5</sup> Reprinted from Journal of Asthma, 52. 2, Westergren, T., Ommundsen, Y., Lødrup Carlsen, K. C., Carlsen, K-H., Mowinckel, P., Fegran, L., & Berntsen, S., A nested case-control study: personal, social and environmental correlates of vigorous physical activity in adolescents with asthma, 155–61., Copyright (2015), with permission from Taylor & Francis.

Twenty sources comprised psychosocial measures associated with PA level, and four sources comprised socioeconomic measures (113, 127-129) associated with PA level. In eight sources, participants were recruited entirely or partly through schools relying on self-reports of the asthma diagnose, symptoms and use of medication (111-113, 122, 128-132). Qualitative studies (n=13) included 4 to 18-year-old participants with asthma. Three studies included also children with other chronic diagnosis than asthma of which findings concerning children with asthma only were extracted (119, 124, 133). Two studies included healthy children in comparison with children with asthma (120, 121). Three studies included parents of children with asthma in addition to their off-springs (119, 123, 134), and one study included also school-staff (27). Description of included studies and study populations is given in Table 3.

**Table 3** Description of included studies (n=34) in the scoping review (paper 3).

| <b>Author(s), year of publication, Origin/country of study, Design</b>                               | <b>Study population</b>  | <b>Instrument to measure psychosocial or socioeconomic factors</b>  | <b>Assessment of physical activity level</b>  |
|--|--|---|---|
| <i>Weston et al. 1989</i> , New Zealand, Cross-sectional population based study                      | 408 children aged 11-13, 65 (15.9%) with asthma  | Sport Competition Anxiety Test, Physical self-concept from Harter's perceived competence scale, Enjoyment; from Children's attitudes towards PA inventory, Deterrence, Motivation   | Daily frequency of school activity, participation in PA and sports (beside school) from a list of 22 physical activities and sports. Perceived activity (more, same, less than peers) |
| <i>Kitsantas &amp; Zimmermann, 2000</i> , New York City, USA, Cross-sectional population based study | 135 girls aged 14-18, 37 (22%) with asthma, 26 (15%) with breathing problems, and 72 healthy | Lung self-efficacy; response of self-beliefs related to 25 physical activities.   | An activity log of participation in 25 physical activities during a week  |
| <i>Williams 2000</i> , London, UK, Qualitative   | 20 (10 males, 10 females) adolescents with asthma aged 15-18 and their main carer            | N.A.  | N.A.  |
| <i>Callery et al. 2003</i> , Manchester, UK, Qualitative   | 25 children with asthma aged 9-16 and their main carers                                      | N.A.  | N.A.  |
| <i>Lang et al. 2004</i> , Baltimore, Maryland, USA, Case-control study                               | 137 children with asthma aged 6-12 and 106 controls  | Categorical (yes /no): Neighborhood safety, Walking distance to recreation center, Adult exercise with child, Recall of physician concerning exercise.<br>Scale: Health beliefs; benefits of exercise, appropriateness of exercise, feelings about exercise | Yesterday Activity Checklist  |
| <i>Pianosì &amp; Davis, 2004</i> , Nova Scotia, Canada, Cross sectional study                        | 58 children with asthma aged 8-12  | Perceived Competence Scale for Children<br>Children's Attitudes Toward Physical Activity questionnaire  | Hay Activity Evaluation Scale   |
| <i>Kelsay et al. 2005</i> , USA, Cross-sectional study   | 63 girls with asthma aged 8-18   | Color-a-Person Dissatisfaction test, Children's Version, Multidimensional Anxiety Scale for Children, Children's Depression Inventory, Children's Asthma Symptoms Checklist, panic and fear subscale  | A 4-point scale for none to 4 hour or more per week   |
| <i>Glazebrook et al. 2006</i> , East Midlands, UK, Case-control study                                | 56 children with asthma and 61 controls aged 7-14  | Exercise beliefs Questionnaire, Strengths and Difficulties Questionnaire, Parent Version, Parental occupation, National Statistics Socio-economic Classification (UK, 2000)   | Children were asked to rate a range of activities, both active and sedentary, (55 items) in a 3-point scale at 3 time points  |

Abbreviation: N.A.; not applicable



**Table 3** (continued)

| <b>Author(s), year of publication, Origin/country of study, Design</b>                        | <b>Study population</b>   | <b>Instrument to measure psychosocial or socioeconomic factors</b>  | <b>Assessment of physical activity level</b>  |
|---|---|---|---|
| <i>Hsu et al. 2006</i> , Taiwan, Cross-sectional survey                                       | 152 children with asthma aged 8-11  | Contemplation stage changing exercise behavior, Perceived health status, Physical self-concept, Environmental factors   | Three day physical activity log   |
| <i>Rhee et al. 2007</i> , Central Virginia, USA, Qualitative                                  | 19 adolescents with asthma aged 12-18   | N.A.  | N.A.  |
| <i>Walsh et al. 2008</i> , Chapel Hill, North Carolina and Temple, Texas, USA, Qualitative    | 20 children with asthma and 21 without aged 8-17  | N.A.  | N.A.  |
| <i>de Borja et al. 2009</i> , Sao Paulo, Brazil, Qualitative case study                       | 3 children with asthma aged 9-10  | N.A.  | N.A.  |
| <i>Fereday et al. 2009</i> , South Australia, Qualitative                                     | 14 children with asthma aged 4-16   | N.A.  | N.A.  |
| <i>Protudjer et al. 2009</i> , Manitoba, Canada, Qualitative                                  | 22 (11 girls, 11 boys) with asthma aged 11  | N.A.  | N.A.  |
| <i>Walders-Abramson et al. 2009</i> , Denver, Colorado, USA, Case-control intervention design | 59 children with asthma and 59 controls aged 10-16 years  | Psychosocial Correlates of Physical Activity interview - parent and child psychosocial correlates composite score   | Pedometer (Omron HJ-112)  |
| <i>Cheng et al. 2010</i> , Chongqing, China, Case-control study                               | 123 children with asthma and 109 controls aged 7-14   | The pediatric asthma quality-of-life questionnaire, Views about the relationship between asthma and exercise, Parents' and teachers' attitudes towards asthmatic children taking part in sports and whether these adults had restricted children's exercise, Doctors' attitudes towards asthmatic children exercising and whether they had discussed physical activity with the children. | Participation in PA; frequency and duration of PA. (days per week and minutes per day). |
| <i>Shaw 2010</i> , Arizona, USA, Qualitative  | 10 children (5 females, 5 males) aged 8-12 years  | N.A.  | N.A.  |
| <i>Spencer-Cavaliere &amp; Watkinson 2010</i> , Alberta and Manitoba, Canada, Qualitative     | 1 child with asthma aged 9  | N.A.  | N.A.  |
| <i>Stevens et al. 2010</i> , USA, Cross-sectional population-based study                      | 6357 with asthma and 57719 without asthma aged 6-17   | Medical Home Total Score (access, continuity, comprehensiveness, family-centered care and coordination of care), Neighborhood environment; availability, neighborhood safety, Poverty status, Parent education (high school graduate vs. less than high school), Parent employment (worked at least 50 weeks last year)   | After School Activity Participation   |
| <i>Williams et al. 2010</i> , Tayside, Scotland, Qualitative                                  | 30 children (15 females, 15 males) aged 6-14, 38 parents, 22 teachers, 2 school nurses, 2 activity coordinators | N.A.  | N.A.  |
| <i>Correia et al. 2012</i> , Recife, Brasil, Cross-sectional study                            | 134 adolescents with asthma aged 10-19  | Athletic competence and self-worth domains of the Self-Perception Profile for Children, Hospital Anxiety and Depression (mother's) Scale, Attitudes and Beliefs towards PA, Additional questions towards mothers whether they could identify asthma or wheezing during or after PA and if they imposed restrictions.  | International Physical Activity Questionnaire   |
| <i>Protudjer et al. 2012</i> , Winnipeg, Manitoba, Canada, Qualitative                        | 12 adolescents with asthma and 10 without   | N.A.  | N.A.  |
| <i>Westergren &amp; Lilleaas 2012</i> , Norway, Qualitative                                   | 5 male adolescents with asthma aged 13-15   | N.A.  | N.A.  |
| <i>Basso et al. 2013</i> , Sao Carlos, Brazil, Cross-sectional study                          | 19 adolescents with asthma aged 11-15   | The pediatric asthma quality-of-life questionnaire  | International Physical Activity Questionnaire   |

Abbreviation: N.A.; not applicable

**Table 3** (continued)

| <b>Author(s), year of publication, Origin/country of study, Design</b>                                      | <b>Study population</b>   | <b>Instrument to measure psychosocial or socioeconomic factors</b>  | <b>Assessment of physical activity level</b>  |
|---|---|---|---|
| <i>Dantas et al. 2014</i> , Pernambuco, Brazil, Cross-sectional study                                       | <b>115 children with asthma (mean age 13 years) and 115 mothers</b> | <b>Questionnaire towards mothers regarding PA prevention.</b>   | <b>International Physical Activity Questionnaire</b>                                |
| <i>Hamer 2014</i> , Christchurch, New Zealand, Qualitative  | 15 male adolescents with asthma aged 12-17                          | N.A.  | N.A.  |
| <i>Latorre-Román et al. 2014</i> , Andalusia, Spain, Case-control design                                    | 107 children with asthma and 78 controls aged 10-15                 | Physical Activity Enjoyment Scale   | Physical Activity Questionnaire for Children  |
| <i>Teng et al. 2014</i> , Taiwan, Cross-sectional population based study                                    | 286 adolescent with asthma and 588 without aged 12-16               | Lee's social support for PA scale<br>Five Social Classes  | International Physical Activity Questionnaire                                       |
| <i>Tiggelman et al. 2014a</i> , Netherlands, Cross-sectional population-based study                         | 261 adolescents with asthma (mean age 11.9)                         | Maternal Sport-Specific Support from the Dutch Sport-Specific Parental Support Scale, Maternal Beliefs About Offspring's Participation in Sport from the Attitude towards Sport Scale, Maternal Beliefs About Own Participation in Sport from the Beliefs about Sport Scale, Maternal Physical Activity, Maternal Self-Efficacy to Stimulate to Participate in Sport, Adolescents' Self-Efficacy from the Self-Efficacy Scale, Adolescent's Beliefs About Sport Participation from the Attitude towards Sport scale | Adolescent participation in sport clubs assigned MET-scores                         |
| <i>Tiggelman et al. 2014b</i> , Netherlands, Longitudinal population-based study                            | 253 adolescents (mean age 13.9) with asthma and their parents       | Hospital Anxiety and Depression Scale, Adolescent Asthma Quality of Life Questionnaire, Perceived Stress Scale-10   | Adolescents' habitual activities assigned MET-scores                                |
| <i>Vangeepuram et al. 2014</i> , New York, California and Ohio, USA, Cross-sectional population-based study | 1182 girls aged 6-8 years (16% with asthma)                         | Self-reported level of caregiver education (high school degree and Bachelor's degree)   | Pedometer; Yamax SW-200 Digi-walker and questionnaire with assignment of MET-scores |
| <i>Latorre-Román et al. 2015</i> , Andalusia, Spain, Quasi-experimental study                               | 105 children (mean age 11.5); 58 intervention, 47 control           | Physical Activity Enjoyment Scale   | International Physical Activity Questionnaire                                       |
| <i>Westergren et al. 2015</i> , Oslo, Norway, Nested case-control study                                     | 95 adolescents with asthma and 79 controls (mean age 13.6)          | Self-perceived personal, social and environmental factors   | Activity monitor; SenseWear Pro2 Armband  |
| <i>Tiggelman et al. 2015</i> , Netherlands, Population-based longitudinal study                             | 253 adolescents (mean age 13.9) with asthma and their parents       | Maternal/paternal Sport-Specific Support from the Dutch Sport-Specific Parental Support Scale, Maternal/paternal general beliefs about their child's sport participation from the Attitude towards Sports Scale, Maternal/paternal asthma-specific beliefs about their child's sport participation, Maternal/paternal self-efficacy to encourage child's sport participation  | Adolescents' sport participation assigned MET-scores                                |

Abbreviation: N.A.; not applicable

*Paper 4* included four boys and two girls aged 10-12 years who attended the intervention study. Twenty-three children met for consultation at the outpatient clinic, whereas ten children did not meet the inclusion criteria. Five children declined, and eight children agreed to participate. Out of those eight, additionally two children withdrew before baseline procedures. Six children (four boys) aged 10-12 years participated in the entire intervention, including baseline, and post-testing. Baseline characteristics are given in Table 4. Participants had well controlled asthma and HRQoL measures indicated a small-to-moderate degree of impairment of asthma. Min / day in MVPA ranged from below to approximately twice of recommendations.

**Table 4<sup>6</sup>** Baseline characteristics of participants included in paper 4 ( $n = 6$ ).

|  |                    |
|--|--------------------|
| Boys <sup>a</sup> , $n$  | 4                  |
| Age (yr), median (min, max)  | 10.5 (10, 12)      |
| FEV <sub>1</sub> (% of predicted) <sup>b</sup> , median (min, max) | 78 (74, 87)        |
| PAQLQ <sup>c</sup> , median (min, max)                             | 6.3 (5.0, 6.9)     |
| Activity scale, median (min, max)                                  | 6.1 (4.2, 7.0)     |
| Symptoms scale, median (min, max)                                  | 5.8 (4.7, 6.9)     |
| Emotion scale, median (min, max)                                   | 6.8 (5.4, 7.0)     |
| ACQ <sup>d</sup> , median (min, max)                               | 0.7 (0.4, 1.0)     |
| Use of ICS, $n$  | 5                  |
| Daily, regular use of $\beta_2$ -agonists, $n$                     | 6                  |
| Overweight, $n$  | 1                  |
| MVPA (min/day), median (min, max)                                  | 68.6 (46.2, 125.2) |
| VO <sub>2max</sub> (ml/kg/min), median (min, max)                  | 48.7 (24.7, 56.7)  |

<sup>a</sup> with reference to girls; <sup>b</sup> missing data in 1 participant; <sup>c</sup> possible score between 0 (severe impairments of asthma) and 7 (no impairments); <sup>d</sup> possible score between 0 (totally controlled) and 6 (extremely poorly controlled), missing data for 1 participant

Abbreviations:  $n$ , number; min, minimum, max, maximum; FEV<sub>1</sub>, forced expiratory volume in 1 s; PAQLQ, Paediatric Asthma Quality Of Life Questionnaire; ACQ, Asthma Control Questionnaire; ICS, inhaled corticosteroids; MVPA, moderate-to-vigorous intensity physical activity; VO<sub>2max</sub>, maximal oxygen uptake in ml/kg/min.

### 5.3 Ethical approvals

The ECA study was approved by the Norwegian Data Inspectorate as well as the Regional Committee for Medical Research Ethics in South-Eastern Norway (Appendix 1 and 2). Written informed consent was obtained from guardians of the participating children and adolescents, and the participating adolescents at 13 year (Appendix 1 and 2). Data analyzed and reported in paper 1 and 2 were provided in anonymous databases in line with the regulations at Oslo University Hospital.

The active play exercise intervention study (paper 4) was approved by the Regional Committee for Medical Research Ethics in South-Eastern Norway (2013/1274, Appendix 3), and written informed consent to take part was obtained from all guardians, and accommodated written and oral information was offered to participating children (Appendix 3).

### 5.4 Methods

Data collection was conducted during four different periods at two different locations. The 10- and 13-year follow-up studies of the ECA (paper 1 and 2) were conducted in Oslo in September 2001 to July 2004, and in October 2005 to June 2006. The active play exercise intervention pilot (paper 4) was conducted between June and December

<sup>6</sup> Reprinted from BMJ Open, 5. 1, Westergren, T., Fegran, L., Nilsen, T., Haraldstad, K., Kittang, O-B., & Berntsen, S., Active play exercise intervention in children with asthma: a PILOT STUDY, e009721. Copyright (2016), with permission according to the Open Access terms of Creative Commons Attribution 4.0 International License.

2013 in Kristiansand. Search, screening, eligibility, and inclusion of studies in the review, and extraction of data continued from January to October 2016 (paper 3).

### 5.4.1 Instruments

*Structured interviews* of parents and children (Appendix 4) were conducted to collect data comprising respiratory symptoms (ISAAC questions validated in Norwegian language (135)), use of medication, household income, parental education, prenatal smoking, perceived exercise limitation, and PA (Paper 1 and 2). In paper 4, items regarding respiratory symptoms, use of medications and perceived exercise limitation only, were included.

*Asthma ever* was defined by at least two of the following three criteria fulfilled: (a) dyspnoea, chest tightness and/or wheezing 0-3 years and/or after 4 years, (b) a doctor's diagnosis of asthma and (c) used asthma medication ( $\beta_2$ -agonists, sodium chromoglycate, corticosteroids, leukotriene antagonists and/or aminophylline) 0-3 years and/or after 4 years. Current asthma was defined as asthma plus at least one of the following; (a) dyspnoea, chest tightness and/or wheezing in the last 12 months, (b) use of asthma medication ( $\beta_2$ -agonists, sodium chromoglycate, corticosteroids, leukotriene antagonists and/or aminophylline) in the last 12 months and/or (c) a positive exercise-induced asthma test (conducted at 10 years only).

*Allergic rhinitis ever* was defined with at least two out of three criteria fulfilled: (a) doctor's diagnosis of rhinitis, (b) symptoms of rhinitis and (c) treatment for eye/nose or allergy symptoms.

*Asthma severity* was in paper 1 classified by a construction of a severity score ranging from 0-9 including controller medication, leukotriene antagonists and/or  $\beta_2$ -agonists, and number of exacerbations the last 12 months (Table 5).

**Table 5<sup>7</sup>** Description of asthma severity score based on the use and dose of inhaled corticosteroids, use of leukotriene antagonists/ $\beta_2$ -agonists and number of exacerbations last 12 months.

|       | Dose of ICS ( $\mu$ g) |         |            | Use of LKTR and/or $\beta_2$ -agonists |    | Number of exacerbations last 12 months |     |    | Total possible score |
|-------|------------------------|---------|------------|--|----|--|-----|----|----------------------|
|       | 0-99                   | 100-399 | $\geq$ 400 | yes                                    | no | 0                                      | 1-3 | >3 |                      |
| Score | 0                      | 2       | 4          | 1                                      | 0  | 0                                      | 2   | 4  | 0-9                  |

Abbreviations: ICS; inhaled corticosteroids, LKTR; leukotriene antagonist

<sup>7</sup> Reprinted from Pediatric Allergy and Immunology, pai.12670., Westergren, T., Berntsen, S., Lødrup Carlsen, K. C., Mowinckel, P., Håland, G., Fegran, L., & Carlsen, K-H., Perceived exercise limitation in asthma: the role of disease severity, overweight and physical activity in children., pai.12670., Copyright (2016), with permission from John Wiley and Sons.

In paper 2, asthma severity was defined by the use of inhaled glucocorticosteroids, use of  $\beta_2$ -agonists, incidence of exacerbations during the last 14 days, and lung function assessed by FEF<sub>50</sub>.

*Asthma control* was assessed in paper 4, using the Asthma Control Questionnaire (ACQ) developed by Juniper et al. (136-138) (Appendix 5). The self-administered form of the questionnaires was used, including 7 items of which the seventh item (FEV<sub>1</sub>), were assessed by a clinician. A total ACQ score >1.5 (cut-off point) was defined as having not well-controlled asthma.

*HRQoL* was assessed at baseline and post-intervention in paper 4 by the Paediatric Asthma Quality of Life Questionnaire (PAQLQ) (Appendix 6), developed by Juniper et al. (139, 140). The self-administered form of the questionnaire with response format in a 7-point response scale ranging from 1 = extremely bothered/all the time to 7 = not bothered/none of the time. The questionnaire comprised 23 items divided in 3 domains (activity limitations, 5 items; symptoms, 10 items; and emotional function, 8 items). Minimal important difference was 0.5.

*Lung function* was measured by maximum forced expiratory flow volume loops (SensorMedics Diagnostics, Yorba Linda, CA, USA (paper 1), Masterlab, Erich Jaeger® GmbH & Co KG, Würzburg, Germany (paper 2)) including forced expiratory volume at 1 second (FEV<sub>1</sub>), forced vital capacity (FVC), forced expiratory flow at 50% or 25-75% of FVC (FEF<sub>50</sub>/FEF<sub>25-75</sub>), and FEV<sub>1</sub>/FVC. In paper 1, predicted values according to Stanojevic et al. (141) were used, while in paper 2 and 4, predicted values of Zapletal et al. (142) were used.

*Bronchial challenge and bronchodilator response* were conducted at 10 years (paper 1) at least four weeks after any suspicion of respiratory tract infection. Methacholine challenge and EIB-test were performed 2–7 days apart, and bronchodilator response to inhalation of Salbutamol was assessed after both challenge tests. Methacholine bronchial challenge was conducted according to standards given by the American Thoracic Society (ATS) (143) by use of SPIRA® dosimeter (Spira Respiratory Care Center Ltd., Hemeelinna, Finland). The provocative dose causing a decrease in FEV<sub>1</sub> by  $\geq 20\%$  (PD<sub>20</sub>) was registered, and the test was considered positive at two levels; severe BHR as PD<sub>20</sub> of  $\leq 1$   $\mu\text{mol}$ , and BHR by PD<sub>20</sub> of  $\leq 8$   $\mu\text{mol}$ . Testing started with inhalation of 0.05  $\mu\text{mol}$  methacholine which was increased until a decrease of FEV<sub>1</sub> by  $\geq 20\%$  was reached, or a maximum cumulative dose of 22.4  $\mu\text{mol}$  methacholine.

A standardized EIB-test (144) was conducted 2-7 days after methacholine challenge. The EIB-test consisted of 6-8 minutes of treadmill running at sub-maximal load, including the last four minutes at 95% of maximal heart rate ( $HR_{max}$ ) and a 5% inclination of the treadmill.  $HR_{max}$  was calculated as 220 beats per minute minus the age of the participant in years. Speed was adjusted during the first two minutes of the run to achieve the intended HR. Maximum expiratory flow volume loops were conducted to assess  $FEV_1$  three, six, ten, fifteen, and twenty minutes after running ceased. Maximum reduction (%) post exercise ( $R_{max}\%FEV_1$ ) compared to baseline value was calculated. The test was considered positive with a reduction in  $FEV_1 \geq 10\%$ . After 20 min, inhalation of Salbutamol 0.5mg per 10 kg bodyweight was administered by nebulisation, and flow volume loops were repeated 15 min thereafter. The sum of percentage decrease post exercise plus the increase after Salbutamol inhalation compared to baseline was calculated as bronchial lability index according to Remes et al. (145). The EIB-test was performed in an ambient temperature of 20-24°C.

Prior to challenge tests, short and long acting  $\beta_2$ -agonists and leukotriene antagonists were withheld 12, 48, and 72h, respectively.

*Anthropometric data* was measured by height with a stadiometer to the nearest 0.5 cm and body mass (Seca 709, Hamburg, Germany (paper 1 and 2) and Seca 713, Birmingham, United Kingdom (paper 4)) to the nearest 0.1 kg wearing light clothing without shoes. Overweight was defined by international cut off points for body mass index by sex and age between 2 and 18 years according to Cole et al (146). Cut off points are designed to pass through  $25\text{kg}/\text{m}^2$  at age 18 years. Skin fold thickness at the biceps, triceps, subscapular, and supra-iliac region (paper 2) was measured with a Harpenden skin fold caliper (Holtain, Dyfed, United Kingdom). Skin fold thickness was given as sum of the four measurements.

*Cardiorespiratory fitness* was assessed according to Berntsen et al. (88) during treadmill running (Woodway ELG55/Gmbh, Weil am Rhein, Germany) until exhaustion at 13 year (paper 2) and in the intervention pilot study (paper 4). Running started at 5km/h and 5.3% inclination of the treadmill. After 5 min of running, speed increased with 2km/h and thereafter 1km/h each minute until 11km/h. Additional load was thereafter added by 1% raised inclination of the treadmill each minute. Minute ventilation ( $V_E$ ), respiratory exchange ratio (RER), and oxygen consumption ( $\dot{V}O_2$ ) were measured using an oxygen analyzer (Oxycon, Jaeger, BeNeLux Bv, Netherlands). Maximal oxygen uptake ( $\dot{V}O_{2max}$ ) was defined as the highest  $\dot{V}O_2$

measured during the last minute expressed as  $\text{ml kg}^{-1} \cdot \text{min}^{-1}$ . Calibration was conducted before each test. The criterion for reaching maximal exhaustion was subjective assessment by the test leader, followed by RER above 1.00, HR >190, or reported perceived exertion above 17 using the Borg RPE Scale (147).

*Heart rate (HR)* was recorded using Polar equipment (Polar Vantage (paper 2), Polar S610i (paper 4), Polar Vantage, Electro KY, Kempele, Finland), and highest measured HR was defined as  $\text{HR}_{\text{peak}}$ . Recordings of HR were conducted during cardiorespiratory fitness tests (paper 2 and 4), EIB-tests (paper 1), and during the active play exercise sessions (paper 4).

*Objective measures of PA level* were recorded according to the method by Berntsen et al. (88) at 13-year of the ECA-study (paper 2) and in the intervention pilot study (paper 4) by SenseWear™ Pro mini Armband activity monitor (Body Media Inc. Pittsburgh, PA, USA). At 13-year of the ECA-study (paper 2), adolescents wore the Armband during 4 days including 3 week-days and 1 weekend-day. In the intervention pilot study (paper 4), children wore the Armband during 7 days. The Armband was not worn during water activity, and data was adjusted for the mean hours each day the Armband was worn to acquire 24hrs of units. Days the Armband was worn less than 80% were excluded from analysis. Recorded data was downloaded and analyzed with software developed by the manufacturer. Hours per day in MVPA and/or VPA was calculated.

*Self-reported PA* was assessed by structured interview of child assisted by their parent(-s) (paper 1). A positive answer to “PA accompanied with breathlessness and sweat 6-7 times each week” were assessed as daily PA. Hours participating in sports per week were assessed by “hours participating in organized exercise each week”. Analysis of the association between self-reported PA and objectively recorded PA was conducted from the 13-year dataset (148). Self-reported PA was associated with objectively recorded MVPA at the same occasion, with a mean difference of 1.81 hours/day (95% CI; 0.99, 2.62;  $p$ -value <0.01). Children reporting daily PA had objectively measured level of MVPA 6.69 hours per day (vs. 4.88). MVPA and hours per week participating in sports was additionally correlated ( $r = 0.40$   $p < 0.01$ ).

*Perceived exercise limitation* was assessed by a positive answer to the question: “present feeling that asthma restrains PA”.

*Psychosocial correlates of PA* were assessed according to Ommundsen et al. (50) through a paper based and self-report questionnaire at 13 years (paper 2) previously validated in healthy 9, 11, and 15-year-old children (50, 51, 149) (Appendix 7). Items were taken from the “Children’s attraction to physical activity scale” (150) (competence, enjoyment), from Reynolds et al. (151) (social support), and Sallis et al. (152) (environmental). The instrument was designed to capture theoretically driven (152-154) relevant perceived intrapersonal, interpersonal and environmental factors shown to influence PA in children and adolescents. The questionnaire was completed by the adolescent at the clinical visit.

An exploratory factor analysis with varimax rotation was conducted to test the construct validity of the instrument in the present cohort of adolescents with and without asthma. Factor analysis revealed 7 domains; Competence-enjoyment (5 items), parental practical support (2 items), parental emotional support (2 items), peer support (3 items), teacher support (2 items), safe environment (4 items), and physical-social opportunity (2 items). Internal consistency values (Cronbach’s  $\alpha$ ) were in the range of 0.48-0.82. Descriptions of the instrument and each factor are given in Table 6.

**Table 6**<sup>8</sup> Description of instrument to measure psychosocial correlates of PA including Cronbach’s  $\alpha$ , and example of items from questionnaire measured by scales.

|  | <b>N of items</b> | <b><math>\alpha</math></b> |
|--|-------------------|----------------------------|
| <b>Parental practical support</b> (response format 1-4 <sup>a</sup> )<br><i>How often does your mother or father take you to exercise or play sports?</i>          | 2                 | 0.59                       |
| <b>Parental emotional support</b> (response format 1-4 <sup>a</sup> )<br><i>How often does your mother or father encourage you to play, exercise or do sports?</i> | 2                 | 0.68                       |
| <b>Peer support</b> (response format 1-4 <sup>a</sup> )<br><i>How often do your friends exercise or play sports with you?</i>                                      | 3                 | 0.82                       |
| <b>Teacher support</b> (response format 1-4 <sup>a</sup> )<br><i>How often does your teacher talk about exercise in lessons?</i>                                   | 2                 | 0.60                       |
| <b>Competence-enjoyment</b> (response format 1-5 <sup>b</sup> )<br><i>I wish I could play more games and sports than I get chance to.</i>                          | 5                 | 0.73                       |
| <b>Safe environment</b> (response format 1-5 <sup>b</sup> )<br><i>It is safe to walk or play alone in my neighbourhood during the day.</i>                         | 4                 | 0.75                       |
| <b>Physical-social opportunity</b> (response format 1-5 <sup>b</sup> )<br><i>There are other children nearby home to go out and play with.</i>                     | 2                 | 0.48                       |

<sup>a</sup>Response format 1-4; 1= never or hardly ever, 2=once or twice a week, 3= almost every day, 4=every day

<sup>b</sup>Response format 1-5; 1= does not suit for me, 5= suits for me

<sup>8</sup> Reprinted from Journal of Asthma, 52. 2, Westergren, T., Ommundsen, Y., Lødrup Carlsen, K. C., Carlsen, K-H., Mowinckel, P., Fegran, L., & Berntsen, S., A nested case-control study: personal, social and environmental correlates of vigorous physical activity in adolescents with asthma, 155–61., Copyright (2015), with permission from Taylor & Francis.



*Feasibility* of the active play exercise intervention was based on measures of attendance to sessions, drop-out rates from the study, exercise intensity (measured by HR), reports of exercise limitations and/or asthma attacks, and satisfaction with the intervention by participating children.

#### **5.4.2 Review methods**

Review methods and development of search strategy followed the approach given by the Joanna Briggs Institute (125, 155). An initial search in JBI Database of Systematic Reviews and Implementation Report, PROSPERO, Cochrane Library, PEDro, Embase, CINAHL, Medline, SPORTDiscus, SocINDEX, Academic Search Complete, PsycINFO, and ISI Web of Science was performed to ensure no systematic or scoping review on this specific topic were published or currently underway. Thereafter, a limited test search was conducted in Medline and SPORTDiscus followed by an analysis of the text words contained in the title, abstract, and index terms used to describe each article. To ensure that no psychosocial or socioeconomic measure or no specific context of PA were excluded by database search, a broad search including search terms for participants and level of PA only were conducted. The following search terms were combined as follows:

(adolescen\* OR child\* OR schoolchild\* OR teenage\* OR young OR youth\*) AND ((exercise\* OR inactiv\* OR motor activ\* OR physical activ\* OR play\* OR sport\* OR training\*) ADJ4 (amount\* OR daily\* OR dose\* OR duration\* OR energy expenditure\* OR frequen\* OR hour\* OR insufficient\* OR intens\* OR less\* OR level OR minute\* OR moderate\* OR more\* OR participat\* OR sufficient\* OR vigorous\* OR week\*)) AND asthma\*.

ADJ4 was used as a combination of the concept linking PA with PA level in the search to avoid inclusion of words concerning different concepts than PA level. In certain databases, N4 or NEAR4 were also used, including results where combinations of these search terms were written with  $\leq 4$  words in between. Database search included Medline, Embase, PsychINFO, CINAHL, SPORTDiscus, Academic Search Complete, SOCIndex, Social Science Index, and ISI WEB of Science. Additionally, the following five databases indexing unpublished studies were searched; Primo Central Index, ProQuest Nursing & Allied Health Source, ProQuest Health Management, ProQuest Psychology Journals and ProQuest Health & Medical Complete.

Titles and abstracts were screened according to inclusion and exclusion criteria (PCC) (125), and relevant studies were assessed for full text eligibility. Studies identified by forward citation search and search of reference list of all included studies, and studies berry picked by experts from the field were also assessed for eligibility. Track of the search, screening, eligibility, exclusion, and inclusion of studies followed the steps given in the PRISMA statement by Moher et al. (156).

Data were extracted as follows; (a) author(s), year of publication, and origin/country of the study, (b) aim, (c) study population, (d) design, (e) outcome assessment (PA level), (f) associations between PA level and psychosocial and socioeconomic factors, (g) instrument used to assess psychosocial and socioeconomic factors, (h) construction and validation of instruments used to assess associations between PA level and psychosocial and socioeconomic factors, and (i) psychosocial and socioeconomic issues related to participation in PA.

In the review, results were mapped and presented in narrative summaries based on point f-i which were considered as key concepts of the study.

### 5.4.3 The active play exercise intervention

Each session of the active play exercise intervention (paper 4) was led by two or three instructors who were sport or public health students at the University of Agder. The intervention lasted for six weeks including exercise sessions of 60 min (Table 7) twice a week in an indoor gym (300 m<sup>2</sup>). Each session started with a 10-15 min warm-up, followed by an interval endurance-type session lasting 30-35 min. Each session ended with a 5-10 min cool-down of low intensity and/or relaxation.

**Table 7<sup>9</sup>** Description of elements in the active play exercise.

|                                    | <b>Exercise</b>       | <b>Description</b>  |
|------------------------------------|-----------------------|---|
| <b>Warm-up<br/>(10–15<br/>min)</b> | Frozen tag<br>10 ball | With variations on how to be “unfrozen” (e.g., crawl between legs, perform 10 squats) There are 2 teams. Each team makes 10 passes without losing the ball. The other team tries to get the ball. |
|                                    | Tail tag              | A “tail” (small rope) is attached to each child’s pants. Each child tries to grab the tail from the other participants.   |
|                                    | Chip and Dale         | Two persons (Chip and Dale) sit back to back. When Chip is called, she/he must run a certain distance with Dale in chase, and vice versa.   |
|                                    | Cleaning up           | “Garbage” (15 beanbags) is placed on each side of a “fence.” Two teams. Each team “cleans” up by throwing as much “garbage” as possible over the fence to the other team. Time: 30 s.             |
|                                    | Naval battle          | Two teams (“ships”) on each side of the room. Area between is “water” with a “canon” (Swiss ball). Each team throws soft balls to try to push the “canon” on to the other team’s “ship.”          |

<sup>9</sup> Reprinted from BMJ Open, 5. 1, Westergren, T., Fegran, L., Nilsen, T., Haraldstad, K., Kittang, O-B., & Berntsen, S., Active play exercise intervention in children with asthma: a PILOT STUDY, e009721. Copyright (2016), with permission according to the Open Access terms of Creative Commons Attribution 4.0 International License.

**Table 7<sup>10</sup>** (continued)

|                                 |                    |  |
|---------------------------------|--------------------|--|
|                                 | Tarzan tag         | All kinds of equipment (benches, mats, “paint ball bunkers,” hula hoops) are spread around the room. One tagger chases the others, and the children must avoid being tagged by moving between equipment without touching the floor.  |
| <b>Main section (35–40 min)</b> | Bus relay          | One child is the “driver” who runs around in the room with a long rope, picking up “passengers” who hold onto the rope and run with the driver.  |
|                                 | Deck of card relay | Two teams. Each team collects spades, hearts, diamonds, or clubs, and must perform various “penalty loops” when they get the wrong card.   |
|                                 | Team game          | Two teams. Different stations (10 jumps on a bench, crawling on the floor, 10 high-jumps on a gymnastic mat, jumping ropes) in a circuit. On the last station, pieces from a puzzle or monopoly money are collected. The team that completes the puzzle or gets the most money first wins. |
|                                 | Flipping cones     | Two teams. 30 cones are spread around the room. One team runs and puts up cones and the other team turns them over. Time: 30 s.  |
|                                 | Hunting beanbags   | Two teams; 5 beanbags in each corner of the room. Each team has to “protect” the beanbags in 2 corners, while at the same time taking beanbags from the other team.  |
|                                 | Gym mat relay      | Two teams. Relay with gymnastic mats to be pushed, rolled over, or lifted a certain distance.  |
|                                 | Obstacle relay     | Two teams. An obstacle course with “obstacles” to jump over, crawl under, balance on, etc.   |
|                                 | Station relay      | Stations: jumping rope, squat-jumps on a gymnastic mat, stepping on a bench, etc.  |
| <b>Cool-down (5–10 min)</b>     | Untie the knot     | Children stand in a circle holding hands and walk over/under arms and legs to make a “knot.” One subject “unties.”   |
|                                 | Relaxation         | Lying on a mat listening to quiet music.   |
|                                 | Shoe relay         | A pile of children’s shoes lie in the middle of the room. Two teams. Each child must find their own shoes, tie them, and run back to the starting position.  |
|                                 | Waking up          | Lights out. Individuals lie on mats. One calmly wakes the other individuals up.  |

#### 5.4.4 Qualitative data generation and analysis

Qualitative data generation in the mixed methods study (paper 4) was conducted by focus group interviews and field observations.

*Focus group interviews* including all participating children were conducted at three occasions during the six week intervention pilot (paper 4). Focus groups are considered advantageous to individual interviews by removing strong emphasis on the adult-child relationship and the pressure to respond beyond experience or to satisfy the researcher. Moreover, such interviews are advantageous to discover children’s view of the world, including their interaction with one another, and to acknowledge children as experts (157).

Interviews were conducted at the beginning of the intervention, and after 3 and 5 weeks. At each focus group interview, participants were served water and fresh fruit. All three focus group interviews were moderated by the author of this thesis based on a semi-structured interview guide (Appendix 8). To enhance children’s confidence

<sup>10</sup> Reprinted from BMJ Open, 5. 1, Westergren, T., Fegran, L., Nilsen, T., Haraldstad, K., Kittang, O-B., & Berntsen, S., Active play exercise intervention in children with asthma: a PILOT STUDY, e009721. Copyright (2016), with permission according to the Open Access terms of Creative Commons Attribution 4.0 International License.

within interviews, no co-moderator was invited. The interview guide comprised open-ended questions about participants' experiences and behaviors in relation to asthma, habitual PA, and the intervention.

The moderator had met all participants prior to the first focus group interview and hence knew their names, and had made a first impression of who were eloquent, and who were of fewer words. Participants were placed using name plates around the table following ideas given by Krueger & Casey (158). The two most eloquent children were placed next to the moderator on each side, and the two most silent children were placed right across the table from the researcher. Hence, the moderator could distribute attention more directly to those of few words on behalf of the most eloquent children when needed, and to ensure all six participants were included in group discussions. Additionally, to enhance each participant's involvement, certain questions were asked to challenge each participant before free and open discussions. Hence, interviews do not represent only one or few participating children, but all voices of the group in addition to the situated interaction between participating children (158, 159). Focus group interviews lasted 43, 40, and 47 minutes, respectively and were audiotaped and transcribed verbatim in Norwegian. When appropriate, notes were written during, and after interviews by the moderator.

*Field observations* were conducted by the author of this thesis during all pre- and post-tests in the intervention study, and during five exercise sessions distributed throughout the six week intervention period. The objective of observations was how children interacted with their peers, parents, and instructors, including verbal and non-verbal communication, level of participation, symptom expressions, expressions about activities and individuals attending, and expressions about experiences from without the intervention. Focus were on face-to-face interaction (160, 161) and special events were noted (e.g. When and how did they participate in, or avoided certain situations or exercise, and what were the consequences/reactions of events?) During observations, the observer assumed an observer-participant role (162), not interfering with instructions but participating in activities to make participants comfortable with his presence. Field notes were written immediately after each observation session in order not to disturb or interfere with activities. Notes were sorted as narratives of observed incidents (including who was present, at what time and during which activities/circumstances), analytical notes (reflective and interpretative notes), and memos (when, where and what was done by the researcher) (162).

*Systematic text condensation* of field notes and transcripts was conducted according to Malterud (163). Field observations and multiple focus group interviews during a time-span do not; however, allow a clear distinction between data generation and data analysis, and analysis of transcribed focus group interviews and field notes from observations started during the data sampling period and was continuously pursued throughout the study (162). Observations was hence considered and discussed during focus groups, and issues identified during groups influenced the focus of subsequent observations. Both orders represented triangulation of data (162).

The transcripts and field notes were eventually and systematically analyzed according to the method of Malterud (163) by support from appropriate software (QSR International NVivo 10). First, the text was read as a whole while identifying emerging themes with emphasis on an open mind and sharp awareness of participants' voices. Secondly, transcripts and field notes were reviewed line by line, sorting each text fragment into meaning units close to participants' own words, experiences, and descriptions. Thirdly, meaning units were condensed and re-grouped more distant to the participants' own words concerning the underlying meaning, context, comparison between meaning units and symbols, and motivations and interests of participating children. Empirical data were hence decontextualized to fewer meaning units across the entire material and individual participants. Finally as the fourth step of systematic text condensation according to Malterud (163), condensed meaning units were synthesized into three descriptive categories representing participants experience with the intervention: 'interaction towards independence and normality', 'being different and limited by asthma', and 'a new context of independence and normality'.

#### **5.4.5 Statistical analysis**

Categorical variables are presented as numbers and percentages. To compare frequencies between groups for categorical variables, Chi-square test was conducted. Continuous normally distributed variables are presented as mean with standard deviation (SD), and independent t-test was used to analyze differences in mean between groups. Skewed distributed variables are presented as median with interquartile range (IQR), and Mann-Whitney Wilcoxon test was preferred for calculating differences between groups.

Variables with a significance level  $<0.20$  were considered for inclusion in multivariate models. Hosmer's stepdown regression analysis was conducted, removing the least significant variable until only significant values remained (164). In paper 1,

logistic regression was performed to calculate odds ratio (OR) with 95% confidence interval (CI) in predicting perceived exercise limitation, which is a binary variable. In paper 2, analysis of covariance was performed to assess the impact of the independent variables on the continuous variables MPA and VPA. Results are given as regression coefficient (*b*) with 95% CI.

Variables in models were carefully chosen to avoid multi-collinearity; different measures of BHR were assessed in different models, and only one lung function variable was included in each single model. Variables in paper 1 representing asthma severity, allergic disease, and BHR were associated with each other, and multivariate models were thus repeated. First asthma severity was excluded, and secondly allergic disease. Nagelkerke  $R^2$  is reported to assess contribution from different factors in statistically explained variance by logistic regression.

In paper 2, Jackknife Residuals and Cook's *d* were used to assess the underlying assumptions of the analysis of covariance. Statistically explained variance from linear regression is reported as adjusted  $R^2$ .

All significant independent variables in each final model as well as gender were checked for interaction terms with perceived exercise limitation (paper 1) or VPA (paper 2).

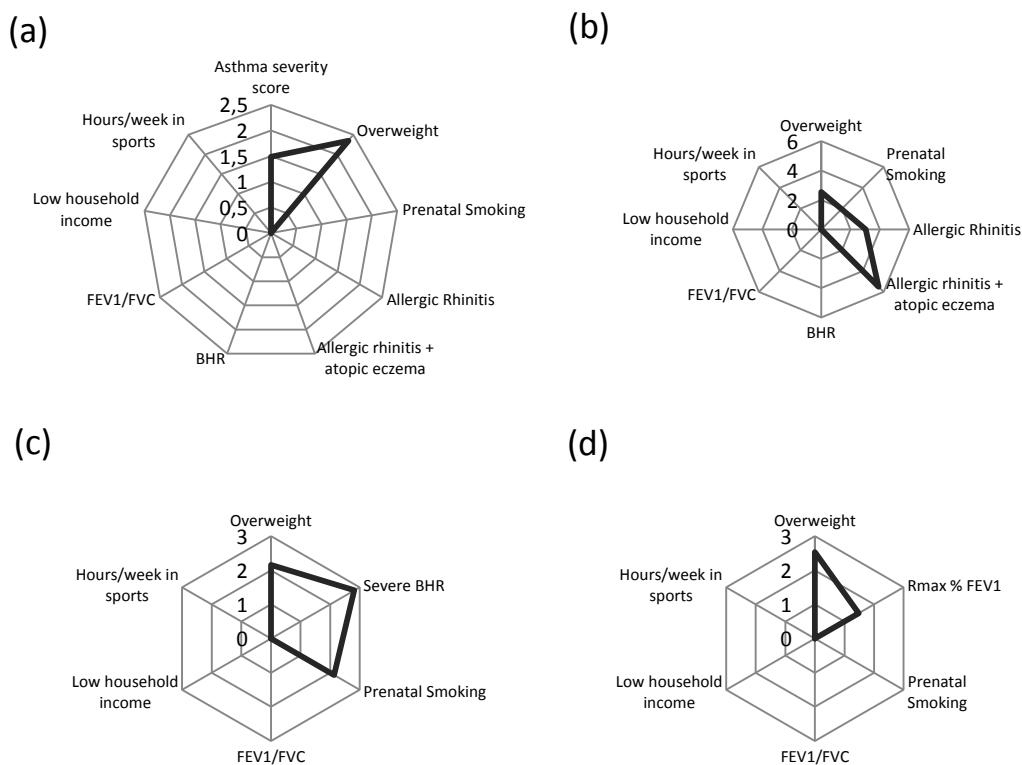
Statistical significance level was set to 5%, and analysis was conducted with the Statistical Package for Social Sciences Version 19.0 (paper 2) and 22.0 (paper 1) (IBM SPSS, Chicago, IL USA).

## 6.0 SUMMARY OF FINDINGS

### 6.1 Factors associated with perceived exercise limitation (paper 1)

The following asthma related pathophysiological factors were associated with perceived exercise limitation; severe BHR by  $PD_{20} \leq 1 \mu\text{mol}$  or  $R_{\text{max}}\%FEV_1$ , allergic rhinitis only, comorbidity of allergic rhinitis and atopic eczema, and overweight. Radar plots visualizing OR of factors associated with perceived exercise limitation are given in Figure 6.

**Figure 6<sup>11</sup>** Radar plots visualizing Odds ratio (OR) of factors associated with perceived exercise limitation from logistic regression models including full model (a), reduced model excluding asthma severity (b), further reduced models excluding also allergic disease including severe BHR (c) or  $R_{\text{Max}}\%FEV_1$  (d) as measures of BHR. Numbers from 0-2.5 (a), 0-6 (b), and 0-3 (c and d) represent OR. Models were adjusted for gender. The least significant variables were removed stepwise until only significant variables remained.



Abbreviations:  $FEV_1$ ; forced expiratory volume in 1 second, FVC; forced vital capacity,  $R_{\text{Max}}\%FEV_1$ ; maximal reduction in  $FEV_1$  post exercise (%), BHR; bronchial hyper responsiveness.

<sup>11</sup> Reprinted from Pediatric Allergy and Immunology, Westergren, T., Berntsen, S., Lødrup Carlsen, K. C., Carlsen, K-H., Mowinckel, P., Håland, G., Fegran, L., & Carlsen, K-H., Perceived exercise limitation in asthma: the role of disease severity, overweight and physical activity in children, Early Online 11 NOV 2016; DOI 10.1111/pai.12670., Copyright (2016), with permission from John Wiley and Sons.

Exercise-induced bronchoconstriction ( $\geq 10\%$  reduction in FEV<sub>1</sub>), PD<sub>20</sub>  $\leq 8$   $\mu\text{mol}$ , and bronchial lability index was not associated with perceived exercise limitation. Overweight more than doubled the probability of reporting exercise limitation (Figure 6a-d) irrespectively of BHR, lung function, low household income, prenatal smoking, overweight, asthma severity score, allergic disease, and PA.

Asthma severity assessed by use and dose of controller medication, leukotriene antagonists and/or  $\beta_2$ -agonists, and number of exacerbations the last 12 months was associated with perceived exercise limitation. Asthma severity score together with overweight (Figure 6a) explained 30.1% of the variance in perceived exercise limitation, while severity assessed by PD<sub>20</sub>  $\leq 1$   $\mu\text{mol}$  or R<sub>max</sub> %FEV<sub>1</sub> together with overweight explained 8.4-9.7% of the variance (Figure 6c and d).

Socioeconomic status was not associated with perceived exercise limitation, either measured as low household income (<350.000NOK/43.000€ per year), or as parental education  $\leq 13$  years of schooling. Physical activity reported as daily PA or hours / week in sports was neither associated with perceived exercise limitation.

## 6.2 Psychosocial and socioeconomic factors associated with physical activity level (paper 2 and 3)

Competence-enjoyment and peer support were positively, and teacher support was negatively associated with VPA irrespectively of asthma and asthma status (Table 8).

**Table 8**<sup>12</sup> Regression coefficients for associated factors of objectively measured VPA.

|  | Regression coefficient with 95% Confidence Interval | P-value |
|--|---|---------|
| Girls <sup>a</sup>                                   | -0.55 (-0.86, -0.25)                                | <0.001  |
| Skin fold thickness (mm)                             | -0.02 (-0.03, -0.01)                                | 0.003   |
| Asthma <sup>b</sup>                                  | -0.18 (-0.47, 0.12)                                 | 0.24    |
| FEF <sub>50</sub> (% of predicted)                   | -   | -       |
| Use of ICS last 14 days <sup>c</sup>                 | -   | -       |
| Use of $\beta_2$ -agonists last 14 days <sup>c</sup> | -   | -       |
| Asthma exacerbations last 14 days <sup>c</sup>       | -   | -       |
| Parental practical support                           | -   | -       |
| Parental emotional support                           | -   | -       |
| Peer support   | 0.29 (0.05, 0.52)                                   | 0.02    |
| Teacher support                                      | -0.26 (-0.50, -0.02)                                | 0.04    |
| Competence-enjoyment                                 | 0.23 (0.01, 0.44)                                   | 0.04    |
| Safe environment                                     | -   | -       |
| Physical-social opportunity                          | -   | -       |

<sup>a</sup>Girls with reference to boys, <sup>b</sup>Asthma with reference to non-asthma, <sup>c</sup>Yes with reference to No

<sup>12</sup> Reprinted from Journal of Asthma, 52. 2, Westergren, T., Ommundsen, Y., Lødrup Carlsen, K. C., Carlsen, K-H., Mowinckel, P., Fegran, L., & Berntsen, S., A nested case-control study: personal, social and environmental correlates of vigorous physical activity in adolescents with asthma, 155–61., Copyright (2015), with permission from Taylor & Francis.



Parental emotional or practical support, perceived safe environment, and physical-social opportunity were not associated with VPA. Together with skin fold thickness and gender, associated factors explained 25% of the variance in VPA.

Fourteen psychosocial factors assessed in relation to PA level in children and adolescents with asthma were identified in the systematic review (Table 9). Socioeconomic factors assessed in relation to PA level that were identified were; parental occupation, employment, and education, poverty, and social class. Measures of socioeconomic factors showed no consistent pattern of correlation with PA level between studies.

**Table 9** Correlates of physical activity level in children and adolescents with asthma reported in the literature.

| Correlate (references)  | Number of studies reporting being correlated | Number of studies reporting being correlated | Number of studies reporting the correlate |
|---|--|--|---|
| Enjoyment (29, 130, 165-167)  | 5  | -  | 5   |
| Physical self-concept (29, 130, 167-169)  | 4  | 1  | 5   |
| Self-efficacy (112, 132, 170)   | 2  | 1  | 3   |
| Body perception (171)   | 1  | -  | 1   |
| Attitudes and beliefs about PA and health (29, 127, 130, 132, 169, 170, 172)      | 4  | 3  | 7   |
| Psychological distress (127, 130, 131, 171)                                       | 3  | 1  | 4   |
| Health-related quality of life (131, 172, 173)                                    | 2  | 1  | 3   |
| Social support/approval of PA (100, 111, 128, 132, 167, 170, 172)                 | 5  | 2  | 7   |
| Restriction of PA (26, 168, 172)  | 1  | 2  | 3   |
| Parents' self-efficacy to stimulate their child's PA (111, 132)                   | 1  | -  | 1   |
| Parents' attitudes and beliefs about PA and health (100, 111, 127, 132, 168, 170) | 3  | 3  | 6   |
| Parents' anxiety and depression (168)   | -  | 1  | 1   |
| Health support (113)  | 1  | -  | 1   |
| Environmental factors (100, 113, 167, 169)  | 2  | 2  | 4   |

Abbreviation; PA; physical activity

Enjoyment, physical self-concept, self-efficacy, attitudes and beliefs about PA and health, psychological distress, HRQoL, and social support were more often

reported to be correlated with PA level than not. Body-perception and health support were reported as being correlated with PA level in one study each while parents' self-efficacy in stimulating their child's PA participation were reported to be correlated twice from the similar cohort. Parents' anxiety and depression were assessed in one study but were not reported as being correlated with PA level. Adult restriction of PA, parents' attitudes and beliefs about PA and health, and environmental factors were similarly, or more often reported as not correlating to PA level. The measure of parents' attitudes and beliefs was; however, identified as a determinant of PA level in one study (111).

The following issues in relation to participation in PA were reported by children and adolescents with asthma in qualitative studies (Table 10); enjoyment, negative feelings, self-esteem, capability, toughen up and downplay of asthma, modification of PA, being similar to peers, social belonging, social support, and gendered roles. Capability and being similar to peers were the most commonly reported issues.

**Table 10** Issues described in qualitative research in relation to participation in physical activity in children and adolescents with asthma.

| <b>Issue described in qualitative research</b>               | <b>Number (%) of studies reporting the issue</b> |
|--|--|
| Enjoyment (27, 30, 174)                                      | 3 (23)   |
| Negative feelings (118-120, 122, 123)                        | 5 (38)   |
| Self-esteem (27)   | 1 (8)  |
| Capability (27, 30, 118, 119, 121, 122, 124, 134, 174, 175)  | 10 (77)  |
| Toughen up and downplay asthma (30, 118, 119, 122, 134, 175) | 6 (46)   |
| Modification (27, 30, 118, 121, 124, 134, 174)               | 7 (54)   |
| Being similar to peers (27, 30, 118, 120-124, 133, 134, 174) | 11 (85)  |
| Belonging (27, 30, 121, 122, 133, 134, 174)                  | 7 (54)   |
| Social support (27, 123, 124, 134)                           | 4 (31)   |
| Gendered roles (27, 118, 119, 122, 175)                      | 5 (38)   |

### **6.3 Feasibility of an active play exercise intervention pilot (paper 4)**

Children enjoyed participating in the active play exercise intervention, and reported no serious asthma attacks or limitation of activities by asthma during exercise sessions. Attendance rate was 90%, and there were no drop-out. Exercise intensity was relatively high with a median time of 22 min at  $HR_{max} \geq 80\%$ , and a median HR during the entire sessions of 74% of  $HR_{max}$ . Highest intensity was recorded during endurance- and interval-based play, and instructors created satisfaction with activities through

games and play that were easy to master, and a social environment of competition, humor, and mutual participation.

### **6.5 Children's perceptions of participating in an active play exercise intervention (paper 4)**

Children reported of unwanted attention from peers as a result of asthma in their daily life, a variety of leisure activities, and of being limited by asthma in PA. The latter may be illustrated by the following quote from a girl:

*"...I always have to stop...to...breathe..."*

Within the intervention, they appreciated being acknowledged as competent and normal, and experienced increased feeling of competence, satisfaction, acceptance, enjoyment, and enthusiasm. As one of the participants stated:

*"Pushing myself is easier when physical activity is fun."*

Moreover, experiences with the exercise instructors were acknowledgement and making the situations harmless, illustrated by the following quotes from three of the participating boys:

*"They (the instructors) want us to be really good."*

*"...encouraging if we are doing wrong, and joking a lot."*

*"When (name of the instructor) says; come on, you can do it...then I manage."*

All participating children perceived that their asthma and fitness improved by end of the intervention. One of the boys stated:

*"...you get better lungs...at least I can feel it...I just feel that I have good fitness."*

## **7.0 DISCUSSION**

In the present thesis, overweight, asthma related pathophysiological factors, and asthma severity were associated with perceived exercise limitation. Competence, enjoyment, and peer support were positively, while female gender, skin-fold thickness, and teacher support were negatively associated with time spent in VPA. In the review, enjoyment, physical self-concept, self-efficacy, attitudes and beliefs about PA and health, psychological distress, HRQoL, and social support were more often reported as being correlated with PA than not. Capability and being similar to peers in relation to participation in PA were the most commonly reported issues in qualitative research. The active play exercise intervention pilot included high attendance and exercise intensity, no drop-out, and satisfaction of participating children. Children also reported enjoyment, appreciated being acknowledged as competent and normal, and experienced improved fitness and asthma post intervention compared with baseline.

The factors associated with perceived exercise limitation may be sorted as individual and biological factors influencing PA related to the ecological model suggested by Bauman et al. (36). Perceived exercise limitation per se might be characterized as an individual and psychological factor, which might have relations to interpersonal factors such as social support and cultural norms and practices (11, 119), as well as influenced by the social, built, and natural environment (113, 117, 132). Factors associated with VPA were both psychological (enjoyment, competence), biological (gender, skin fold thickness), and interpersonal (peer and teacher support). Likewise, the psychosocial factors identified as correlates of PA level in the literature, and all reported issues identified in qualitative literature relate to the individual interacting with the surroundings. The latter were exemplified by the two most common issues related to PA reported in qualitative studies; capability and being similar to peers. Moreover, results from the active play exercise intervention pilot may illustrate individual, interpersonal and environmental interplay of barriers and facilitators to PA in the individual child with asthma.

### **7.1 Findings related to previous knowledge**

#### **7.1.1 The barriers of physical activity and specific challenges in asthma**

In line with previous research (114-116), perceived exercise limitation was not associated with EIB assessed by  $\geq 10\%$  reduction in FEV<sub>1</sub>. Previously, reduced cardiorespiratory fitness has been reported to be associated with the perception of

breathlessness during activities (114, 116). In the present study, we did not assess cardiorespiratory fitness at 10 years, and were hence not able to verify if reduced physical fitness was related to perceived exercise limitation. Nevertheless, the association between  $PD_{20} \leq 1 \mu\text{mol}$  and perceived exercise limitation indicated that severe bronchoconstriction causing airflow limitation may cause sensation of exercise limitation. The association between  $R_{\text{max}} \%FEV_1$  post exercise and perceived exercise limitation additionally supported that severe EIB may cause perception of exercise limitation. Present findings altered previous reports (114-116), and were supported by Johansson et al. (176), who reported a prevalence of 42% of EIB in children with exercise-induced dyspnea, compared with 15% in controls without such symptom reports.

Exercise limitation in asthma has been associated with physiological mechanisms including lack of ventilatory reserve (177-179), reduced muscle endurance (177), and reduced cardiac stroke volume (179). Moreover, Pianosi & Davis (29) reported that overweight children report greater limitations of PA, which is also in concordance with findings in the present thesis. Previously reported relations between overweight and asthma include increased morbidity (57, 58), and that a vicious cycle of asthma and overweight may be set in motion (29). The association between overweight and exercise limitation irrespective of asthma severity, allergic disease, and BHR; however, support that perceived exercise limitation is a complex phenomenon. Overweight may theoretically appear through inactivity caused by exercise limitation, or cause perception of exercise limitation or dyspnea by increased demands from ventilatory and/or exercising limb muscles due to increase body mass (29). Joyner et al. (114) also reported similar level of cardiorespiratory fitness and decondition in obese and non-obese children. Assessment of fitness was; however, conducted on cycle ergometer whereas the participants did not bear their own body mass, and oxygen consumption was not adjusted for body mass (114). Nevertheless, overweight may influence sensation of capability of PA and create victimization both at a personal level, and as an interpersonal phenomenon including social exclusion, stereotyping and bullying (49).

The association between allergic disease (allergic rhinitis only and comorbidity of allergic rhinitis and atopic eczema) and perceived exercise limitation in the present study suggests that allergic asthma per se may challenge participation in PA, or that both perceived exercise limitation and comorbidity of allergic disease are features of a more severe asthma disease. Allergic rhinitis and allergic asthma; however, are related

to allergens in the environment (57, 63), and the relationship between allergic disease and perceived exercise limitation in the present study could hence be interpreted in agreement with the interplay of host and environmental risk factors of asthma (69). Perception of symptoms and limitations may thus rely on the individual with allergic disease exposed to allergens in environment of PA locations. Such associations could be further investigated in future studies with a multidimensional approach about correlates and determinants of PA in children with asthma.

Severity of asthma, either assessed by a severity score, or objectively by BHR was also associated with perceived exercise limitation. Present findings were contrary to Panditi & Silverman (115), who reported no association between EIB or asthma severity and perception of exercise-induced symptoms. Asthma severity and control, as defined, are related (10), and Panditi & Silverman assessed asthma severity differently by treatment steps only, and small numbers of participants with severe asthma. The score used to assess severity in the present thesis range from high score in participants with high dose of controller medication, use of  $\beta$ 2-agonists and/or leukotriene antagonists, and >3 exacerbations during the last 12 months, to none of the above features and the lowest score. A score of 5 might have appeared in well-controlled severe asthma (highest use of medication, no exacerbations) or in not well-controlled asthma (highest exacerbation score and low medication score or medium score of both). Likewise, severe BHR may be found both in uncontrolled and severe asthma (10). Thus, asthma severity in relationship to perceived exercise limitation as assessed in the present study might represent both perceptions due to severe and uncontrolled asthma. Nevertheless, the findings illustrated specific (individual/biological) challenges to participate in PA among children with asthma. Moreover, the present thesis included 302 children with asthma at 10 years which may provide possibilities to better discriminate probability of perceived exercise limitation by asthma severity, contrary to previous findings including 43 children (115).

In addition to asthma severity and pathophysiological mechanisms, perceived limitation of PA has been reported to relate to individual perceptions, interpersonal influence, and environment (11, 29). From an additional perspective, self-report of asthma symptoms and limitations have also been identified to be associated with stressors within everyday life in communities with low socioeconomic status (117). Exercise limitation in asthma may also appear as an individual and interpersonal phenomenon including parents' and children's beliefs that asthma per se limits PA (11), or that children should avoid PA to avoid symptoms or even normal

breathlessness (27). In the present thesis, lack of association between socioeconomic factors and perceived exercise limitation, as well as lack of association between self-reported PA and perceived exercise limitation were in contrast to previous reports. The ECA cohort has been described as a relatively well-controlled and physically active cohort (88). By attending several follow-up studies, participating children and their families may enhance their competence on asthma, and how to manage their disease. Furthermore, the measures of socioeconomic factors, self-reported PA, and perceived exercise limitation may not be enough discriminative to detect real differences in how the social environment of the child influence perceptions about PA, as suggested and reported elsewhere (11, 27, 29, 117).

Findings in paper 3 concerning experiences reported by children and adolescents with asthma in qualitative studies may elaborate understanding of perceived limitations. Reports of capability, downplay of asthma, negative feelings, being similar to peers, and belonging relate to the alternation of social cost of being different and making one's difference visual through use of medication or through asthma symptoms in relation to PA, as described by Protudjer et al (30). Perceived exercise limitation may thus also be related to the social and/or emotional discomfort the child or adolescent with asthma wishes to avoid. Williams et al. (11) also reported that gendered norms may force males to push themselves too hard while girls may be less active and still be similar to their peers. Both genders may experience stigma in PA and asthma, and both genders may perceive exercise limitation due to asthma (11). In girls, guilt of being inactive due to asthma are reported, while in boys, willpower despite asthma influences PA positively (119). Thus, perception of exercise limitation may be related both to experiences of inactivity and experiences of PA participation, giving further reflection to present findings of similar PA in those reporting exercise limitations compared with those not reporting limitations.

Competence of PA or physical self-concept, reported as a correlate of PA level in paper 2 and 3, may be assessed as opposite measures of perceived exercise limitation. The measure of perceived exercise limitation not associated with PA level was not a continuous measure based on several items such as measures of physical self-concept. Perceived exercise limitation was measured categorically as 'yes' or 'no' in response to the question "present feeling that asthma restrains PA". In the instrument measuring competence-enjoyment, five questions including a 1-5 response format were used (paper 2). "I feel that I am better than most peers at similar age in sports/physical activity" is one example from the questionnaire used. Hence, the

instrument may be expected to capture nuances differently than a categorical question. Supported by the discussion above, a child together with the present parent might theoretically answer ‘no’ when being asked about whether asthma restrains PA to meet social expectations of activity, or ‘yes’ as a report of belief that asthma is a limitation per se without having any experience of this. Moreover, introducing the gendered logic and the desire to be like peers reported by Williams et al. (11) and in paper 3, bias of both measures may appear. Admitting perception of limitation may be to admit weakness which is more problematic in boys than girls, and one may also expect higher scores of competence along with higher level of PA in boys than girls. No interaction between gender and competence-enjoyment in association with VPA (paper 2); however, supported that the instrument used was not biased by gender. Frequency of perceived exercise limitation did neither differ between boys and girls (paper 1).

Children participating in the active play exercise intervention pilot (paper 4) reported limitations of activities and unwanted attention from peers as a result of asthma in their daily life. The change in reports and the observed behavior within the intervention suggest that such perceptions can be modified with change in social environment. Children participating in the intervention were characterized as having well-controlled asthma, supporting that while asthma related pathophysiological barriers to PA are well-controlled (16, 24), psychosocially induced perceptions of barriers to PA can be consciously manipulated in interventions.

### **7.1.2 The facilitators, individuals belonging with peers**

Psychosocial correlates of PA may be interpreted as facilitators of enhanced PA level. Knowledge on such correlates in the healthy population of children and adolescents is mainly based on cross-sectional data, and competence, self-efficacy, and social support are reported as consistent correlates of PA (36, 46). Psychosocial factors may theoretically be accentuated in children with specific challenges in being physically active, for instance as in children with asthma.

Competence, enjoyment, and peer support were positively associated with VPA irrespectively of asthma and asthma severity. Teacher support, female gender, and skin fold thickness were negatively associated with VPA. Skin fold thickness was a confounder of the association between teacher support and VPA. A possible explanation of the negative association of teacher support with VPA could hence be



that adolescents who reported enhanced teacher support also were those identified as less fit by their teachers.

Analysis was cross-sectional and the association between VPA and competence-enjoyment, as well as peer support should not be interpreted as causal. Neither could previous quantitative studies help in interpreting a possible causality, as peer support was not assessed in any previous study, and findings on enjoyment and/or competence/physical self-concept were all based on cross-sectional analysis.

In qualitative studies included in the review (paper 3), enjoyment, capability, being similar to peers, and belonging with peers were reported in relation to participation in PA. Moreover, in paper 4, enjoyment, less perceived limitation and social acceptance within the intervention were interpreted as facilitators of managing PA and exercise. One may argue that children with asthma who are in a social environment which positively ‘normalize’ PA may be more active than children in social environments which problematize PA in asthma. Positive parental asthma specific beliefs about PA reported as a determinant of PA by Tiggelman et al. (111) may support such an interpretation. Furthermore, findings on competence-enjoyment and peer support from paper 2, and findings on experiences and beliefs of children from paper 3 and 4, also support the influence of a positive social environment concerning PA. The positive association between PA level and parents’ self-efficacy to stimulate children’s PA (111, 132) may also support such interpretations. In contrast, lack of consistent pattern of correlation between PA level and the measures of parents’ beliefs about PA and health between studies do not support that interpretation. Health belief models and measures have though been previously reported to fail in receiving clear support of correlation with PA in healthy individuals (37).

Support of children with asthma by asthma control and precautions of exercise-induced symptoms without forcing them publicly into a spot as ‘the different one with asthma’ may possibly reduce barriers of PA and facilitate participation. Both PA and asthma may be viewed as physiological acts and mechanisms, and as an integrated social phenomenon. From an ecological perspective about factors influencing PA during the life-course (36), physiological/biological, psychological, interpersonal and environmental factors are interrelated in children in general, in children with asthma, and in the individual with asthma who do, or do not participate in PA.

## 7.2 Methodological considerations, strengths and limitations

The present thesis and findings on barriers and facilitators of PA among children and adolescents with asthma should be judged and interpreted concerning validity and trustworthiness. Validity is a property of inferences which refers to the approximate of truth of an inference (180) and in qualitative inquiries, trustworthiness corresponds to a similar property (181).

*External validity* of present findings relate to the representativeness of the study populations; the generalizability in the ‘true’ population (180), and transferability or application of findings beyond the study context (181). A main strength of the present study was that participants in paper 1 and 2 were enrolled through a birth cohort with relatively high attendance rates (initially 75% of eligible children at birth). By those originally enrolled at birth, analysis between later decliners and attenders in the nested case-control study has been done without detecting important differences in the children’s background at birth and in background and asthma at 10 years as described in study populations section. There is; however, a threat to external validity by the 25% declining participation at birth, and of whom we do not know the characteristics. Moreover, 1427 children were considered not eligible for inclusion, including 1045 out of 1172 children with immigrant background who were excluded due to language problems (182). Thereby, one should note that participants in paper 1 and 2 to a very limited extent represent immigrant children. The birth cohort also included what have been described as relatively well-controlled children with asthma (88), which may differ from study populations referred to specialist health service. Such cohorts may include more severe and uncontrolled asthma, as in the study by Vahlkvist & Pedersen (89). Participating children may also have modified their behavior and knowledge according to the Hawthorne effect (183).

Participants in paper 4 were similar in age to those in papers 1 and 2, and asthma was defined by the similar criteria plus an objective confirmation of airflow reversibility. The limited number of participants allows no statistical inference of generalizability, and transferability rather than generalizability of findings should be applied in the interpretation of findings and knowledge provided. Transferability, defined as “*the extent to which the findings can be applied in other situations*” (181,p.69), relies on how (well) background information is given (181), and detailed descriptions of participants, the researcher, the intervention, the methods used were given to enable trustworthy transference by interpretation. Similarities of the study

population in paper 4 with the study population in paper 1 and 2 also enhance the representativeness of the integrated findings in the present thesis, as well as the credibility of findings from the paper 4.

The age range in studies included in the review (paper 3) was 4-19 years, which was greater than in paper 1, 2 and 4. The greatest age difference between the youngest and oldest participants in a single study was 11 years. Moreover, studies were conducted in five continents and eleven countries and may thus represent children >4 years old with asthma worldwide. Contrary, heterogeneity between studies may be a threat to external validity if real differences between age groups and origin are concealed (180), and detailed characteristics of each study and study population was thus reported in the review. There were differences between studies in recruitment, and in definitions of asthma ranging from self-reports only to clinical evaluation including objective measures of lung function and airflow variability, which may challenge generalizability.

*Internal validity* concerns whether a causal connection between variables can be inferred (180). Casual interpretation of the influence of a factor measured on a behavior (PA) is according to Bauman et al. (37) fundamental to understand why people are physically active or not. The strength of the relationship, a temporal sequence, the dose-response relationship, and a conceptualization of plausibility by biological mechanisms or empirical framework and models may enable interpretation of causality (37). Generalized casual inference from cross-sectional and case-control analysis, as in the present thesis, may though be questioned (37, 180), as cross-sectional studies are considered more appropriate to determine associations and prevalence including alternative explanations for observed differences (184). Strengths of the present thesis was the observational data from well-defined study populations providing knowledge about correlates of PA and perceived exercise limitation from which plausible interpretations were, or can be done. The present study design may thus enable ‘generated hypotheses’ of casual relations rather than inference of casual relations per se, as suggested by Bauman et al. (37). One factor only identified in the review (paper 3) was characterized as a determinant based on longitudinal analysis (111). Longitudinal analysis and randomized controlled trials should be conducted in the future to further investigate hypotheses provided from the basis of the present thesis.

*Credibility* concerns how methods correspond with the intensions (181), or the in-study conceptual strengths and limitations (184). Strengths of the study were objective recordings of cardiorespiratory fitness, PA, BHR, and lung function according to standardized and validated procedures, including reference values. Lack of flow-volume loops during exercise to assess airflow restriction during PA and lack of fitness assessment and objective recordings of PA in paper 1 were though limitations in the study.

We are not aware of any previous study combining objective measures of PA in relation to a previously validated theoretically derived psychometric instrument measuring psychosocial correlates of PA in children with asthma. To test the construct validity of the instrument (paper 2) in the present population, a factor analysis was conducted, and construct of factors was adjusted as described in the methods section. Reliability, or internal consistency of concepts in the instrument, were assessed with Cronbach's  $\alpha$ . Normally, Cronbach's  $\alpha > 0.70$  is considered satisfactory while lower values may indicate poor consistence between items within the concept (185). Few items additionally increases the risk of underestimating reliability by Cronbach's  $\alpha$  (185), and the four concepts with lowest Cronbach's  $\alpha$  (0.48 to 0.68) included only two items each. Peer support (3 items, Cronbach's  $\alpha$  0.82), the combined measure of competence-enjoyment (5 items, Cronbach's  $\alpha$  0.73), and safe environment (4 items, Cronbach's  $\alpha$  0.75); however, showed satisfactory consistence reliability, and competence-enjoyment and peer support were also positive correlates of PA. Moreover, the association between VPA and peer support as well as competence-enjoyment irrespectively of asthma and asthma severity enhance the validity of the two concepts as generic correlates of PA in adolescents. The inclusion of the full model also increased overall construct validity. Single constructs identified from systematic reviews or special interests may be isolated from the models from which they stems (36, 37). Correlates of PA should ideally be tested as ingredients of direct influence, mediators, or moderators within a particular full theoretical model.

Asthma severity as a concept is unclear (10). The construction of the scale; however, was based on what Taylor et al. (10) suggest as the most clinically useful concept of asthma severity, and the construct of the scale is transparently reported. The ambiguity and relationship between asthma control and severity discussed previously may; however, be a threat to the content and construct validity of the measure. Nevertheless, the associations of the scale with BHR measures and with perceived

exercise limitation suggest that the measure was valid to assess asthma specific barriers to PA.

Self-report of PA in paper 1 (10 years) may be questioned with respect to validity of the measure. A fundamental shortcoming of all subjective approaches to assessing PA is the potential of overstatements (186), or socially desirable responding (187). Self-reported PA is basically a representation of perceived PA rather than PA per se (186). Self-reports in children, are particularly challenging due to their sporadic and intermittent nature of movement, but may be advantageous in measuring mode and domains of PA (186). Choice of instrument to measure PA level depends on validity of the measure in a representative population, budget, and what aspects sought to measure (186, 188). Objective recordings of PA are more expensive, but may when validated better represent PA per se than self-reports (186, 188).

To assess the association between self-reported PA and objective recordings, analysis from the 13-year dataset of the ECA was done. Both daily PA and hours / week in sports were statistically associated with objectively recorded MVPA (148). The objective and self-report measures of PA differ with respect to face and/or content validity, suggesting that the two self-reports cannot be validated by criterion of objectively recorded PA. Self-reported PA, as reported in the present thesis, may instead be used as an indicator of PA level with objective measures as criterion.

The measure of perceived exercise limitation was categorical and did not include any nuances reflecting the level of limitation, and was also not explored to assess face validity (189) by participants. A child (or parent since the question was answered by the child and parent together) may think asthma restrains PA per se (11), or may experience severe airflow limitation or symptoms of bronchoconstriction related to participation in PA (114, 190). Moreover, general shortness of breath during VPA may be interpreted as an asthma attack (191). A child may also theoretically relate the question to low self-efficacy or physical competence (29, 112). The association with overweight in the present study may also be interpreted as if overweight per se contributes to present feeling that asthma restrains PA, either through low fitness, or by victimization and discomfort of overweight (49) which can be labeled to asthma. The measure was; however, strongly related to asthma severity including an explained variance of 30% together with overweight, and was also contrary to several studies (114-116) associated with severe BHR either measured by methacholine bronchial challenge or EIB-test. Those results may strengthen the

biological and clinical validity (189), or criterion-related validity (192) of the measure. The measure of perceived exercise limitation could have been strengthened by evaluation of face validity, construct of a scale measuring different dimensions of exercise limitation reported in the literature, evaluation in relation to concepts of attitudes and beliefs of PA in asthma, and flow volume loops during PA.

All measures may be biased by the so called socially desirable responding, meaning that participants answer to present a favorable image of themselves (187). Psychosocial correlates of PA, the asthma severity scale, self-reported PA, and perceived exercise limitation all includes dimensions children may perceive as socially preferable. The associations of measures with objective recordings of PA and BHR; however, strengthen validity of scales despite that they were not adjusted by any scale designed to detect the phenomenon of socially desirable responding.

The mixed methods design in paper 4, and triangulation of data strengthened credibility of the study (181). Moreover, credibility was strengthened by comprehensive descriptions of the context and participants, and by not concealing the background, decisions, and influence of the researcher(-s), or the interaction with the research field (162, 181, 193). The moderator of the focus groups had previous experience with the method and was familiar with the age group. Familiarity with the research field by being a children's nurse, a father of (healthy) children at the similar age as participants, and a volunteer instructor at the local sports club enable access, thrust, and the focus of investigation as much as it challenges the reflexive distance and ability to look and interpret from a naïve perspective (162, 193, 194). Efforts to increase reflexivity between research colleagues were made including mutual discussion and analysis, and reflexive notes were written in connection with focus group interviews and field observations. Findings were also related to previous examinations and knowledge, and negative or disparate reports and observations were included in analysis and interpretations with transparent report of relations to main findings. Children were returned to for several occasions during the study period enabling iterative questioning, and focus on each individual's perceptions and interactions with peers, parents and instructors. Detailed description of the practical implementation, triangulation of methods, and in-depth description of methods and reflections additionally enhanced credibility, dependability and conformability of the study, as defined by Shenton (181). Conformability issues were also handled by reflexive efforts, and by creating distance to the material including iterative efforts to

depend on participants own voices and actions, and avoid presupposed analysis and interpretation from the horizon of the researcher(-s) (181).

Lack of objective recording of PA in most of the studies in the literature review (paper 3) was a limitation. Heterogeneity between studies concerning study population, measures of PA, psychosocial factors, and socioeconomic factors were also evident. Nevertheless, the comprehensive map of previously published knowledge about barriers and facilitators of PA may represent a triangulation of findings. The review was conducted according to established methods (125), and expertise within the field of research methodology, sports psychology, asthma, physical activity and health, and exercise interventions were included as reviewers. Two studies included in the review were written by members of the review group. To ensure similar management and interpretation of each study, evaluation of, and data extraction from those two studies, were conducted by members of the group who had not co-authored the two primary studies. Despite heterogeneity of study population, methods and findings between studies, the study confirmed that several intra- and interpersonal psychosocial factors were associated with PA in children with asthma aged 5-19 years worldwide. The review findings also supported findings of barriers and facilitators of PA in asthma from paper 1, 2 and 4. No stratified analysis or mapping with respect to age, study population (country of origin or differences in asthma), or assessment of PA level was; however, conducted.

### **7.3 Ethical considerations**

Children may be considered as vulnerable research participants in need of extra protection and support, which requires enhanced attention by the researcher(-s) (184). Written information about the study was adjusted for guardians and participating children, followed by verbal information and possibilities for children and parent to address their concerns. Consent was collected from both children and their guardians, and each child could at any time withdraw from participation without giving any reasons for their withdrawal.

Ethical approvals were collected from appropriate institutions, and national and international guidelines of research ethics were followed. Assurance of each participant was covered, and a medical responsible was available at all tests and during the exercise sessions for medical assistance if needed. No unauthorized person had access to information about participating children, and the identities of participants in

the ECA were not known to the author of the present thesis as the data files shared were anonymous.

Research and data generation imply interaction between researchers and participants, as well as possible interaction between participants. Research is not observation from a neutral angle (194), and may have influenced participating children and their life-world positively and/or negatively more or less (184). Children in the study may have experienced beneficence from participation by gaining competence from specialists and peers, and awareness of their situation and disease. Contrary, children may have experienced inconvenience by expenditure of time, discomfort during examinations and tests, and possible discomfort of being in focus of attention from researchers and peers.

One may ask whether the present thesis act emancipatory of those researched, or could do more harm by victimization or giving stigma to mothers who have smoked during pregnancy, children avoiding their medications in public, children not enjoying PA, children feeling incompetent in PA, or overweight children reporting exercise limitation. Focus in the thesis have been on the combination of perceptions and objective records, and participating children have hence been included and given autonomy, more or less ranging from open ended interviews to pre-defined response format in questionnaires. The obligation to present reflexive and transparent results represents an opportunity for emancipatory knowledge rather than instrumental knowledge of 'others' possibly creating stigma, victimization, and harm.



## 8.0 CONCLUSIONS

### 8.1 Main conclusion(s)

The overall aim of the present thesis was to identify barriers and facilitators of PA among children and adolescents with asthma, and the contribution of this thesis was as follows:

Factors related to perceived exercise limitation:

- (1) Overweight led to a two-fold risk of reporting exercise limitation in children with asthma irrespectively of asthma severity, allergy, low household income, prenatal smoking or PA. Allergic rhinitis and comorbidity of allergic rhinitis and atopic eczema, severe BHR ( $PD_{20} \leq 1 \mu\text{mol}$ ), and larger maximal reduction in  $FEV_1$  ( $R_{\text{max}}\%FEV_1$ ) post exercise significantly increased probability of reporting exercise limitation.
- (2) Asthma severity, assessed by use and dose of controller medication, use of  $\beta_2$ -agonists and/or leukotriene antagonists, and number of exacerbations in the last 12 months, increased probability of reporting exercise limitation. Explained variance of perceived exercise limitation by asthma severity and overweight alone was 30.1%, compared with 9.7% and 8.4% by overweight and  $PD_{20} \leq 1 \mu\text{mol}$  or  $R_{\text{max}}\%FEV_1$ , respectively.
- (3) Neither low household income, nor parental education  $\leq 13$  years of schooling increased the probability of reporting exercise limitation in in children with asthma.
- (4) Self-reported daily PA and hours / week in sports were not associated with perceived exercise limitation in children with asthma.

Psychosocial and socioeconomic factors associated with level of physical activity:

- (5) Perceived competence, enjoyment as well as peer support were positively, while perceived teacher support was negatively associated with objectively recorded VPA in adolescents with and without asthma.
- (6) Enjoyment, physical self-concept, self-efficacy, attitudes and beliefs about PA and health, psychological distress, HRQoL, and social support were more often reported as correlates of PA level than not in children and adolescents with asthma in previous research. Socioeconomic factors were reported with no consistent pattern of correlation with PA level between studies. A measure of

parental asthma-specific beliefs about PA was identified as a determinant of PA in one study. Capability and being similar to peers in relation to participation in PA were the most commonly reported issues in qualitative research.

Feasibility and perceptions of the active play exercise intervention:

- (7) The active play exercise intervention included attendance of 90%, no drop-out, exercise intensity  $\geq 80\%$  of  $HR_{max}$  in two thirds of the time in endurance activities, no reports of limitation or serious asthma attacks, easy-to-master activities, an inclusive atmosphere, humor, and mutual participation.
- (8) Participating children reported satisfaction and enjoyment, appreciated being acknowledged as competent and normal, and experienced improved fitness and asthma post intervention compared to baseline.

## **8.2 Implications for clinical practice and future research**

Based on findings in the present thesis, emphasis should be placed on how PA is experienced beyond issues of breathlessness and airflow limitation, in addition to treatment increasing asthma control and enabling participation in PA.

Despite a negative association between teacher support and VPA, and no association between parental support or environmental factors and VPA, such factors should not be overlooked. Present findings; however, point in the direction of experiences of the individual child and adolescent, and its interaction with peers. Experiences related to overweight, capability, social/emotional discomfort, desire to be similar to peers, belonging socially, peer support, and gendered issues should be addressed while helping a child with asthma to overcome barriers of PA. Moreover, efforts to enhance enjoyment and perceived competence of PA should be taken while acknowledging the child's desire to be similar to peers, either included in exercise interventions, or when arranging for, and supporting children and adolescents with asthma to participate in PA. Therefore, knowledge based attempts by health services to increase PA in children and adolescents with asthma must be done through interaction between the individual with asthma, the context of the individual, and the evidence-informed health practitioner.

Based upon the present thesis, particularly concerning the design of the active play exercise intervention pilot, international collaboration to conduct a large scale exercise intervention study in both children and elderly with asthma has been

established. In 2016, a proposal for research funding from the European Union Commission Horizon 2020 was completed by the coordination of Professor Nicola Scichilone at the University of Palermo in collaboration with Imperial College in London, University of Porto, University of Agder, and the Norwegian School of Sport Sciences.

Further knowledge and intervention development are needed with longitudinal analysis and randomized controlled intervention studies, including individual biological and psychological, interpersonal, and environmental elements referred to in the study and in the ecological model by Bauman et al. (36). Construction of a continuous measure to assess graded experience of asthma related exercise limitation should be conducted with a clearer differentiation between exercise-induced symptoms, and perception of limitation. Possible outcomes of interventions could be perceived exercise limitation, level of PA assessed by objective recordings, enjoyment of PA, physical self-concept, social support from peers, parents, and teachers, HRQoL, asthma control, and asthma related pathophysiological factors. In addition, psychosocial, environmental, and socioeconomic correlates or determinants of PA should be included in longitudinal analysis to inform not only health practitioners and public health administrators, but authorities deciding and planning the social, built, and natural environment from a range of political and administrative fields.

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## APPENDICES

- Paper 1-4
- Ethical approval of the ECA 10-year follow-up study and informed consent form from the study (paper 1)
- Ethical approval of the ECA 13-year follow-up study and informed consent form from the study (paper 2)
- Ethical approval of the active play exercise intervention pilot study and informed consent forms from the study (paper 4)
- Questionnaire for structured interviews (paper 1,2 and 4)
- ACQ-questionnaire (paper 4)
- PAQLQ-questionnaire (paper 4)
- Questionnaire to assess personal, social and environmental correlates of physical activity (paper 2)
- Semi-structured interview guide of focus group interviews (paper 4)



**Perceived exercise limitation in asthma: the role of disease severity, overweight and physical activity in children.**

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## ORIGINAL ARTICLE

# Perceived exercise limitation in asthma: The role of disease severity, overweight, and physical activity in children\*

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## Keywords

bronchial hyper-reactivity; bronchial provocation tests; cohort studies; exercise-induced asthma; overweight; pulmonary function tests; self-report; socioeconomic status

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## Abstract

**Background:** Children with asthma may be less physically active than their healthy peers. We aimed to investigate whether perceived exercise limitation (EL) was associated with lung function or bronchial hyper-responsiveness (BHR), socioeconomic factors, prenatal smoking, overweight, allergic disease, asthma severity, or physical activity (PA).

**Methods:** The 302 children with asthma from the 10-year examination of the Environment and Childhood Asthma birth cohort study underwent a clinical examination including perceived EL (structured interview of child and parent(s)), measure of overweight (body mass index by sex and age passing through 25 kg/m<sup>2</sup> or above at 18 years), exercise-induced bronchoconstriction (forced expiratory volume in one-second (FEV<sub>1</sub>) pre- and post-exercise), methacholine bronchial challenge (severe BHR; provocative dose causing  $\geq 20\%$  decrease in FEV<sub>1</sub>  $\leq 1$   $\mu$ mol), and asthma severity score (dose of controller medication and exacerbations last 12 months). Multivariate logistic regression analyses were conducted to assess associations with perceived EL.

**Results:** In the final model explaining 30.1%, asthma severity score (OR: 1.49, (1.32, 1.67)) and overweight (OR: 2.35 (1.14, 4.82)) only were significantly associated with perceived EL. Excluding asthma severity and allergic disease, severe BHR (OR: 2.82 (1.38, 5.76)) or maximal reduction in FEV<sub>1</sub> post-exercise (OR: 1.48 (1.10, 1.98)) and overweight (OR: 2.15 (1.13, 4.08) and 2.53 (1.27, 5.03)) explained 9.7% and 8.4% of perceived EL, respectively.

**Conclusions:** Perceived EL in children with asthma was independently associated with asthma severity and overweight, the latter doubling the probability of perceived EL irrespectively of asthma severity, allergy status, socioeconomic factors, prenatal smoking, or PA.

Asthma may result in reduced physical activity (PA) and thus poor physical fitness in childhood (1). Overweight children with asthma report greater limitations of PA (2). Improvement in asthma control by use of long-term controller medication is shown to be associated with increased PA (1). Furthermore, psychological adjustment to asthma and perceived competence of PA are positively associated with increased fitness in children with asthma (2, 3). Nevertheless, vigorous intensity PA may induce asthma symptoms in up to 90% of children with non-treated asthma and result in avoidance of PA (4).

The agreement between self-reported exercise-induced symptoms and objectively measured exercise-induced bronchoconstriction (EIB) is reported to be poor (5–7). Panditi and Silverman (7) found a weak association between children's symptom perception and EIB, which was unaffected by age, gender, asthma severity, medication, habitual PA, and attitudes toward PA or competitiveness. Seear et al. (5) and Joyner et al. (6) revealed that only 15% and 24% of children reporting exercise limitation met the criteria of EIB (decrease of  $\geq 10\%$  of forced expiratory volume in 1 second (FEV<sub>1</sub>) post-exercise),

respectively, explaining perceived exercise limitation (EL) by low cardiorespiratory fitness rather than EIB. Johansson et al. (8), however, reported a prevalence of EIB in 42% among adolescents reporting exercise-induced dyspnea which was significantly higher compared with controls. Nevertheless, misinterpreted symptoms in symptom-based management may lead to further inactivity (5, 6), and differential diagnoses may be overlooked (5, 8, 9). Moreover, overprotection by parents, and children and parents' misinterpretation of regular breathlessness during vigorous intensity PA may result in fear of asthma symptoms and restriction from participation in PA leading to further reduced fitness (10). Additionally, household stress factors related to low socioeconomic status are associated with perceived EL in children with asthma (11).

In this study, we aimed to investigate whether perceived EL in children from a prospective birth cohort study with asthma was associated with reduced lung function or bronchial hyper-responsiveness (BHR), socioeconomic factors, prenatal smoking, overweight, allergic rhinitis (AR), atopic eczema (AE), markers of asthma severity, or by PA.

## Materials and methods

### Study design and subjects

From the Environment and Childhood Asthma (ECA) birth cohort described elsewhere, 1019 children attended the 10-year follow-up (12). Children without suspicion of respiratory tract infection for the least 4 weeks, only, were included. Two clinical examinations with measures of BHR (EIB test and methacholine bronchial challenge on separate days) were performed 2–7 days apart after withholding short- and long-acting  $\beta_2$ -agonists for at least 12 and 48 h, respectively, and leukotriene antagonists for 72 h. This study comprises the 302 children (193 boys, 64%) with asthma of the 1019 children examined at 10 years, who were similar to the remaining 717 children without asthma with respect to height, weight, household income, prenatal smoking, AR, and AE.

*Asthma* (ever) was defined in accordance with previously reported criteria from ECA (12) by at least two of the following three criteria fulfilled: (i) dyspnea, chest tightness, and/or wheezing 0–3 years and/or 4–10 years, (ii) a doctor's diagnosis of asthma, and (iii) used asthma medication ( $\beta_2$ -agonists, sodium chromoglycate, corticosteroids, leukotriene antagonists, and/or aminophylline) 0–3 years and/or 4–10 years. *Allergic rhinitis* (ever) was defined with at least two of three criteria fulfilled: (i) doctor's diagnosis of rhinitis, (ii) symptoms of rhinitis, and (iii) treatment for eye/nose or allergy symptoms.

The study was approved by the Norwegian Data Inspectorate as well as the Regional Committee for Medical Research Ethics in South-Eastern Norway. Written informed consent to take part was obtained from guardians of the participating children.

## Methods

*Lung function* was measured according to European standard (13) using SensorMedics Vmax 20c (SensorMedics Diagnostics,

Yorba Linda, CA, USA), as forced expiratory flow volume loops reported as FEV<sub>1</sub>, forced vital capacity (FVC), and forced expiratory flow at 25–75% of FEV<sub>1</sub> (FEF<sub>25–75</sub>) and were presented as percent predicted according to Stanojevic et al. (14), in addition to FEV<sub>1</sub>/FVC.

*EIB tests* were conducted as a 6- to 8-min treadmill run with an exercise load of 95% of maximal heart rate during the last 4 min, following a standardized procedure (12, 15). The tests were considered positive as EIB with a reduction in FEV<sub>1</sub>  $\geq$  10% of baseline FEV<sub>1</sub> at 3, 6, 10, 15, or 20 min after running ceased. Maximal reduction (%) in FEV<sub>1</sub> (R<sub>Max</sub>%FEV<sub>1</sub>) post-exercise compared with baseline was calculated.

*Methacholine bronchial challenges* with controlled tidal ventilation were performed according to American Thoracic Society (ATS) guidelines (16) by use of SPIRA<sup>®</sup> dosimeter (Spira Respiratory Care Center Ltd., Hemeelinna, Finland). The starting dose was 0.05  $\mu$ mol and the test continued until FEV<sub>1</sub> was reduced by 20% or a maximum cumulative dose of 22.4  $\mu$ mol was reached. The tests were classified as positive in two categories with a provocative dose causing  $\geq$ 20% decrease in FEV<sub>1</sub> (PD<sub>20</sub>) of  $\leq$ 8  $\mu$ mol and  $\leq$ 1  $\mu$ mol, respectively; the latter categorized as severe BHR.

*Bronchodilator response* was assessed by the highest value of FEV<sub>1</sub> after inhalation of Salbutamol 0.5 mg per 10 kg body-weight 20 min post-exercise. A bronchial lability index indicating of the total variability in FEV<sub>1</sub> (%) was calculated as the sum of the percentage decrease post-exercise changes in FEV<sub>1</sub> plus the increase after Salbutamol inhalation compared to baseline (17).

*Structured interview* by a physician was conducted to collect data comprising respiratory symptoms of the child (ISAAC questions validated in Norwegian language (18)), use of medication, household income, parental education, prenatal smoking, PA, and perceived EL. Daily PA was assessed by a positive answer of 'PA accompanied with breathlessness and sweat 6–7 times each week'; hours participating in sports per week were assessed by 'hours participating in organized exercise each week'; and perceived EL was assessed by a positive answer to the question: 'present feeling that asthma restrains PA'. Self-reported daily PA and hours/week in sports were correlated with objectively recorded PA at 13-year measurements, described in detail elsewhere (19).

*Anthropometric data* were assessed measuring height with a stadiometer to nearest 0.5 cm and weight (Seca 709, Seca, Hamburg, Germany) to the nearest 0.1 kg wearing light clothing without shoes. Overweight was defined by international cutoff points for body mass index by sex and age between 2 and 18 years according to Cole et al. (20). Cutoff points are designed to pass through 25 kg/m<sup>2</sup> at age 18 years.

An *asthma severity score* ranging from 0 to 9 was constructed based upon steps suggested by Taylor et al. (21). This score included the reported asthma controller medication (inhaled corticosteroids (ICS) and leukotriene antagonists and/or  $\beta_2$ -agonists) in addition to exacerbations reported during the last 12 months (classified as 0, 1–3, and >3). Description of the asthma severity score is given in Table 1.



**Table 1** Description of asthma severity score based on the use and dose of inhaled corticosteroids, use of leukotriene antagonists/ $\beta_2$ -agonists, and number of exacerbations last 12 months

|       | Dose of ICS ( $\mu$ g) |         |            | Use of LKTR and/or $\beta_2$ -agonists |    | Number of exacerbations last 12 months |     |      | Total possible score |
|-------|------------------------|---------|------------|--|----|--|-----|------|----------------------|
|       | 0–99                   | 100–399 | $\geq 400$ | Yes                                    | No | 0                                      | 1–3 | $>3$ |                      |
| Score | 0                      | 2       | 4          | 1                                      | 0  | 0                                      | 2   | 4    | 0–9                  |

ICS, inhaled corticosteroids, LKTR, leukotriene antagonist.

### Statistical analysis

Chi-square tests were conducted to compare frequencies of categorical variables between children with and without asthma and between the groups with and without perceived EL. Continuous normally distributed variables are presented as mean with standard deviation (SD). Independent *t*-tests were used to analyze differences between groups. Skewed variables are presented as median with interquartile range (IQR), and Mann–Whitney Wilcoxon tests were preferred for calculating differences in not normally distributed data.

Variables with a significance level of  $\leq 0.20$  from bivariate analyses were considered for multivariate logistic regression analysis. Stepwise multivariate logistic regression analysis according to Hosmer et al. (22) was conducted, removing the least significant variable until only significant values remained. Results from logistic regression models are presented as odds ratio (OR) with 95% confidence interval (CI).

Multivariate analysis was conducted in five separate models including one measure of BHR in each: EIB;  $R_{\text{Max}}\%FEV_1$ ;  $PD_{20} \leq 1 \mu\text{mol}$ ;  $PD_{20} \leq 8 \mu\text{mol}$ ; and bronchial lability index. To avoid multicollinearity, each model included only one lung function variable with the lowest p-value ( $FEV_1/FVC$ ). Analysis of each model was repeated twice: first by excluding asthma severity markers from the total models as severity was significantly associated with all five BHR variables, and secondly, allergic disease was additionally excluded from the reduced model due to significant associations with both  $PD_{20}$  variables and bronchial lability index. All significant independent variables in each final model as well as gender were checked for interaction terms with perceived EL.

Statistical significance level was set to 5%. Nagelkerke  $R^2$  was reported as explained variance from logistic regression models. Statistical analyses were performed with Statistical Package for Social Sciences Version 22.0 (SPSS, Chicago, IL, USA).

### Results

Fifty-eight (20%) children with asthma reported EL. As shown in Table 2, these children had significantly larger  $R_{\text{Max}}\%FEV_1$  post-exercise as well as significantly more often severe BHR, more often a mother who smoked during pregnancy, overweight, and comorbidity of both AR and AE than children without perceived EL. The asthma severity score was

significantly higher and  $FEV_1/FVC$  lower in children with compared to without perceived EL. A non-significant ( $p = 0.07$ ) tendency to higher rate of positive EIB was found among children with (35%) compared to without (24%) perceived EL (Table 2). Groups did not differ significantly with regard to participation in sports or daily PA. Positive EIB test,  $PD_{20} \leq 1$ ,  $PD_{20} \leq 8 \mu\text{mol}$ , bronchial lability index  $\geq 10\%$  or  $FEV_1/FVC \leq 80\%$  individually or combined ranged from 29 to 67% in children with perceived EL.

In the final model, including gender, BHR,  $FEV_1/FVC$ , low household income, prenatal smoking, overweight, allergic disease, asthma severity score, and hours/week in sports; asthma severity score (1.49 (1.32, 1.67)) and overweight (2.35 (1.14, 4.84)) only were independently associated with perceived EL (Fig. 1a). In the model, 30.1% of the variance was explained. In the reduced model, excluding asthma severity score 15.5% of the variance in EL was explained (Fig. 1b). Children more likely to report EL were those whose mother smoked during pregnancy (1.95 (1.02, 3.80)), overweight children (2.54 (1.30, 4.95)), children with AR only (3.03 (1.06, 8.69)), and children with comorbidity of AR and AE (5.53 (2.49, 12.31)).

BHR was significantly associated with perceived EL only when excluding both asthma severity score and allergic disease from analysis. Children with severe BHR were 2.82 (1.38, 5.76) times more likely (Fig. 2a), and children with 10 percent increased  $R_{\text{Max}}\%FEV_1$  were 1.48 (1.10, 1.98) times more likely (Fig. 2b) to report EL, respectively. These models explained 9.7% and 8.4% of the variance in EL.

Overweight children were more than twice likely to report EL with significant associations to EL in all multivariate analysis (OR between 2.15 (1.13, 4.08) and 2.54 (1.30, 4.95)). This association was not significantly influenced by BHR, lung function, low household income, maternal prenatal smoking, allergic diseases, asthma severity score, or hours per week in sports. Overweight did not significantly influence the associations between perceived EL and asthma severity score, comorbidity of AR and AE or BHR. There were no significant interactions between independent variables and perceived EL in the reported models.

### Discussion

Exercise limitation was reported in 20% of children with asthma. In the final model explaining 30.1%, asthma severity

**Table 2** Descriptive characteristics of children with asthma reporting or not reporting exercise limitation (EL). Data are given as count (%) including n = 294 unless otherwise stated

|  | Perceived EL<br>(n = 58) | Not perceived<br>EL (n = 236) | p-value*        |
|--|--------------------------|-------------------------------|-----------------|
| Boys†  | 35 (60)                  | 152 (64)                      | 0.57            |
| EIB (≥10% fall in FEV <sub>1</sub> ) <sup>(n=264)</sup>              | 18 (35)                  | 49 (23)                       | 0.07            |
| R <sub>Max</sub> %FEV <sub>1</sub> , median (IQR) <sup>(n=264)</sup> | 7 (10)                   | 6 (6)                         | <b>0.02</b>     |
| Bronchial lability index (%), median (IQR) <sup>(n=253)</sup>        | 10 (12)                  | 9 (8)                         | 0.09            |
| Severe BHR (PD <sub>20</sub> ≤ 1 μmol) <sup>(n=291)</sup>            | 17 (29)                  | 33 (14)                       | <b>0.01</b>     |
| BHR (PD <sub>20</sub> ≤ 8) <sup>(n=291)</sup>                        | 31 (53)                  | 101 (43)                      | 0.17            |
| FEV <sub>1</sub> (% of predicted), mean (SD) <sup>(n=290)</sup>      | 94 (11)                  | 96 (9)                        | 0.12            |
| FVC (% of predicted), mean (SD) <sup>(n=290)</sup>                   | 99 (10)                  | 98 (9)                        | 0.91            |
| FEV <sub>1</sub> /FVC, mean (SD) <sup>(n=290)</sup>                  | 83 (7)                   | 84 (6)                        | <b>0.04</b>     |
| FEF <sub>25–75</sub> (% of predicted), mean (SD) <sup>(n=290)</sup>  | 81 (22)                  | 86 (19)                       | 0.14            |
| Low household income (<350,000NOK/year)‡ <sup>(n=290)</sup>          | 16 (28)                  | 40 (17)                       | 0.07            |
| Low parental education (no education beyond 13 years of schooling)   | 22 (38)                  | 88 (37)                       | 0.93            |
| Prenatal smoking   | 20 (35)                  | 50 (21)                       | <b>0.03</b>     |
| Overweight   | 21 (36)                  | 46 (20)                       | <b>0.01</b>     |
| Allergic rhinitis only   | 7 (12)                   | 23 (10)                       | 0.60            |
| Atopic eczema only   | 14 (24)                  | 60 (25)                       | 0.84            |
| Allergic rhinitis + atopic eczema                                    | 24 (41)                  | 43 (18)                       | <b>&lt;0.01</b> |
| Asthma severity score, median (IQR)                                  | 5 (5)                    | 0 (3)                         | <b>&lt;0.01</b> |
| Use of ICS last 12 months  | 37 (64)                  | 46 (20)                       | <b>&lt;0.01</b> |
| Hours/week in sports, median (IQR)                                   | 2 (3)                    | 2 (2)                         | 0.16            |
| Daily physical activity  | 13 (22)                  | 41 (18)                       | 0.39            |

n, numbers, EIB, exercise-induced bronchoconstriction, FEV<sub>1</sub>, forced expiratory volume in 1 second, R<sub>Max</sub>%FEV<sub>1</sub>, maximal reduction in FEV<sub>1</sub> post-exercise (%), IQR, interquartile range, BHR, bronchial hyper-responsiveness, SD, standard deviation, FVC, forced vital capacity, FEF<sub>25–75</sub>, forced expiratory flow at 25–75% of FEV<sub>1</sub>, NOK, Norwegian Kroner, ICS, inhaled corticosteroids.

\*Statistical differences between groups in bold. Analysis conducted: categorical variables; chi-square tests, continuous normally distributed variables; independent t-tests, skewed variables; Mann–Whitney Wilcoxon tests. Statistical significant differences at 5% level are given in bold.

†With reference to girls.

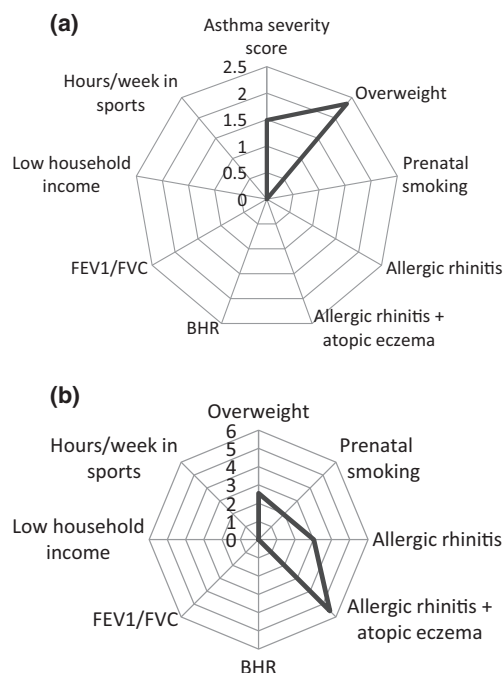
‡Corresponding to ≈43,000€.

score and overweight only were significantly associated with perceived EL. Excluding asthma severity and allergic disease, 9.7% and 8.4% of perceived EL were explained by significant associations to overweight and severe BHR or R<sub>max</sub>%FEV<sub>1</sub> post-exercise, respectively. Overweight children were more than twice likely to report EL irrespectively of any other included factor.

The 20% of children reporting EL is lower than the general activity limitation reported in 52% of children with current asthma (23), although the frequency of EIB (35%) among children reporting EL in the present study was comparable to previously reported range between 8 and 42% in studies comparing self-reported symptoms with EIB test (5, 6, 8, 9, 24). Nevertheless, 67 of 264 (25%) had a positive EIB compared to previously reported 51–55% (25, 26) including also children with current asthma and ICS treatment. The variations in rate of reported EL or exercise-induced symptoms and associations between EIB and perceived exercise-induced symptoms (5–8) may be related to study populations, asthma definitions, and control. Children with asthma ever in the present birth cohort study are likely to have less severe asthma (27) than the current asthma patients in the study by Yeatts et al. (23). Also, different assessments may affect the rate of EL or EIB, with our children responding to a question whether they experienced

that their asthma restricted their physical activity, compared to limited activities because of wheezing ≥1 times per month.

Despite no significant association between a positive EIB and perceived EL, the associations between R<sub>max</sub>%FEV<sub>1</sub> as well as severe BHR and EL suggest that perceived EL reflects BHR. This is supported by a report by Sanchez-Garcia et al. (24), suggesting that the direct methacholine challenge and the indirect mannitol tests have high sensitivities to detect BHR in steroid-naive children complaining of one or more symptoms after exercise. Sanchez-Garcia et al. (24) reported a detection rate of BHR in 96.7% with a methacholine test, increasing to 100% when combined with mannitol test (24). In contrast, Anderson et al. (28) reported a sensitivity of 59% and 56%, and a specificity of 65% and 69% to identify objectively measured EIB by mannitol and methacholine, respectively (28). The American Thoracic Society guidelines recommend mannitol test or hyperosmolar aerosols of 4.5% saline or eucapnic voluntary hyperpnoea of dry air as surrogates of exercise test (29), although these were not performed in the present study. Nevertheless, neither methacholine bronchial challenge, nor EIB test individually or combined with FEV<sub>1</sub>/FVC ≤80% or bronchial lability index ≤10% confirmed EIB in more than 67% of children reporting EL. This may be related to the anti-inflammatory BHR reducing effect of ICS (16), used by many

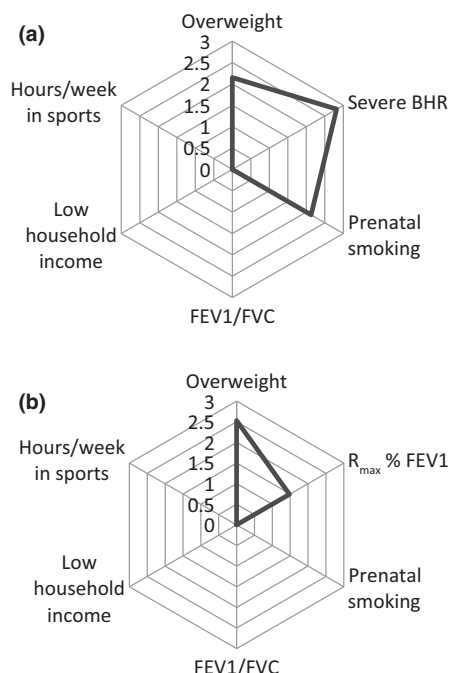


**Figure 1** Radar plots visualizing odds ratio (OR) of factors associated with perceived exercise limitation (EL) in children with asthma showing (a) a total model with explained variance of 30.1% in EL including a composite asthma severity score (use of asthma medication and asthma exacerbations) and (b) a model excluding the asthma severity score with explained variance of 15.5% in EL. Numbers from 0 to 2.5 (a) and 0 to 6 (b) illustrate the OR for reporting EL. Models were adjusted for gender. The least significant variables were removed stepwise according to Hosmer et al. (22) until only significant variables remained. BHR, bronchial hyper-responsiveness; FEV<sub>1</sub>, forced expiratory volume in 1 second; FVC, forced vital capacity.

of our study subjects compared to the steroid-naïve children in the study by Sanchez-Garcia et al. (24). The associations between perceived EL and asthma severity and allergic disease may additionally reflect the impact of uncontrolled asthma.

In the models excluding severity and allergic disease, explained variation of perceived EL was 8.4% to 9.7%. Asthma severity score and overweight adjusted for gender, however, statistically explained 30.1% of the variance in reported EL, and in the model excluding severity; 15.5% of the variance were explained without contribution from objective measurements. Both asthma severity score and allergic disease, which are clinically accessible without objective measures, were hence advantageous to objective measures in explained variation of reported EL. Moreover, contrary to Panditi and Silverman (7) who found no association of severity and perception of exercise-induced symptoms, our findings confirmed that severity assessed objectively by BHR or qualitatively by a severity score was related to perceived EL.

We found no significant associations between reported PA and perceived EL, in line with previous studies (2, 9), possibly indicating an absence of felt limitation due to inactivity or participation in PA despite perceived EL. Children and their



**Figure 2** Radar plots visualizing Odds ratio (OR) of factors associated with perceived exercise limitation (EL) in children with asthma using severe BHR (a) and R<sub>max</sub>%FEV<sub>1</sub> (b) to assess BHR in separate reduced multivariate logistic regression models excluding asthma severity and allergic disease from analysis. Model including severe BHR (a) explained 9.7%, and model including R<sub>max</sub>%FEV<sub>1</sub> (b) explained 8.4% of the variance in EL, respectively. Numbers from 0 to 3 illustrate the odds ratio for reporting EL. Models were adjusted for gender. The least significant variables were removed stepwise according to Hosmer et al. (22) until only significant variables remained. FEV<sub>1</sub>, forced expiratory volume in 1 second; FVC, forced vital capacity; R<sub>max</sub>%FEV<sub>1</sub>, maximal reduction in FEV<sub>1</sub> post-exercise (%); BHR, bronchial hyper-responsiveness.

parents may avoid symptoms through less PA, through overprotection (10) and/or beliefs that asthma limits the possibility for PA (30). On the other hand, we previously showed in the ECA study by objective recordings of PA at 13 years of age that children were rather active (19, 27), indicating that children in the present study might have been rather active despite 80% reporting PA less frequently than daily.

The robust association between perceived EL and overweight was in contrast to the report by Joyner et al. (6) who found no association between BMI and self-reported EL. Pianosi and Davis (2), however, reported that overweight children with asthma perceived greater limitations of PA. Causal relationship explaining why overweight may induce limitations is complex as asthma symptoms may induce perceived EL, reduced PA level and thus development of overweight (1). We were not able to verify whether low cardiorespiratory fitness, as suggested in previous reports (5, 6, 9), may explain perceived EL in children with asthma even without BHR. However, similar fitness and PA level in

overweight and normal weight children with asthma are previously reported (2). We hence interpret overweight as an independent perceived barrier of PA which may be labeled to asthma by children, irrespectively of reduced lung function, BHR, low household income, prenatal smoking, allergic disease, asthma severity score or hours/week in sports.

### Strengths and limitations

The main strengths of the present study were the nested case-control design, and the assessment of perceived EL related to objective assessment of BHR and lung function through validated and standardized procedures. Lack of objective measures of PA as well as fitness, and flow volume loops during exercise indicating expiratory flow limitations are considered as a limitation, in addition to lack of parents' and children's reports of attitudes and beliefs about PA. Also, we asked whether the child experienced exercise limitation or not, and did not include any information on grading of limitation. We were therefore unable to identify whether marked EL correlated better with objective measures than did limited

degree of EL. It should be underlined that results from a population-based study will differ from a study based on patients referred to specialized service as the study by Vahlquist and Pedersen (1), which included patients with more severe asthma whereas the present population-based study will differ as far as severity and consequences of the disease are concerned.

### Conclusion

Perceived EL in children with asthma was independently associated with asthma severity and overweight, the latter doubling the probability of perceived EL irrespectively of asthma severity, allergy status, socioeconomic factors, prenatal smoking, or PA.

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**A nested case-control study: personal, social and environmental correlates of  
vigorous physical activity in adolescents with asthma.**

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## ADOLESCENT

**A nested case–control study: personal, social and environmental correlates of vigorous physical activity in adolescents with asthma†**Thomas Westergren, RN, MSc<sup>1</sup>, Yngvar Ommundsen, PhD<sup>1,2</sup>, Karin C. Lødrup Carlsen, MD, PhD<sup>3,4</sup>, Kai-Håkon Carlsen, MD, PhD<sup>2,3,4</sup>, Petter Mowinckel, MSc<sup>3</sup>, Liv Fegran, RN, PhD<sup>1</sup>, and Sveinung Berntsen, PhD<sup>1</sup><sup>1</sup>Faculty of Health and Sport Sciences, University of Agder, Grimstad/Kristiansand, Norway, <sup>2</sup>Norwegian School of Sport Sciences, Oslo, Norway, <sup>3</sup>Department of Paediatrics, Oslo University Hospital, Oslo, Norway, and <sup>4</sup>Faculty of Medicine, University of Oslo, Oslo, Norway**Abstract**

**Objective:** Physical activity (PA) is associated with health benefits. Children and adolescents with asthma may be limited in their PA, particularly at vigorous intensity due to asthma symptoms or poor psychological adjustment to asthma. We aimed to investigate if self-perceived competence, enjoyment, support from others and social-physical environment were associated with vigorous physical activity (VPA) and secondarily to assess if such associations were modified by asthma and asthma severity. **Methods:** Data from a nested case–control study at 13 years of age within the birth-cohort Environment and Childhood Asthma Study were compiled from 95 participants with and 79 without asthma. The participants completed a questionnaire designed to capture self-perceived competence, enjoyment, support from others and social-physical environment. VPA, defined as  $\geq 6$  Metabolic Equivalents, was recorded objectively by SenseWear™ Pro<sub>2</sub> Armband. Asthma severity was assessed pragmatically by lung function and use of inhaled glucocorticosteroids and  $\beta_2$ -agonists and incidence of exacerbations in the last 14 days. Data were analysed using linear regression analysis. **Results:** No significant differences between adolescents with and without asthma were identified in terms of VPA, competence-enjoyment, support from others and social-physical environment. Peer support ( $b = 0.29$  (0.05–0.52)) and competence-enjoyment ( $b = 0.23$  (0.01–0.44)) were significantly and positively associated with VPA, and teacher support ( $b = -0.26$  (–0.50 to –0.02)) were inversely associated. The model explained 25% of the variance in VPA. **Conclusions:** Peer support and competence-enjoyment were positively associated with increased VPA in adolescents irrespectively of asthma and asthma severity.

**Keywords**

MeSH, competence, social support, social environment, psychological adjustment, health benefits, factor analysis

**History**Received 30 April 2014  
Revised 21 July 2014  
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Published online 29 August 2014**Introduction**

Physical activity (PA) is associated with health benefits and positively affects psychological functioning, quality of life, morbidity and cardiorespiratory fitness [1,2]. PA is also associated with improved self-esteem, social interaction and fewer depression symptoms [3]. Physical exercise is well tolerated and recommended for patients with asthma [2,4,5]. However, in studies it has been shown that children with asthma and poor disease control have lower levels of objectively recorded vigorous physical activity (VPA) [6]. A similar distinction is reported in children with asthma overall by self-reported VPA [7]. Objective recording may

though be more adequate to capture actual PA [8]. However, differences in moderate to VPA are not evident in either of the studies [6,7], which is confirmed in a Norwegian cohort [9], of which this study depends on. Furthermore, van Gent et al. [10] did not find lower level of VPA based on both self-reports and objective recordings, and neither did Nystad [11] at any level of exercise frequency or exercise hours a week in asthma based on self-reports. Even though asthma control and severity are associated with level of PA [1,6,7] and that increased intensity and exercise load is associated with bronchoconstriction [12], there is also evidence that psychosocial and socio-demographical factors and knowledge/competence are important for level of PA in children and adolescents with asthma [1,13–18]. Parents observing shortness of breath in their child may lead them to restrain their children from exertion [14], with subsequent increasing fear of breathlessness followed by personal or parental restrictions [15,16].

PA in school-children and adolescents, in general, are determined by a complex mixture of psychological and social factors and differs in form throughout different locations [19]. Competence and enjoyment scales derived from Harter's

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competence motivation theory [20], in which these two aspects are regarded as highly related [21], scales on support from significant others, which are emanated from Bandura's social-cognitive theory and social-physical environment scales including opportunity, facility and license to PA are shown to capture such factors [21]. Age accounts for a considerable amount of variance, while the supportive role from adults diminishes as they get older [19]. However, male gender [22], parental support [19,22,23], parental social support [24], teacher support [19,23,25] and peer support [22,23] are positively associated with enhanced PA, whereas inverse associations have been observed for parental emotional support for adolescent girls [24] and higher body mass index (BMI) z-score [22]. Perceived school environment is reported as associated with PA [25], while environmental factors have been reported to be of limited, no or unclear impact on PA [19,21–23].

In order to improve motivational strategies for children with asthma to be physically active, we aimed to investigate if self-perceived competence, enjoyment, support from others and social-physical environment were associated with VPA and secondarily to assess if such associations were modified by asthma and asthma severity.

## Materials and methods

### Study design

The present nested case–control study includes data from a 13-year follow-up [9] between October 2005 and June 2006 of the Environment and Childhood Asthma (ECA) study in Oslo, Norway [26]. The study initially enrolled 3754 children from a general urban population. The 1250 children who had their lung function measured at birth [27] and/or attended an investigation in the two-year nested case–control study based upon recurrent bronchial obstruction versus no lower respiratory tract disease ( $n = 562$ ) were invited for a 10-year follow-up study, attended by 1019. Further details of study design are given elsewhere [27,28].

This study included adolescents who were defined with current asthma at 10 years of age and/or at 13-year inclusion using the following definitions:

*Asthma* was defined by the presence of at least two of the following three criteria [28]: (a) dyspnoea, chest tightness and/or wheezing, (b) doctors diagnosis of asthma and/or (c) use of asthma medication ( $\beta_2$ -agonists, sodium cromoglycate, corticosteroids, leukotriene antagonists and/or aminophylline).

*Current asthma* at 10 or 13 years was defined asthma, plus at least one of the following three criteria fulfilled [28]: (a) dyspnoea, chest tightness and/or wheezing in the last 12 months, (b) use of asthma medication ( $\beta_2$ -agonists, sodium cromoglycate, corticosteroids, leukotriene antagonists and/or aminophylline) in the last 12 months and/or (c) a positive exercise-induced asthma test (conducted at 10 years only).

During the 13-year follow-up visit, the adolescents attended a one-day clinical examination and four days home monitoring of PA.

The study was approved by the Norwegian Data Inspectorate as well as by the Regional Committee for Medical Research Ethics. Written informed consent to take

part was obtained from the participating children and their parents.

### Subjects

All 310 adolescents who at the 10-year follow-up investigation of the ECA study had defined current asthma, and the child born closest in time without a history of lower respiratory disease were asked to attend the 13-year follow-up investigation [28]. Fifty-six percent ( $n = 174$ ) agreed to participate, 95 (66 boys) with current asthma at the 10-years or at 13-year inclusion and 79 (41 boys) without asthma were included in the present study. At 13-year inclusion, four adolescents without asthma from 10-year follow-up had current asthma by definition above.

In the present 13-year follow-up, there were no difference between attendees and decliners at 10 years of age with respect to socioeconomic factors (income and education), BMI, lung function, bronchial hyper responsiveness, use of inhaled corticosteroids or  $\beta_2$ -agonists, prevalence of wheeze and exercise-induced bronchoconstriction [28].

### Methods

All participants with asthma used their regular medications, whereas the investigations were postponed whenever appropriate to ensure at least three weeks with no signs or symptoms of any respiratory tract infection.

Study personnel performed a parental structured interview including questions related to airways symptoms and any medication used by the child [28,29].

Self-perceived personal, social and environmental factors were assessed by a paper-based validated self-report questionnaire (Table 1) [19,21,23] completed by the adolescent on

Table 1. Self-perceived personal, social and environmental factors with Cronbachs  $\alpha$  and example of items from questionnaire measured by scales.

|   | <i>N</i> of items | $\alpha$ |
|---|-------------------|----------|
| Parental practical support (response format 1–4 <sup>a</sup> )<br><i>How often does your mother or father take you to exercise or play sports?</i>          | 2                 | 0.59     |
| Parental emotional support (response format 1–4 <sup>a</sup> )<br><i>How often does your mother or father encourage you to play, exercise or do sports?</i> | 2                 | 0.68     |
| Peer support (response format 1–4 <sup>a</sup> )<br><i>How often do your friends exercise or play sports with you?</i>                                      | 3                 | 0.82     |
| Teacher support (response format 1–4 <sup>a</sup> )<br><i>How often does your teacher talk about exercise in lessons?</i>                                   | 2                 | 0.60     |
| Competence-enjoyment (response format 1–5 <sup>b</sup> )<br><i>I wish I could play more games and sports than I get chance to.</i>                          | 5                 | 0.73     |
| Safe environment (response format 1–5 <sup>b</sup> )<br><i>It is safe to walk or play alone in my neighbourhood during the day.</i>                         | 4                 | 0.75     |
| Physical-social opportunity (response format 1–5 <sup>b</sup> )<br><i>There are other children nearby home to go out and play with.</i>                     | 2                 | 0.48     |

<sup>a</sup>Response format 1–4; 1 = never or hardly ever, 2 = once or twice a week, 3 = almost every day and 4 = every day

<sup>b</sup>Response format 1–5; 1 = does not suit for me, 5 = suits for me.

the clinical visit. The questionnaire is designed to capture theoretically derived relevant perceived personal, social and environmental factors shown to influence PA in children.

PA levels were recorded using the SenseWear™ Pro<sub>2</sub> Armband (BodyMedia Inc., Pittsburgh, PA) and computed at one-minute intervals, randomly started on a Wednesday or on a Sunday and included three week-days and one weekend-day. Data from the monitor was downloaded and analysed with software developed by the manufacturer of the Armband (Innerview Professional Research Software Version 5.1, Body Media Inc., Pittsburgh, PA). PA data were adjusted for the mean hours each day the Armband was worn, to acquire 24-h units. Days where the Armband was worn less than 19.2 h (80%) are excluded from analysis.

VPA was defined as PA above 6 Metabolic Equivalents (METs). Moderate physical activity (MPA) was defined as PA with cut of points between three and six METs.

Body weight was measured with the subject wearing light clothing and without shoes (Seca 709, Germany). Height was measured to the nearest 0.5 cm by using a stadiometer. BMI was calculated as body mass (kg) divided by height (m) squared. Overweight were defined according to Cole et al. [30]. Skin fold thickness was measured with a Harpenden skin fold calliper (Holtain, Dyfed, UK) at the biceps, triceps, subscapular and suprailiac region and given as the sum of the four measurements.

Lung function was measured by maximum forced expiratory flow-volume curves (Masterlab, Erich Jaeger® GmbH & Co KG, Würzburg, Germany) and reported as forced expiratory volume in one second (FEV<sub>1</sub>), forced vital capacity (FVC) and forced expiratory flow at 50% of FVC (FEF<sub>50</sub>). Measurements were conducted according to criteria of European Respiratory Society and American Thoracic Society [31]. The predicted values of Zapletal et al. [32] were used for comparisons.

Highest recorded oxygen uptake (VO<sub>2max</sub>) expressed in ml kg<sup>-1</sup> × min<sup>-1</sup> during treadmill running (Woodway GmbH, Weil am Rhein, Germany) until exhaustion was measured [9]. Heart rate was recorded every minute (Polar Vantage, Polar Electro KY, Kempele, Finland). Minute ventilation, respiratory exchange ratio and oxygen uptake were measured and recorded every minute after 4 min of running using an oxygen analyser with mixing chamber (Oxycon Champion, Erich Jaeger® GmbH & Co KG, Hoechberg, Germany). Calibration was conducted before each test. The main criterion for having reached maximal effort was a subjective assessment by the test leader that the participant had reached his or her maximal effort. The second criterion was a respiratory exchange ratio above 1.00, heart rate above 190 beats × min<sup>-1</sup> or reporting perceived exertion above 17 using the Borg-RPE-Scale [33].

Asthma severity was assessed pragmatically by use of inhaled glucocorticosteroids in the last 14 days, use of β<sub>2</sub>-agonists in the last 14 days, incidence of exacerbations in the last 14 days and lung function (assessed by FEF<sub>50</sub>).

### Statistical analysis

Continuous data are reported as mean with standard deviation when normally distributed and median with interquartile

range elsewhere. Categorical data are reported as numbers and percent.

Bivariate analysis using independent t-test, Mann–Whitney Wilcoxon tests and Chi-Square-test were performed when comparing adolescents with asthma and controls. Linear regression analysis was used to detect associations between VPA/MPA, and gender, skin fold thickness, asthma, use of inhaled glucocorticosteroids in the last 14 days, use of β<sub>2</sub>-agonists in the last 14 days, incidence of exacerbations in the last 14 days, lung function assessed by FEF<sub>50</sub> and seven relevant personal, social and environmental factors (as presented in Table 1) and interactions between significant variables in the model. Jackknife Residuals and Cook's d were used to assess the underlying assumptions of the analysis of covariance. First, bivariate regression analysis were conducted with each dependent variable (VPA and MPA). Second, multivariate linear regression analysis were conducted. The independent variables were removed stepwise retaining the most significant independent variables until only significant variables remained.

To test the construct validity for the instrument of PA-influencing factors in the current cohort, exploratory factor analysis with varimax rotation was conducted. In the parental practical support, teacher support and physical-social opportunity scales one item each with poor loading were removed to increase internal reliability. In this case, an abbreviated version (enjoyment three items and perceived competence two items) from the enjoyment and competence subscales [21] was used. Exploratory factor analysis revealed these five items to load on one factor which was labelled *competence-enjoyment*. Hence, competence and enjoyment were collapsed to represent one scale. Cronbach's α was used to assess the internal reliability of the personal, social and environmental factors within the study sample. Table 1 presents factors including examples of items in questionnaire, number of items in each factor, response format and Cronbach's α values. Internal consistency values (α) were in the range of 0.48–0.82. Scores were reversed in case of questions formulated disparate to ensure accordance between increased score and increased positive value of factors.

Statistical significance level was set to 5%. Statistical analyses were performed with Statistical Package for Social Sciences Version 19.0 (SPSS, Chicago, IL).

### Results

The characteristics of the attending adolescents are presented by adolescents with and without asthma in Table 2. In Table 3, median score of the seven personal, social and environmental factors are presented by group.

Age, height, weight, MPA, VPA, VO<sub>2max</sub>, skin fold thickness (Table 2), competence-enjoyment, support from others (four factors) and perceived environment (two factors) scores (Table 3) were not significantly different between groups. Neither were there significantly more participants who were overweight in any of the groups (Table 2). Adolescents without asthma had significantly better lung-function (FEV<sub>1</sub> % of predicted values, FEV<sub>1</sub>/FVC, FEF<sub>50</sub> % of predicted values), and there were significantly more boys in the group of adolescents with asthma compared to those without (71% vs. 52%, *p* value 0.01; Table 2).



Table 2. Descriptive data of participants presented by adolescents with and without asthma. Data are given as mean and standard deviation (SD) in parentheses unless otherwise stated<sup>a</sup>.

|   | Adolescents with asthma<br>(n = 95) Mean (SD) | Adolescents without asthma<br>(n = 79) Mean (SD) | p Value <sup>b</sup> |
|---|---|--|----------------------|
| Age (years); Mean (Min – Max) <sup>a</sup>                              | 13.6 (12.8-14.3)                              | 13.6 (12.6-14.3)                                 | 0.64                 |
| Height (cm)   | 164 (9)                                       | 162 (7)  | 0.16                 |
| Weight (kg)   | 53 (11)                                       | 50 (10)  | 0.09                 |
| FEV <sub>1</sub> (% of predicted)                                       | 100 (13)                                      | 104 (13)   | <b>0.04</b>          |
| FEV <sub>1</sub> /FVC   | 85 (7)  | 87 (6)   | <b>0.01</b>          |
| FEF <sub>50</sub> (% of predicted)                                      | 86 (21)                                       | 98 (22)  | <b>&lt;0.001</b>     |
| Skin fold thickness (mm)  | 37.3 (13.1)                                   | 36.1 (12.8)                                      | 0.55                 |
| VO <sub>2max</sub> (ml kg <sup>-1</sup> × min <sup>-1</sup> )           | 53.5 (7.7)                                    | 53.4 (9.2)                                       | 0.95                 |
| Vigorous PA (hours day <sup>-1</sup> ); median (IQR) <sup>a</sup>       | 1.21 (1.33)                                   | 1.31 (1.26)                                      | 0.94                 |
| Moderate PA (hours day <sup>-1</sup> ); median (IQR) <sup>a</sup>       | 3.59 (2.06)                                   | 3.46 (1.78)                                      | 0.27                 |
| Boys; n (%) <sup>a</sup>  | 67 (71)                                       | 41 (52)  | <b>0.01</b>          |
| Overweight; n (%) <sup>a</sup>  | 15 (16)                                       | 8 (11)   | 0.29                 |
| Use of ICS last 14 days; n (%) <sup>a</sup>                             | 30 (32)                                       | NA   | –                    |
| Use of β <sub>2</sub> -agonists last 14 days; n (%) <sup>a</sup>        | 35 (37)                                       | NA   | –                    |
| Asthma exacerbations last 14 days; n (%) <sup>a</sup>                   | 11 (12)                                       | NA   | –                    |
| Self-reported exercise induced asthma exacerbations; n (%) <sup>a</sup> | 34 (36)                                       | NA   | –                    |
| Activity limitations due to asthma; n (%) <sup>a</sup>                  | 21 (22)                                       | NA   | –                    |

<sup>a</sup>Unless otherwise stated. <sup>b</sup>p Values for any differences between groups. Statistic significant differences between groups are given in bold.

Min, minimum; Max, maximum; FEV<sub>1</sub>, forced expiratory volume in 1 s; FVC, forced vital capacity; FEF<sub>50</sub>, forced expiratory flow at 50% of FVC; PA, physical activity; IQR, interquartile range; ICS, inhaled corticosteroids; and NA, non-applicable.

Table 3. Median score of perceived personal, social and environmental factors presented by adolescents with and without asthma.

|                             | Adolescents<br>with asthma<br>(n = 82)<br>Median (IQR) | Adolescents<br>without asthma<br>(n = 65)<br>Median (IQR) | p Value <sup>a</sup> |
|-----------------------------|--|---|----------------------|
| Parental practical support  | 1.75 (1.38)  | 1.50 (1.00)   | 0.66                 |
| Parental emotional support  | 2.50 (1.50)  | 2.00 (1.00)   | 0.86                 |
| Peer support                | 2.33 (1.00)  | 2.33 (0.67)   | 0.10                 |
| Teacher support             | 1.50 (1.00)  | 1.50 (1.00)   | 0.93                 |
| Competence-enjoyment        | 3.80 (1.20)  | 3.90 (1.05)   | 0.97                 |
| Safe environment            | 5.00 (0.75)  | 5.00 (0.31)   | 0.14                 |
| Physical-social opportunity | 4.50 (1.00)  | 4.50 (1.50)   | 0.44                 |

<sup>a</sup>p Values for any differences between groups.

Data are given as median with interquartile range (IQR) in parentheses.

In linear regression analysis, peer support and competence-enjoyment were significantly and positively associated with VPA, and female gender, skin fold thickness and teacher support were inversely associated (Table 4). The final model explained 25% of the variance in VPA. Participants reporting one point higher perception of peer support had increased VPA of 0.29 hours each day. Participants reporting one point higher perception of the competence-enjoyment scale perceived their competence-enjoyment as increased and were 0.23 hours more in VPA. Participants reporting one point higher perception of teacher support were 0.26 hours less in VPA. There were no significant association between MPA and either factor included in the model (results not shown).

No significant interactions between asthma or gender and peer support, teacher support and competence-enjoyment were detected in association with VPA.

## Discussion

Peer support and competence-enjoyment were significantly associated with increased time spent in VPA for

both adolescents with and without asthma and female gender, skin fold thickness and teacher support were inversely associated. The model explained 25% of the variance. Asthma and markers of asthma severity did not modify the associated factors of VPA. Adolescents with and without asthma were not significantly different in time spent in VPA, aerobic fitness, perceived competence-enjoyment and support from others or in perception of their environment.

Similar level of VPA in adolescents with and without asthma, as in this study, is presented and discussed previously based on the same cohort [9,34]. Self-perceived competence, enjoyment, support from others and social-physical environmental factors related to PA are general and not asthma-specific. Nevertheless, such personal, social and environmental factors that may contribute to higher levels of PA in the general population may be even more important in asthma.

As previously shown in the ECA study, aerobic fitness is shown to be associated with VPA in adolescents with asthma, which confirms the importance of VPA to improve fitness. [34]. Research support that exercise intensity above 80% of maximal heart rate improves aerobic fitness to a greater extent than moderate exercise intensity [35]. Factors contributing to more time spent in VPA may thereby be essential for adolescents with asthma to avoid a decreasing fitness which may increase physiological barriers of PA and subsequent fear of breathlessness and personal and parental restrictions of PA [15,16].

We have not found any studies published who have evaluated perceived personal, social and environmental factors shown to influence VPA in adolescents with asthma. While adolescents with and without asthma did not differ significantly by time spent in VPA or by competence-enjoyment, support from others and perception of their physical-social environment, it is appropriate to consider the results compared with school children in general (a population without asthma). Peer support [19,23], self-efficacy [23], parental support [19] and teacher support [19,25] are

Table 4. Regression coefficients for associated factors of objectively measured VPA in a linear regression model.

|  | Bivariate analysis                       |                  | Multivariate analysis                    |                  |
|--|--|------------------|--|------------------|
|  | Coefficient with 95% Confidence Interval | <i>p</i> Value   | Coefficient with 95% Confidence Interval | <i>p</i> Value   |
| Girls <sup>a</sup>                                   | <b>-0.61 (-0.93 to -0.29)</b>            | <b>&lt;0.001</b> | <b>-0.55 (-0.86 to -0.25)</b>            | <b>&lt;0.001</b> |
| Skin fold thickness (mm)                             | <b>-0.02 (-0.03 to -0.01)</b>            | <b>0.001</b>     | <b>-0.02 (-0.03 to -0.01)</b>            | <b>0.003</b>     |
| Asthma <sup>b</sup>                                  | -0.02 (-0.35 to 0.30)                    | 0.89             | -0.18 (-0.47 to 0.12)                    | 0.24             |
| FEF <sub>50</sub> (% of predicted)                   | -0.004 (-0.01 to 0.003)                  | 0.28             | -  | -                |
| Use of ICS last 14 days <sup>c</sup>                 | -0.01 (-0.44 to 0.42)                    | 0.96             | -  | -                |
| Use of $\beta_2$ -agonists last 14 days <sup>c</sup> | -0.06 (-0.46, 0.34)                      | 0.77             | -  | -                |
| Asthma exacerbations last 14 days <sup>c</sup>       | 0.00 (-0.63 to 0.64)                     | 0.99             | -  | -                |
| Parental practical support                           | 0.17 (-0.08 to 0.41)                     | 0.19             | -  | -                |
| Parental emotional support                           | 0.08 (-0.11 to 0.28)                     | 0.39             | -  | -                |
| Peer support   | <b>0.42 (0.18 to 0.66)</b>               | <b>0.001</b>     | <b>0.29 (0.05 to 0.52)</b>               | <b>0.02</b>      |
| Teacher support                                      | -0.13 (-0.40 to 0.13)                    | 0.33             | <b>-0.26 (-0.50 to -0.02)</b>            | <b>0.04</b>      |
| Competence-enjoyment                                 | <b>0.41 (0.20 to 0.62)</b>               | <b>&lt;0.001</b> | <b>0.23 (0.01 to 0.44)</b>               | <b>0.04</b>      |
| Safe environment                                     | 0.08 (-0.13 to 0.30)                     | 0.44             | -  | -                |
| Physical-social opportunity                          | 0.17 (-0.07 to 0.36)                     | 0.06             | -  | -                |

<sup>a</sup>Girls with reference to boys.

<sup>b</sup>Asthma with reference to non-asthma.

<sup>c</sup>Yes with reference to No.

Statistically significant coefficients are given in bold.

associated with increased PA. Peterson et al. [24] reported that parental social support is associated with increased PA in both girls and boys, but for boys indirectly through self-efficacy while parental emotional support is negatively associated with PA for adolescent girls [24]. Perceived personal, social and environmental factors associated with VPA (contrary to moderate to vigorous PA) in adolescents are less studied than level of PA in general, but Allison et al. [36] found self-efficacy to be predictive of self-reported VPA in high school students, and Corder et al. [22] found peer support to be associated with VPA in weekdays and family logistic support in weekend-days.

In this study, the association between VPA and the one factor solution of competence-enjoyment may reflect a sense of mastery and enjoyment as being two sides of the same coin in young people; both important prerequisites for enhanced VPA. Our finding would be in accordance with competence motivation theory [20] and knowledge on predictors of PA in general [16,23,24,36]. Competence-enjoyment which theoretically resembles an intrinsically motivational orientation may represent a resource to overcome possible physiological barriers of VPA. Indeed, perceived competence and enjoyment of PA have been shown to associate positively with enhanced PA [19,23]. In a previous study on children and adolescents in general, where social and functional outcome expectations also were measured, these dimensions were inter-correlated with competence and enjoyment [21]. Accounting for adolescents with asthma's possible fear of breathlessness or asthma symptoms during PA [15,16], or their possible poor psychological adjustment [1], one could expect a distinct association with VPA for adolescents with asthma compared with adolescents without. Contrary, as long as activity level of adolescents with and without asthma are similar, one could assume that competence-enjoyment is an important factor of VPA for adolescents in general. Irrespective of whether low level of competence-enjoyment and thereby lower level of PA is explained by barriers related to asthma symptoms, or barriers related to cardiorespiratory

exhaustion in general, competence-enjoyment may be an independent factor determining level of PA. Lack of significant interaction between group and competence-enjoyment in the present study support this interpretation.

As far as peer support is concerned, the factor's association with VPA is sensible compared with previous research [14,16,19,21–24]. Children and adolescents with asthma endeavour to be “normal” amongst peers [37], which may contribute to the perception of peer support by those with high level of PA and that boys participate in 0.55 hours more VPA each day than girls in the present study. Gender differences in PA are well known in several studies [7,22,24,38]. We found, however, no interaction between peer support and gender in association with VPA and may interpret peer support as a contributor of VPA irrespectively of gender. We would, nevertheless, be careful about conclusions of whether peer support is casual to VPA or concurrent. The association may appear as those who are physically active and engage in sports with peers also perceive peer support to a greater extent. Theoretical derivation of the concept, and previous validation of the scales, however, support that peer support is a contributor of PA [19,21].

The lack of associations between VPA and parental support and a negative association with teacher support are not in accordance with previous studies [19,22–25]. Differences in findings could be related to age of participants as we may assume that teacher support is less important for a 13-year-old than a 10-year-old [25]. One may also assume that those individuals who participate in less VPA receive more articulated support from teachers who want them to be more in PA. Skin-fold thickness were a confounder of teacher support in the analysis, which may support an interpretation that adolescents who are less active and have larger skin-fold thickness receive inefficient support from their teachers. The negative association may then be interpreted as concurrent rather than a casual relation. Lack of association between VPA and parental practical and emotional support, as in this study, may also be explained by age of subjects. Studies

showing a positive association between PA and different parental support are all based on participants who are younger (9–11 years) [21–23,25] than the subjects in this study, or studies with a larger range of age in subjects [19]. Older subjects seems less sensible of parental support [19]. Concerning parental restrictions to PA by fear of breathlessness in children and adolescents with asthma [15,16], one may also expect the association to be negative. Lack of negative significant association of parental support may thereby be interpreted as satisfactory.

As far as safe environment and physical-social opportunity is concerned, we are not surprised by the lack of association with VPA since evidence in former research is not concurrent [13,19,21–23,25]. Environment may change through seasonal variations and differences between weekdays and weekend days may influence the role of the environment. Further exploration and validation of the measurement of perception of environment is also needed [21]. Environment may also be less important for a 13-year-old than younger children. Questions were stated with “neighbourhood” or “nearby home” and one could expect increased physical range and more independent management of insecure environment in older children.

We have not found any studies where personal, social and environmental factors determining level of PA are evaluated in adolescents with and without asthma, but several factors have been described in different terms in both qualitative and quantitative studies in patients with asthma at different ages. Knowledge, perception of symptoms, disease and treatment [14], exercise tolerance [17], winter season (cold air/air-pollution) [13,16], time constraint, lack of motivation, less self-efficacy and perceived asthma severity [16] are associated with low level of PA or inactivity. Social support are identified as an important facilitator of PA [16]. Summer season, larger homes, younger mothers, mothers who do not work or attend school and being a boy are all correlated with increased PA in a cohort of urban four-year old children in New York [13]. These factors may all be related to aspects of competence-enjoyment, support from others and environmental factors.

The main strengths of this study are the objective recording of PA, which gives reliable and valid measurements [8] and the nested case-control design in a population based birth-cohort [9,26–28]. The standardized instrument used to measure perceived personal, social and environmental influences on PA also strengthen the study. Previous research shows that indexes of the questionnaire are valid [19,21,23], and internal consistency of the present significant factors ( $\alpha$ : 0.82, 0.73 and 0.60) are satisfactory. However, environmental factors (safe environment/physical-social opportunity) are divided differently in the present study and low internal consistency of these latter factor ( $\alpha$ : 0.48) is a methodological limitation to be considered. These findings regarding parental support in the study may also be biased due to a non-ideal consistency of the measurement of the factors ( $\alpha$ : 0.59, 0.68) and may fail to capture the intricate and contradictory association between VPA and parental practical support and parental emotional support as reported by Peterson et al. [24]. When conducting exploratory factor analysis, we found competence and enjoyment to load on one dimension.

Although competence and enjoyment with PA may be regarded conceptually different [19], children may nevertheless perceive them as integrated. Good fit indices obtained in a confirmatory factor analysis of an enjoyment-competence dimension in a previous study [21] support the view that competence and enjoyment could be considered two sides of the same coin.

Findings in this study should be considered when developing interventions to increase level of PA in adolescents with asthma or in the general population. If interventions are designed to increase enjoyment, underpin competence and are carried out in an environment of supportiveness including peer participation, we may assume that VPA will increase [19]. Enjoyable activities accommodated to adolescents' abilities may support perceptions of competence and enjoyment, and reinforce an intrinsic motivational orientation towards PA. We cannot; however, rule out the importance of parental or teacher support or the physical-social environment as important factors [19,21–25] to consider when designing interventions to increase PA. Psychosocial factors associated with PA may be complex [19,21,24], and we consider statistical explained variance of 25% as satisfying to point out the importance of competence-enjoyment and peer-support. Nevertheless, we suggest that peer support and competence-enjoyment should be central elements of PA interventions for adolescents with or without asthma. Considering similar level of VPA in girls and boys as an objective, we suggest females may have exceptional focus in certain interventions.

## Conclusion

In conclusion, peer support and competence-enjoyment are positively associated with level of PA in adolescents irrespectively of asthma and asthma severity. These may be perceived as resources in adolescents' own premises to enable VPA in adolescents with asthma. Interventions to increase PA ought to be designed to maximize peer support, competence and enjoyment to succeed.

## Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing the paper.

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**Relationships between physical activity level and psychosocial and socioeconomic factors and issues in children and adolescents with asthma: a scoping review.**

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## **Relationships between physical activity level and psychosocial and socioeconomic factors and issues in children and adolescents with asthma: a scoping review**

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## **Executive summary**

*Background:* Asthma is a heterogeneous chronic airway disease. The disease may reduce capability for physical activity. In healthy individuals, physical activity is influenced by psychosocial and socioeconomic factors. Knowledge about the role of these factors has not been mapped in children and adolescents with asthma.

*Objective:* The main objective of this scoping review was to identify psychosocial and socioeconomic factors associated with physical activity level in children and adolescents with asthma in the literature. The specific objectives were to map the instruments to measure these factors, report on the construction and validation of these instruments, map psychosocial and socioeconomic issues related to physical activity level reported in qualitative studies, and identify gaps in knowledge about the relationships between psychosocial and socioeconomic factors and physical activity level in children and adolescents with asthma.

*Inclusion criteria:*

*Types of participants:* Children and adolescents with asthma aged 6–18 years.

*Concept:* Psychosocial and socioeconomic factors related to physical activity level and participation.

*Context:* All physical activity contexts.

*Types of sources:* Quantitative and qualitative primary studies, in English, with no date limit.

*Search strategy:* The databases searched included nine major databases for health and sports science, and five databases for unpublished studies. After screening and identification of studies, the reference lists of all identified reports were searched, and forward citation searches were conducted using four databases.

*Extraction of the results:* The following data were extracted: (a) relevant study characteristics and assessment of physical activity level, (b) instruments used to assess psychosocial and socioeconomic factors, (c) associations between physical activity level and these factors, (d) construction and validation of instruments, and (e) psychosocial and socioeconomic issues related to physical activity participation.

*Presentation of the results:* Twenty-one quantitative and 13 qualitative studies were included. In cross-sectional studies, enjoyment, physical self-concept, self-efficacy, attitudes and beliefs about physical activity and health, psychological distress, health-related quality of life, and social support were more often reported as being correlated with physical activity level. In three studies, the construct validity was assessed by factor analysis and construct reliability tests for the study population. Qualitative studies report 10 issues related to physical activity participation, and capability and being like peers were most commonly reported. There was no direct evidence that qualitative research informed the development or adjustment of instruments in quantitative studies.

*Conclusions:* Six individual factors and one interpersonal factor correlated with physical activity level; capability and being like peers were the most commonly reported issues. Reports of the construction and validation of instruments were sparse.

*Implications for research:* Longitudinal and/or experimental studies with objective recording of physical activity are needed to increase understanding of the correlates of physical activity in children and adolescents with asthma. Knowledge about the experiences of children and adolescents with asthma should inform the future development of instruments.

*Implications for practice:* Clinicians should address the correlates of physical activity and the capability and desire to be like their peers to encourage physical activity participation in children and adolescents with asthma.

Keywords: Asthma; asthmatic children and adolescents; physical activity; psychosocial factors; socioeconomic factors

## Background

Asthma is a chronic disease that is characterized by airway inflammation, which causes expiratory airflow limitation, shortness of breath, chest tightness, wheeze, and cough.<sup>1</sup> In children and adolescents with asthma, the disease may reduce perceived capability for,<sup>2</sup> and participation in, physical activity (PA).<sup>3</sup> Physical activity is defined as any bodily movement, such as play, exercise, or daily activities produced by the contraction of skeletal muscles, that increases energy expenditure above the resting level.<sup>4</sup>

Physical activity level may be assessed in terms of the intensity, frequency, type, mode, and duration.<sup>5</sup> Physical activity can be recorded by objective measures of energy expenditure or movement (e.g., steps per day, distance, accelerometer counts per minute, heart rate, or oxygen consumption); by subjective reports of exhaustion; or by descriptive measures of the activities.<sup>6</sup> Objective measures of acute airflow limitation induced by vigorous PA (exercise-induced bronchoconstriction (EIB)) do not completely explain children's and adolescents' reports of exercise-induced symptoms.<sup>7,8</sup> Nevertheless, exercise limitation and reduced PA are frequently reported to be associated with physiological mechanisms, respiratory symptoms,<sup>3,9-19</sup> and psychosocial and socioeconomic factors in children and adolescents with asthma.<sup>2,9,10,14,18,20-26</sup> Qualitative research has described barriers to PA such as fear of breathlessness and misinterpretation of symptoms,<sup>27</sup> and these are influenced by gendered habits,<sup>28,29</sup> social support,<sup>30-32</sup> role models, and efforts to appear similar to peers.<sup>33,34</sup>

Participation in PA is considered feasible by children and adolescents with well-controlled asthma.<sup>35-38</sup> Asthma control is defined as "the extent to which the manifestations of asthma have been reduced or removed by treatment."<sup>39(p545)</sup> Increased PA is associated with increased cardiorespiratory fitness,<sup>36,38,40</sup> psychological functioning,<sup>37</sup> health-related quality of life (HRQoL),<sup>36-38,40,41</sup> psychological well-being, and self-esteem, and decreased morbidity.<sup>36,37,40</sup> Increased fitness may also elevate the EIB threshold by reducing the ventilatory requirement for any PA involving play or exercise.<sup>36,42</sup>

There is no consensus in the literature about whether children and adolescents with asthma participate in less PA than their healthy peers.<sup>37,43</sup> Some studies have reported similar fitness and PA levels in children with asthma compared with their peers.<sup>44-47</sup> By contrast, lower PA and fitness levels have been identified<sup>2,3,10,14,15,19</sup> in children who are newly diagnosed or have poor asthma control.<sup>3,19</sup>

Asthma symptoms and lung function may change rapidly in response to the environment and/or treatment, whereas airway wall remodeling and responsiveness tend to adapt slowly. Thus, the clinical manifestations and the underlying disease mechanisms of asthma do not always correspond.<sup>39</sup> An asthma diagnosis may include four domains: symptoms, variable airway obstruction, inflammation, and hyperresponsiveness.<sup>39</sup> Various combinations of one or more of these four domains and other features are included when defining asthma in different study populations. Study populations also vary with respect to the level of asthma control and severity in participating children. Asthma severity is defined by the treatment intensity required to obtain asthma control.<sup>39</sup> Deficient asthma control may also occur through poor compliance, poor inhaler technique, under-prescribing, environmental factors, severe disease, and/or resistance to therapy.<sup>39</sup> Hence, the associations between PA and asthma,

asthma control, and asthma severity are complex and involve both psychosocial and socioeconomic issues.<sup>20</sup>

### ***Asthma and PA from childhood into adolescence***

The disease,<sup>48</sup> level of PA,<sup>49-51</sup> and management of both asthma and PA change throughout childhood and adolescence.<sup>48,52</sup> Asthma is more common in boys than girls during childhood<sup>53</sup> but is more common in girls during adolescence.<sup>48,54</sup> Parents are responsible for the everyday management of their child's asthma, whereas shared responsibility by the adolescent and parents is desired to enhance the adolescent's growing responsibility for managing his/her disease.<sup>55</sup>

In healthy children, PA level varies between boys and girls<sup>49-51</sup> and according to social support.<sup>50</sup> Peer support positively influences PA across gender,<sup>50</sup> age, and location.<sup>56,57</sup> The influences of social support from parents and teachers, and relating to the physical environment, may change with time and location (at school or at home, during school or leisure time, and during the week or weekend), and age.<sup>56,57</sup> Such changes may be related to major shifts in autonomy, parental license, and movement to different schools during childhood and adolescence.<sup>56</sup> Eighty percent of school-age adolescents worldwide do not reach the international recommendations of 60 min/day of moderate-to-vigorous intensity PA (MVPA).<sup>58,59</sup> There is a need for more knowledge about why some young people are active and others are not, in particular the psychosocial and socioeconomic correlates and determinants of differences in PA levels.<sup>60</sup> Correlates are derived from associations identified in cross-sectional studies, and determinants are derived from associations identified in longitudinal observational or experimental studies.<sup>60</sup>

Psychosocial factors include individually measured perceived intrapersonal factors (motivation, beliefs, and cognition); interpersonal factors (support from others and cultural norms and practices); and environmental factors (social, built, and natural environment). The concepts relating to these factors and their interactions have been derived from several theories and models.<sup>60</sup> Socioeconomic factors are explained by a multidimensional concept comprising resources, power, and/or prestige, and include educational level, income, and occupation at the individual, household, or neighborhood level.<sup>61</sup> These measures are not interchangeable<sup>61</sup> and, in children and adolescents, indicative measures are often used, such as car ownership, internet access, and unshared bedrooms.<sup>62,63</sup> Such indicative measures must be refined according to economic, technological, and societal changes in a given society.<sup>63</sup> Hence, transparency in the development of instruments and reporting of in-study reliability and validity is needed when mapping knowledge about the associations between these factors and PA in given populations. In addition, mapping of psychosocial and socioeconomic issues in relation to PA by qualitative research may strengthen the evidence derived using quantitative instruments.

### ***Rationale for the review***

As outlined above, there is a need for more detailed knowledge about the psychosocial and socioeconomic influences on PA level<sup>60</sup> in children and adolescents with asthma, especially among those with specific challenges to PA participation because of airflow limitation. To our knowledge, there is no consensus about the best instruments to assess the psychosocial and socioeconomic

factors that may influence PA in children and adolescents with asthma. A scoping review on this topic is needed before further studies or synthesis of research findings can be conducted to identify the factors that may be feasible, appropriate, meaningful, and effective for inclusion in interventions aimed at increasing PA level in children and adolescents with asthma. This scoping review follows the methodology of Peters et al.<sup>64</sup> An initial search in the JBI Database of Systematic Reviews and Implementation Reports, PROSPERO, Cochrane Library, PEDro, Embase, CINAHL, Medline, SPORTDiscus, SocINDEX, Academic Search Complete, PsycINFO, and ISI Web of Science was performed. To our knowledge, no systematic or scoping review on this specific topic has been published or is currently underway. The objectives, inclusion criteria, and methods of analysis for this review were specified in advance and documented in a protocol.<sup>65</sup>

### **Objectives**

The objective of this scoping review was to identify psychosocial and socioeconomic factors associated with PA level in children and adolescents with asthma reported in the literature. Specific objectives were to map the instruments to measure these factors, to report on the construction and validation of these instruments, to map psychosocial and socioeconomic issues related to PA level reported in the qualitative studies, and to identify gaps in the evidence about the relationships between psychosocial and socioeconomic factors and PA level in children and adolescents with asthma.

### **Inclusion criteria**

#### ***Types of participants***

In this review, we considered studies that included children and adolescents with asthma aged 6–18 years. This age range included participants who were more likely to participate autonomously in physical education and organized sports than were preschool children and, therefore, were more likely to report autonomously about their participation in PA and associated factors. No uniform definition of asthma was required for inclusion. The definitions of asthma and descriptions of participants with regard to asthma control, severity, comorbidities, and other conditions given in the primary studies were mapped and reported. Studies that included children with other chronic conditions were included if the findings for the children with asthma could be isolated and extracted. We included studies of children or adolescents that reported intrapersonal, interpersonal, environmental, and socioeconomic factors and issues, and studies that included caregivers' reports of interpersonal, environmental, and socioeconomic factors and issues relating to their child's PA participation. The distinctions regarding children's/adolescents' own reports and caregivers' reports were also mapped and reported.

#### ***Concept***

In this review, we considered studies that had investigated or explored psychosocial and socioeconomic factors and issues in relation to the level of and participation in PA.

#### ***Context***

In this review, we considered studies including all contexts of PA such as school time, leisure time, time at home, and organized exercise time performed in all countries.



### ***Types of sources***

We considered only primary research studies in accordance with the aim of the review to avoid double-reports from primary and review studies.

The quantitative component of the review considered for inclusion both experimental and epidemiological study designs, including randomized controlled trials, nonrandomized controlled trials, quasi-experimental studies, before-and-after studies, prospective and retrospective cohort studies, case-control studies, analytical and descriptive cross-sectional studies, case series, and individual case reports.

The qualitative component of the review considered studies that focused on qualitative data including, but not limited to, designs such as phenomenology, grounded theory, ethnography, action research, and feminist research, and in which children and adolescents with asthma were interviewed and/or observed.

### **Methods**

#### ***Search strategy***

The search strategy aimed to trace both published and unpublished studies. A three-step search strategy was used. An initial limited search of MEDLINE and SPORTDiscus was undertaken and was followed by an analysis of the words contained in the title and abstract and index terms used to describe each article. Search terms for psychosocial and socioeconomic factors partly covering the study concept components did not limit search results and were thus excluded. A second search using all identified keywords and index terms was then undertaken across all included databases; the second search included the title, abstract, and index terms within each database. The test search resulted in about 4000 results from MEDLINE, which included several irrelevant studies related to the terms 'moderate' and 'participate' that are used to assess the level of PA. The search terms for 'physical activity' and 'physical activity level' were then linked in the search by the positional operator to retrieve studies using these terms (in any order) within four words of each other.

The databases searched included:

Medline, Embase, PsycINFO via the Ovid interface, CINAHL, SPORTDiscus, Academic Search Complete, SocINDEX via the EBSCOhost interface, Social Science Index, and ISI Web of Science.

The search for unpublished studies included:

Primo Central Index, ProQuest Nursing & Allied Health Source, ProQuest Health Management, ProQuest Psychology Journals, and ProQuest Health & Medical Complete.

After screening and identifying the studies, the reference lists of all identified reports were searched, and forward citation searches in ISI Web of Science, CINAHL, Scopus, and Google Scholar were performed. Studies published in English and unrestricted by the year of publication were considered for inclusion in this review.

The detailed search strategy for the three major databases (Medline, SPORTDiscus, and CINAHL) is appended (Appendix 1). Database searches were conducted January 4–6, 2016, and were followed

by forward citation searches and reference searches from the included sources.

### ***Extraction of the results***

For this review, relevant descriptive information and qualitative and quantitative data were extracted and charted from papers included in the review using a template developed specifically for this review and presented in the protocol.<sup>65</sup> Extracted data included specific details about (a) author(s), year of publication, and origin/country of the study; (b) aim of the study; (c) study population (recruitment strategy, gender, age, asthma status, and asthma definition); (d) design; (e) outcome assessment (PA level); (f) instrument used to assess psychosocial or socioeconomic factors; (g) associations between PA level and psychosocial and socioeconomic factors; (h) construction and validation of the instruments used to assess the associations between PA level and psychosocial and socioeconomic factors; and (i) psychosocial and socioeconomic issues related to participation in PA. Because the objective was to map the reported information, there was no attempt to contact authors to obtain information not reported in the papers.

## **Results**

### ***Inclusion of studies***

Through database searches, 3624 records were identified including 1314 duplicates, which were removed. Five studies<sup>52,66-69</sup> were identified through reference and forward citation searches, and four qualitative studies<sup>28,29,33,70</sup> were identified by experts in the field. Records that were screened by title and abstract included 2319 studies, 2270 of which were excluded. Studies without any reference to objective of the review in the title and abstract were excluded in the screening process. Any study of doubt was assessed for full-text eligibility. The full text for 48 studies were assessed for eligibility and another 14<sup>10,52,71-82</sup> were excluded for various reasons (Figure 1). Thirty-four studies were included in the review.

The study by Rhee et al.<sup>68</sup> was identified in the references of the paper by Fereday et al.<sup>30</sup> and was initially excluded because there was no reference to the objective of the review in the title and abstract. However, the study by Fereday et al.<sup>30</sup> included an outline of the findings of Rhee et al.,<sup>68</sup> which were related to the objective. The study by Rhee et al.<sup>68</sup> was assessed for full-text eligibility and thereafter included in the review despite the lack of reference to the objective of the review in the title and abstract. Figure 1 presents a PRISMA flow diagram from search to inclusion of the studies according to Moher et al.<sup>83</sup>

### ***Characteristics of the identified sources***

Twenty-one sources were quantitative primary studies that covered the participant age range of 6–19 years. Twenty studies included psychosocial measures associated with PA level,<sup>2,14,15,18,21,22,26,67,84-95</sup> and four sources included socioeconomic measures associated with PA level.<sup>15,22,25,89</sup> The oldest study was published in 1989<sup>84</sup> and the most recent in 2015.<sup>67,94,95</sup> PA level was measured using a step counter in two studies<sup>25,87</sup> and by activity monitor-based accelerometry and heat production in one study.<sup>95</sup> In the other 18 sources, PA level was assessed by different self-report instruments, and the International Physical Activity Questionnaire was used in four studies.<sup>22,90-92</sup> Only two studies included

longitudinal measures to identify the factors that predict PA level.<sup>87,94</sup> In 19 studies, associations between psychosocial/socioeconomic factors and PA level were investigated cross-sectionally.<sup>2,14,15,18,21,22,25,26,67,84-86,88-93,95</sup>

We identified 13 primary qualitative studies published between 2000<sup>29</sup> and 2014<sup>69,78</sup> that described psychosocial issues in relation to PA level reported by children and adolescents aged 4–18 years with asthma.<sup>27-30,33,34,66,68-70,96-98</sup> No description of socioeconomic issues in relation to PA level was identified in qualitative studies. Three studies included participants with another chronic condition in addition to asthma,<sup>29,30,98</sup> two studies included healthy children in comparison with children with asthma,<sup>34,96</sup> three studies included parents,<sup>27,30,66</sup> and one study included school staff (teachers, school nurses, activity coordinators) in addition to children and/or adolescents with asthma.<sup>27</sup> Detailed characteristics of each of the 34 included studies are given in the extraction chart (Appendix 2).

### ***Narrative summaries of key findings***

#### *Psychosocial correlates and determinants of PA level*

Table 1 provides an overview of the psychosocial factors associated with PA level, which were classified as intrapersonal, interpersonal, and environmental. The following psychosocial factors were identified as being correlated with PA level: enjoyment (5/5 studies),<sup>2,67,84,93,95</sup> physical self-concept/competence (4/5 studies),<sup>2,84,86,90,95</sup> self-efficacy (2/3 studies),<sup>18,26,87</sup> attitudes and beliefs about PA and health (4/7 studies),<sup>2,15,26,84,86-88</sup> psychological distress (3/4 studies),<sup>15,21,84,85</sup> HRQoL (2/3 studies),<sup>21,88,92</sup> and social support (5/7 studies).<sup>14,22,26,87,88,94,95</sup> Body perception<sup>85</sup> and health support<sup>89</sup> were reported to be correlated with PA level in one study each, while parents' self-efficacy in stimulating their child's PA participation<sup>26,94</sup> were reported to be correlated twice from the same cohort. Parents' anxiety and depression<sup>90</sup> were assessed in one study but were not reported as being correlated with PA level. Adult restriction of PA (1/3 studies),<sup>88,90,91</sup> parents' attitudes and beliefs about PA and health (3/6 studies),<sup>14,15,26,87,90,94</sup> and environmental factors (2/4 studies)<sup>14,86,89,95</sup> were more often reported as not correlating to PA level. Among the measures of parents' attitudes and beliefs, the instrument developed by Lang et al.<sup>14</sup> was used in three studies. Parents' attitudes measured using this instrument correlated with PA level in one study,<sup>14</sup> did not correlate in a second study,<sup>90</sup> and were a determinant of PA level in a third study<sup>94</sup> (Table 1).

#### *Description of instruments to measure psychosocial correlates*

Most measures were based on several items and a Likert-scale type response format. Body perception was measured by participants' coloring of a body-figure,<sup>85</sup> and social support and restriction of PA measured by Lang et al.<sup>14</sup> and Dantas et al.<sup>91</sup> were categorical measures. Glazebrook et al.<sup>15</sup> did not report information about the construction and validation of an exercise beliefs measure. Cheng et al.<sup>88</sup> did not report information about the construction and validation of a support and restriction of PA measure, and Hsu et al.<sup>86</sup> did not report such information about the measure of perceived environment.

One measure of enjoyment,<sup>2</sup> three measures of physical self-concept based on Harter's perceived competence scale,<sup>2,84,90</sup> and three measures of attitudes and beliefs<sup>2,14,86</sup> involved scales,

but the reliability and construct validity of these scales were not reported. The reliability and construct validity were also not reported for two measures of psychological distress,<sup>84,85</sup> the Paediatric Asthma Quality of Life Questionnaire,<sup>88,92</sup> and one measure each of parents' attitudes and beliefs,<sup>90</sup> parents anxiety and depression,<sup>90</sup> and the environment.<sup>89</sup> Stevens et al.<sup>89</sup> conducted a factor analysis of the health support measure applied in their study, but apparently did not build upon the findings from the factor analysis.

Hsu et al.,<sup>86</sup> Kitsantas and Zimmermann,<sup>18</sup> Walders-Abramson et al.,<sup>87</sup> Teng et al.,<sup>22</sup> and Tiggelaman et al.<sup>21,26,94</sup> reported on the construction of scales and validation by reliability testing of consistency between the response items that contributed to each factor/concept in their measures of physical self-concept, self-efficacy, children's/adolescents' attitudes and beliefs, HRQoL, social support, and parents' self-efficacy, attitudes, and beliefs. None of these reports contained in-study factor analysis. Kelsay et al.<sup>85</sup> reported a high interrater reliability between different researchers' coding of the measure of body-perception.

Two measures of enjoyment,<sup>84,93</sup> one of which included two factors, enjoyment and boredom,<sup>93</sup> and the other of which included a combined measure of enjoyment and competence,<sup>95</sup> were reported as theoretically derived scales that had been constructed and validated by in-study factor analysis and reliability tests of consistency between the responses for items that contributed to each factor. Similarly, two measures of attitudes and beliefs, motivation and deterrence,<sup>84</sup> and one measure each of peer support, teacher support, parental practical support, parental emotional support, safe environment, and physical-social opportunity<sup>95</sup> were reported and included in factor analysis and reliability tests. These measures are shown in bold in Table 1.

No measures with an in-study assessment of content or face validity by participants were reported, and there were no cross-citations between qualitative and quantitative reports. This indicated that the findings in the included qualitative studies were not used to inform the development of instruments used to measure psychosocial factors in quantitative studies. The study by Fereday et al.<sup>30</sup> was cited in the background and/or discussion section for four studies,<sup>26,90,91,94</sup> and this study might have informed the choice of instruments used to measure parental support in those studies. Kitsantas and Zimmerman<sup>18</sup> reported the assessment of content validity based on suggestions from pulmonologists. Table 2 provides detailed descriptions of the reported construction and validation of each measure.

#### *Socioeconomic correlates of PA level and description of instruments*

Among the four studies that included measures of socioeconomic factors, there was no consistent pattern in the correlation between PA level and socioeconomic factors.<sup>15,22,25,89</sup> Three of the four studies included parental occupation.<sup>15,22,89</sup> PA did not correlate significantly with a parent having a professional/managerial occupation vs other occupations<sup>15</sup> or with social class (with occupation and educational level as contributors).<sup>22</sup> By contrast, having a parent employed for >50 weeks in the preceding year correlated with PA level.<sup>89</sup> In the study by Stevens et al.,<sup>89</sup> household income relative to the federal poverty level correlated with PA level. Three studies included reports of educational level.<sup>22,25,89</sup> Vangeepuram et al.<sup>25</sup> reported that PA correlated positively with having a parent with a

bachelor's degree but not with having a parent who had graduated from high school. Stevens et al.<sup>89</sup> reported a positive correlation between PA level and having a caregiver who had graduated from high school. The social class measure used by Teng et al.<sup>22</sup> included both parental education and occupation, and had no correlation with PA level.

Socioeconomic measures reported by Glazebrook et al.,<sup>15</sup> Stevens et al.,<sup>89</sup> and Vangeepuram et al.<sup>25</sup> were based on dichotomization of parental occupation, education, and household income. Two of these studies included having a parent who had graduated high school as a measure for comparison.<sup>25,89</sup>

The social class measure in the study by Teng et al.<sup>22</sup> was based on the Five Social Classes instrument developed by Hollingshead and Redlich (1958),<sup>22</sup> which was reduced to three levels (low, medium, and high). Table 3 provides a detailed description of the socioeconomic measures and associations between these factors and PA level.

#### *Psychosocial and socioeconomic issues covered in the qualitative literature*

Thirteen qualitative studies reported on the psychosocial issues related to PA level (Table 4).<sup>27-30,33,34,66,68-70,96-98</sup> By contrast, none of the qualitative studies described the relationship between socioeconomic issues and PA level. The findings extracted from the original studies were initially classified as intrapersonal, interpersonal, and environmental, and thereafter coded and sorted into emerging categories that described the issues reported. We did not choose to define any distinct boundary between intra- and interpersonal issues, or between interpersonal and environmental issues, because these issues were reported as interrelated, and we did not want to distort the integrated experiences reported. Nevertheless, we found 10 categories of issues concerning participation in PA described in the studies. These were ordered logically from intrapersonal to interpersonal to environmental as follows: 'enjoyment', 'negative feelings', 'self-esteem', 'capability', 'toughen up and downplay asthma', 'modification', 'being like peers', 'belonging', 'social support', and 'gendered roles'. 'Capability' and 'being like peers' were reported in 10 (77%) and 11 (85%) of the studies, respectively, which included participants in the age range of 4–18 years. 'Self-esteem' was reported only in the study by Williams et al.<sup>27</sup> of participants aged 6–14 years. 'Enjoyment' was reported in three (23%) studies<sup>27,33,70</sup> of participants aged 8–14 years, and 'social support' was reported in four (31%) studies<sup>27,30,66,97</sup> of participants aged 4–16 years. The remaining issues were reported in five to seven (38–54%) studies each of participants aged from 4, 6, or 8 up to 18 or 19 years. Table 4 provides an overview of the reported issues and ages of participants.

#### **Discussion**

Enjoyment, physical self-concept, self-efficacy, attitudes and beliefs about PA and health, psychological distress, HRQoL, and social support were more often reported as being correlated with PA level than not. Only two of 21 studies included longitudinal analysis, and one determinant of PA level was identified: parents' specific beliefs about their asthmatic child's participation in PA.<sup>94</sup> In three studies, the construct validity was assessed by factor analysis and construct reliability tests for the study population and was reported transparently.<sup>84,93,95</sup> Qualitative studies reported 10 issues related

to participation in PA; in these studies, capability and being like peers were the two most commonly reported. There was no direct evidence that qualitative studies identified in the review had informed quantitative studies and instruments.

The findings in our review support the concept that intra- and interpersonal factors are related to PA level in children and adolescents with asthma and that environmental and socioeconomic factors seemed to be less important or may need further investigation. We note that the constructs for these factors were heterogeneous or lacked sufficient information to allow for a more systematic analysis across studies. Quality assessment of the studies was not conducted. Interpretations of psychosocial and socioeconomic correlates of PA between studies should be conducted with care. Further investigation of PA participation by children and adolescents with asthma, in particular the use of objective recordings of PA, is needed.

Studies to understand the factors that influence PA level may benefit from an ecological approach by integrating individual psychological, biological, interpersonal, and environmental factors into regional, national, and global policies and structures.<sup>60</sup> Factors may influence PA in combination and through interactions with each other.<sup>60</sup> It has been suggested that there should be a stronger focus on determinants research as opposed to correlates research, and multidimensional approaches.<sup>60,99</sup> Among children and adolescents in general, the consistent psychosocial correlates of PA are self-efficacy, perceived behavioral control, previous PA, and support for PA.<sup>60</sup> A different umbrella review found that correlates of PA included perceived competence, self-efficacy, goal orientation/motivation, outcome expectations, fewer perceived barriers, participation in community sports, parental support, support from significant others, access to sport/recreational facilities, time outdoors, parental education, family income, and socioeconomic status.<sup>99</sup> Compared with children in general, children with asthma may have specific challenges to being physically active.<sup>20</sup> The findings of our review suggest that the ecological approach may also be suitable for assessing the influences on PA in children with asthma. The more consistent pattern of evidence for the intra- and interpersonal correlates of PA than for the environmental and socioeconomic correlates in children with asthma was similar to that in the general population.<sup>60,99</sup> There is also a similar need for longitudinal, experimental, and multidimensional study designs.

One important aspect of research instruments is whether they are valid measures of the higher-order constructs they are intended to conceptualize, which is referred to as construct validity.<sup>100</sup> Face validity concerns how the instrument or items in the questionnaire are perceived to represent what is measured, and content validity concerns whether the appropriate items represent the higher-order constructs or concepts as judged by experts, previous knowledge, and qualitative inquiries. Criterion-related validity is established according to an external (known) criterion and the association with the measure, either predictive or concurrent.<sup>100</sup> The validity of instruments to measure correlates of PA relies on established knowledge, theories, and models;<sup>60,101</sup> on in-study reports of the validation and reliability of instruments; and on associations between constructs and recorded PA level. Factor analysis is used to identify clusters of items on a scale, to assess the attributes or dimensions of items empirically, and to group and distinguish these attributes.<sup>100,102</sup> Reliability and internal consistency are

a property of the instruments used to study a specific population. According to Tavakol and Dennick,<sup>102</sup> these measures of reliability should be obtained simultaneously with the use of a specific instrument.

In this review, we found no direct evidence that the results of qualitative studies have been coupled to quantitative studies; that is, quantitative studies do not seem to be informed by the knowledge gained from qualitative studies. Instruments developed previously, both asthma specific and generic, may have included an exploration of the face and content validity in qualitative studies, although we were not able to trace such research. The lack of information about how theory and empirical data informed the face validity, content validity, and construct validity also made interpretation of the constructs challenging. Correlation research, even when the evidence has been obtained in longitudinal studies or summarized in systematic reviews, may contain reduced overall construct validity. By leaning on single constructs isolated from a full theoretical framework from which it stems, patterns of relationships between variables in the theoretical framework may be overlooked.<sup>60,101,103</sup> The influence of single constructs (correlates) within a model of PA may appear to differ in importance to PA compared with what might have been the case had the particular correlate been examined as part of a full theoretical framework. Consequently, future research may benefit from considering the relative importance of correlates of PA by testing these as ingredients that may operate as direct influences, mediators, or moderators within the particular full theoretical model from which they originate rather than as isolated sets of correlates originating from different models.

Generic concepts and constructs, such as enjoyment, physical self-concept, self-efficacy, body perception, health and PA beliefs, psychological distress, social support, parental self-efficacy, belief, anxiety and depression, health support, and environmental factors, may be appropriate for assessing the factors that influence PA in both children with asthma and healthy peers. However, some of these factors may also need adjustment when applied to young people with asthma. Several of the instruments used in the studies reviewed here included adjustments or asthma-specific constructs such as lung self-efficacy for PA,<sup>18</sup> asthma-specific PA and health beliefs,<sup>14,15,88,90,94</sup> asthma-specific panic and fear,<sup>85</sup> asthma-specific HRQoL,<sup>21,88,92</sup> social support for PA in children and adolescents with asthma,<sup>14,88</sup> and restrictions on PA related to asthma.<sup>90,91</sup> One may assume that such adjustments or construction of instruments for use with children with asthma have been informed by knowledge about children with asthma. Measures of HRQoL reported in the present review are previously validated in children and adolescents with asthma,<sup>104-106</sup> and HRQoL have been used as an outcome of exercise interventions in asthma.<sup>36,38,40,41</sup> To our knowledge, the other asthma-specific measures have not been validated or used elsewhere, and knowledge about these instruments comes only from the studies included in the present review.

Most studies lack factor analysis to test for construct validity in the asthma population. There is also a lack of transparency about the source of knowledge about experiences reported by children with asthma informing development of instruments, which suggests that there could be several sources of bias in the evidence concerning the psychosocial correlates of PA in children with asthma. Moreover, if the experiences of children with asthma were not included in the development of

instruments adjusted to the asthma population, the conceptualization of the psychosocial factors may have failed to capture the individual perceptions of children with asthma in favor of expert perspectives. With some exceptions,<sup>56,107,108</sup> construct validation studies of the correlates of PA, in particular psychosocial factors, have been based on statistical approaches to examine these correlates as observed variables usually in the format of composite scores of items.<sup>56</sup> This approach is not able to account for the error variance following any measurement of empirical conceptualizations of theoretical constructs. To deal with this, correlation research on PA among populations of children with asthma (and children in general) may benefit from using a latent variable approach, in which the error variance of each indicator underlying the latent construct can be controlled.<sup>109</sup>

The gaps in knowledge identified in our scoping review were (a) the lack of longitudinal and/or experimental designs to assess the casual relationships, (b) the lack of objective recording of PA in most studies, (c) the small number of studies and inconsistent knowledge about environmental and socioeconomic correlates of PA, and (d) the questionable validity and large heterogeneity of constructs including lack of transparency about the source of knowledge about the experiences of children and adolescents with asthma, lack of transparent and theory- or evidence-informed adjustment of generic measures for children and adolescents with asthma, and lack of an ecological framework of asthma-specific and generic influences on PA level.

### ***Strengths and limitations***

The main strength of the present review is the comprehensive database search without a date limit. We are confident that no study about the concept in scope published in the English language was excluded. Another strength of this review is its mapping of measures of PA level in each study (Appendix 2). The PA level may be a valid criterion to measure the correlates of PA, and the gaps of knowledge about the correlates of PA level in children and adolescents with asthma were accentuated by the heterogeneity of measures applied to assess PA level. The quantitative and qualitative studies included in our review contained reports from both children/adolescents and their parents; this is a strength because it strengthens understanding of interpersonal, environmental, and socioeconomic perspectives of the influences on PA level in young people with asthma. By contrast, inclusion of data obtained from people other than the young person may bias the understanding of how the children's and adolescents' own perceptions, motivation, cognition, and beliefs can influence their PA level. To avoid bias in studies in which these perceptions were captured by instruments, reports from people other than children and adolescents are indicated in tables and identified appropriately in the text. Similarly, when participants with other chronic diseases were included in the qualitative studies or when the analyses were conducted separately for boys and girls, we have noted this in the tables. One quantitative study<sup>90</sup> included participants up to the age of 19 years, and one qualitative study<sup>30</sup> included children from 4 years of age. Despite the inclusion criterion of participants aged 6–18 years, these two studies were included because they involved few children outside the defined age range, and the average ages were 13 and 9.5 years, respectively.

The first author screened the records with assistance from two co-authors. Each study assessed for eligibility was evaluated by at least two additional co-authors, and the data were



extracted by the first author in collaboration with at least two co-authors. Two of the included studies<sup>28,95</sup> were authored by one and four of the authors of the review, respectively. Data extraction from those studies was conducted by other co-authors to ensure an unbiased interpretation for all studies. Any disagreement was discussed between authors until a common interpretation was achieved.

### **Conclusions**

Enjoyment, physical self-concept, self-efficacy, attitudes and beliefs about PA and health, psychological distress, HRQoL, and social support were more commonly reported as correlated with PA level than not. Reports of the construction and validation of instruments were sparse. Ten issues related to participation in PA were reported in qualitative studies, and capability and being like peers were the two most frequently reported. There was no direct evidence that qualitative studies included in this review had informed the quantitative studies and instruments. The gaps in the present knowledge identified in this review were lack of designs to assess casual relationships, lack of objective recording of PA, and sparse evidence for the environmental and socioeconomic correlates of PA.

### **Implications for research**

To assess the influences on PA in children and adolescents with asthma, future research should include longitudinal and experimental designs and objective recording of PA. Transparency is needed when reporting the evidence that informs the construction and validation of instruments. Instruments to assess the influences on PA may need to be adjusted or developed for use with children and adolescents with asthma, and these should be informed by knowledge about the experiences of these children and adolescents. Future research should also be theoretically grounded in an ecological approach.

### **Implications for practice**

According to the qualitative studies included in the present review and consistent with the correlates of PA reported, participation in PA by children and adolescents with asthma is influenced by intra- and interpersonal factors and issues. To encourage PA participation by children and adolescents with asthma, clinicians should consider enjoyment, physical self-concept, self-efficacy, capability, downplaying of asthma, modification of activities, attitudes and beliefs about PA and health, psychological distress, negative feelings, HRQoL, desire to be like peers, belonging, social support, and gendered roles.

### **Conflicts of interest**

The authors report no conflict of interest. The authors alone are responsible for the writing of the review study.

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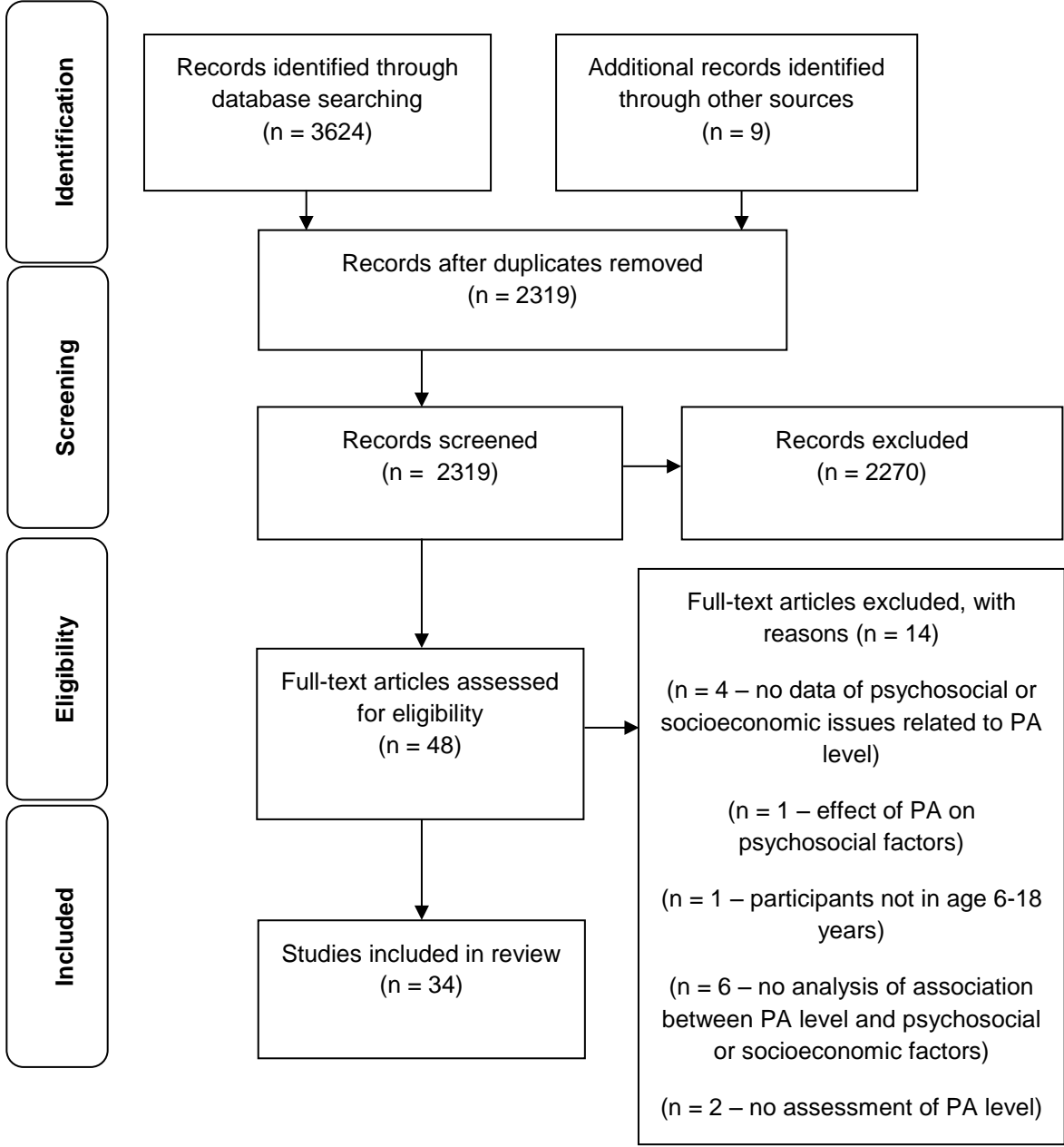
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**Figure 1:** PRISMA Flow Diagram for the scoping review.



**Table 1** Psychosocial factors associated with PA level from included studies (n=20). Factors associated with PA level at one point of measure are reported as correlate while the concept determinant is used in longitudinal assessment. Empty fields (-) means not measured/not reported. Measures are reported by child/adolescent unless otherwise stated. Factors in bold were reported as theoretically founded scales constructed and validated by in-study factor analysis and reliability tests.

| Authors and year of publication<br>Age of participants | Intrapersonal factors |                       |                 |                 |   |                        | Interpersonal factors          |                               |                   |   |   | Environmental factors            |                |                       |
|--|-----------------------|-----------------------|-----------------|-----------------|---|------------------------|--------------------------------|-------------------------------|-------------------|---|---|----------------------------------|----------------|-----------------------|
|  | Enjoyment of PA       | Physical self-concept | Self-efficacy   | Body perception | Attitudes and beliefs about PA and health | Psychological distress | Health-related quality of life | Social support/approval of PA | Restriction of PA | Parents' self-efficacy to stimulate their child's PA† | Parents' attitudes and beliefs about PA and health‡ | Parents' anxiety and depression‡ | Health support | Environmental factors |
| Weston et al. 1989, CS<br>11-13 years                  | Correlated†           | Correlated†           | -               | -               | Correlated                                | Correlated†            | -                              | -                             | -                 | -   | -   | -                                | -              | -                     |
| Kisantas & Zimmermann, 2000, CS<br>14-18 years§        | -                     | -                     | Correlated†     | -               | -   | -                      | -                              | -                             | -                 | -   | -   | -                                | -              | -                     |
| Lang et al. 2004, CC<br>6-12 years                     | -                     | -                     | -               | -               | -   | -                      | -                              | -                             | -                 | Correlated†   | -   | -                                | -              | Not Correlated        |
| Planosi & Davis, 2004, CS<br>8-12 years                | Correlated            | Correlated            | -               | -               | Correlated                                | -                      | -                              | -                             | -                 | -   | -   | -                                | -              | -                     |
| Kelsay et al. 2005, CS<br>8-18 years§                  | -                     | -                     | -               | Correlated      | -   | Correlated             | -                              | -                             | -                 | -   | -   | -                                | -              | -                     |
| Glazebrook et al. 2006, CC<br>7-14 years               | -                     | -                     | -               | -               | Not Correlated                            | Correlated             | -                              | -                             | -                 | -   | Not Correlated                                      | -                                | -              | -                     |
| Hsu et al. 2006, CS<br>8-11 years                      | -                     | Not Correlated        | -               | -               | Not Correlated                            | -                      | -                              | -                             | -                 | -   | -   | -                                | -              | Correlated†           |
| Walders-Abramson et al. 2009, CC Int.<br>10-16 years   | -                     | -                     | Not Correlated† | -               | Not Correlated                            | -                      | -                              | Not Correlated†               | -                 | -   | Not Correlated                                      | -                                | -              | -                     |
| Cheng et al. 2010, CC<br>7-14 years                    | -                     | -                     | -               | -               | Correlated                                | -                      | Correlate                      | Correlated                    | Correlated        | -   | -   | -                                | -              | -                     |
| Stevens et al. 2010, CS<br>6-17 years                  | -                     | -                     | -               | -               | -   | -                      | -                              | -                             | -                 | -   | -   | Correlated††                     | Correlated††   | Correlated††          |



**Table 2** Reported information about instruments to measure psychosocial factors, and reported information about construction, validity and reliability of instruments from included quantitative studies (n=20).

| <b>Authors and year of publication</b>  | <b>Measurement of psychosocial and/or socioeconomic factor</b>  | <b>Construction and validation of measurement</b>  |
|---|---|--|
| <b>Weston et al. 1989</b>               | <p><b>Anxiety</b> (Sport Competition Anxiety Test (Martens, 1977))</p> <p><b>Physical self-concept</b> (seven items from Harter's (1982) perceived competence scale).</p> <p><b>Enjoyment</b>; partly from Children's attitudes towards PA (CATPA) inventory (Schutz et al 1985) in six dimensions; social interaction, fitness and health, competence, competition, asceticism and enjoyment per se.</p> <p><b>Deterrence</b>, 11 items in 5-point scale</p> <p><b>Motivation</b> (Gill et al. 1983) 13 items.</p> | <p>Questionnaires completed by children themselves in their classrooms by supervision of their teachers and one investigator.</p> <p><b>Factor analysis</b><br/> <i>Enjoyment</i>: fitness-health ("keeping yourself physically fit", "keeping yourself healthy as well", "being physically active", "moving around a lot"; <i>competition-asceticism</i> ("seeing if you're better than others", "doing long and hard training", "competing against others", "pushing yourself hard"); <i>mastery</i> ("being good at it", "doing it well")<br/> <i>Deterrence</i>: overall dislike of exercise ("it's too much effort", "I don't like exercise or sport", "I don't have enough energy");<br/> <i>asthma/asthma symptoms</i> ("asthma", "feeling short of breath", "coughing")<br/> <i>Motivation</i>: fitness-health ("to keep fit", "it's good for me", "to keep myself healthy"); <i>competition</i> ("I like the competition", "it gives me something to do", "to get better at it"); <i>compulsion</i> ("I have to do it at school", "my parents say I should"); <i>social</i> ("to make new friends", "to have fun", "to be with my friends")<br/> <b>Reliability</b><br/>                     Re-administration of questionnaires to 15% (n=61) students.<br/>                     ICC of enjoyment, deterrence and motivation dimensions ranged from 0.53 (modest) to 0.93 (excellent) except from mastery which was excluded (ICC=0.40).</p> |
| <b>Kitsantas &amp; Zimmermann, 2000</b> | <p><b>Lung self-efficacy</b>; response of self-beliefs related to 25 physical activities.</p>   | <p><i>Lung self-efficacy</i>; items developed from activities commonly used in quality of life questionnaires and from suggestions from pulmonologists. Question stated: "How sure are you that you can engage in the following activities without experiencing breathing problems?" with response alternatives in a 5-point Likert scale (5 (completely sure), 4 (slightly sure), 3 (undecided), 2 (slightly unsure), 1 (completely unsure)).<br/> <b>Reliability</b><br/>                     The interitem reliability Cronbach's <math>\alpha</math> of the self-efficacy scale was 0.94.</p>  |
| <b>Lang et al. 2004</b>                 | <p><b>Categorical (yes /no):</b><br/>                     -Neighborhood safety<br/>                     -Walking distance to recreation center<br/>                     -Adult exercise with child<br/>                     -Recall of physician advice regarding exercise.</p> <p><b>Scale: Health beliefs; benefits of exercise, appropriateness of exercise, feelings about exercise</b></p>   | <p>Scale of health beliefs constructed as answer of questions/statements only (5-point Likert scale ranging from "strongly disagree" to "strongly agree". No factor analysis or reliability tests.<br/>                     Other factors were categorical; yes/no. Parents were responders and were asked to have their child present during interviews so children also could be asked the similar questions.</p>  |
| <b>Pianosi &amp; Davis, 2004</b>        | <p><b>Perceived Competence Scale for Children</b> (Harter 1982), modified version.</p>  | <p>No in-study information provided.</p>   |

|                                      |   |
|--------------------------------------|---|
| <p><b>Kelsay et al. 2005</b></p>     | <p><b>Children's Attitudes Toward Physical Activity (CATPA) questionnaire</b> (Schutz et al 1985).</p> <p><b>Body perception</b><br/>Color-a-Person Dissatisfaction test, Children's Version. (CAPT-C) (Breitenoder-Wehrung et al, 1998)</p> <p><b>Psychological status</b><br/>Multidimensional Anxiety Scale for Children. (MASC) (March et al, 1997)<br/>Children's Depression Inventory (CDI) (Kovacs, 1985)</p> <p><b>Asthma perception</b><br/>Children's Asthma Symptoms Checklist (CASCL), panic and fear subscale (Fritz &amp; Overholser, 1989)</p> <p><b>Exercise beliefs Questionnaire</b></p> <p><b>Mental health</b><br/>(Strengths and Difficulties Questionnaire (SDQ), Parent Version, Goodman, 1997)</p> <p><b>Contemplation stage changing exercise behavior</b>; Five stages of Trans-theoretical Theory (Prochaska et al. 1997, Walton et al. 1999)</p> <p><b>Perceived health status</b>; 4 items, from Perceived Health Status scale (Hunt et al 1980, Yoos et al 1997)</p> <p><b>Physical self-concept</b>; 29 items (Fox et al 1989, Marsh 1993, Chung 1996)</p> <p><b>Environmental factors</b> (no information provided)</p>   |
| <p><b>Glazebrook et al. 2006</b></p> | <p><i>Body perception</i>; coloring of frontal and side view of body figure (male or female) corresponding to very happy, happy, neutral or okay, unhappy and very unhappy. Child color the figure based on how they feel about their body. Score of 60 areas between 1 and 5 (1 indicating the greatest satisfaction. Coded by a student</p> <p><b>Reliability</b><br/>10% double coded by researcher, inter-reliability; 0.98.<br/><i>Anxiety</i>; 39 items, 4-point scale from "never true about me" to "often true about me". Excellent internal reliability, good convergent validity and divergent validity (in other study; March et al 1997)<br/><i>Depression</i>; 27 items where participant pick one out of three sentences that best describes them over the past 2 weeks including affective, social, attitudinal and vegetative symptoms of depression. Test-retest reliability between 0.74 and 0.77 and internal consistency estimated by coefficient alpha of 0.84 (in other study; Smucker et al 1986)</p> <p><i>Exercise beliefs</i>; asthma as a barrier and increased control as a facilitator reported. No information regarding construction of factors or questionnaire. Responses from both parents and children.<br/><i>Mental health (SDQ)</i>; 25 items divided into 5 subscales each of 5 items; conduct problems, hyper-reactivity/inattention, emotional symptoms, peer problems and prosocial behaviors. Internal consistency reported by Goodman, 2001; Cronbach's <math>\alpha</math> 0.73. The instrument has been reported to discriminate child mental health clinic attendees from community controls.</p> <p><i>Perceived health status</i>; 4 items, 5 point Likert scale from Perceived Health Status scale (Hunt et al 1980, Yoos et al 1997).</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha</math> 0.71.</p> <p><i>Physical self-concept</i>; 29 items with a 6-point Likert scale, high score represents positive self-concept. Items cover flexibility, endurance, appearance, agility, obesity and strength.</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha</math> 0.89.</p> |
| <p><b>Hsu et al. 2006</b></p>        | <p><b>Psychosocial Correlates of Physical Activity interview</b>; (Saunders et al 1997; Motl et al 2000) with strong psychometric properties and extensive previous use in literature. Motl et al 2000; Dishman et al 2002; Sallis et al, 2000)</p> <p>One parent from each family and the identified child were asked to respond to a set of items using Likert-type scales, with interviews lasting approximately 45 min. A sample item included asking the youth to respond to the following question along a five-</p>  |

point Likert-type scale of how much they agree with the statement: "I can be physically active during my free time on most days."  
**Reliability**  
 A parent and child psychosocial correlates composite score was generated to compile responses across domains of health beliefs, activity attitudes, self-efficacy, and social support for physical activity. Cronbach's  $\alpha$  for all measures ranged between 0.70 and 0.87 in the present study.

**Cheng et al. 2010**

**The pediatric asthma quality-of-life questionnaire (PAQLQ,** Juniper et al, 1996)

**Questionnaire for children with asthma:**

- Views about the relationship between asthma and exercise
- Parents' and teachers' attitudes towards asthmatic children taking part in sports and whether these adults had restricted children's exercise.
- Doctors' attitudes towards asthmatic children exercising and whether they had discussed physical activity with the children.

No further information provided.

**Stevens et al. 2010**

**Medical Home Total Score** (perceived, including five features; access, continuity, comprehensiveness, family-centered care and coordination of care.

**Neighborhood environment;** availability of parks/playgrounds and recreation or community center; neighborhood safety (Likert scale of 2 items including safety of school and safety of community).

Medical Home Total Score based on American Academy of Pediatrics seven features previously used (Bethell et al, 2004, Stevens et al, 2009).

Each questions were assigned a score of 0-12 (12 correspond to the best score).

Factor analysis of Medical Home Total Score; indicating 4 features. 5 features still created.

Summary score of each feature divided on all non-missing questions.

Total score as average of the averages.

Neighborhood environment; no further information provided.

**Correia et al. 2012**

**Athletic competence and self-worth domains of the Self-Perception Profile for Children** (Harter, 1982)

**Mothers' anxiety levels with the Hospital Anxiety and Depression Scale** (Botega et al 1995)

**Attitudes and Beliefs towards PA** (Lang et al, 2004)

Additional questions towards mothers whether they could identify asthma or wheezing during or after PA and if they imposed restrictions.

No further information given.



|                                  |   |  |
|----------------------------------|---|--|
| <b>Basso et al. 2013</b>         | <b>The pediatric asthma quality-of-life questionnaire</b> (PAQLQ, La Scala et al, 2005)   | PAQLQ: 23 items in three domains (symptoms – 10 items, activity limitation – 5 items, emotional function – 8 items). Children report how they feel the previous week in a 7-point scale ranging from extremely bothered (1) to not bothered at all (7). Scores for each domain are summed and divided by number of questions, and total score by summing the individual domain scores.   |
| <b>Dantas et al. 2014</b>        | <b>Questionnaire towards mothers regarding PA prevention.</b>   | <i>Questionnaire towards mothers regarding PA prevention</i> ; "Do you prevent your child from taking part in sports or games because of asthma in the period when he/she is not having an attack?"  |
| <b>Latorre-Roman et al. 2014</b> | <b>Physical Activity Enjoyment Scale (PACES)</b> (Motl et al, 2001; Moreno et al, 2008).  | PACES; 16 items, preceded by the sentence "When I am active..." evaluating the enjoyment from the highest level to the lowest. Answers are given in a 5-point Likert scale.<br><b>Factor analysis</b> reveal 2 factors; PA enjoyment and PA boredom. Confirmatory factor analysis results show an acceptable goodness of fit confirming the factorial structure of the scale of enjoyment. Further, the scale revealed convergent validity with PA.  |
| <b>Teng et al. 2014</b>          | <b>Family support</b> (Lee's social support for PA scale (2000).  | <i>Family support</i> ; high score indicate stronger family support.<br><b>Reliability</b><br>Cronbach's $\alpha$ 0.83 and test-retest reliability 0.89.<br>Then classified into two groups by 50 <sup>th</sup> percentile; below and above 50 <sup>th</sup> .   |
| <b>Tiggelman et al. 2014a</b>    | <b>Maternal Sport-Specific Support</b> (4 items from the Dutch Sport-Specific Parental Support Scale (Jurg et al 2005) and 2 items from Davison et al (2003)<br><b>Maternal Beliefs About Offspring's Participation in Sport.</b> 12 items from the Attitude towards Sport Scale (Jurg et al 2005).<br><b>Maternal Beliefs About Own Participation in Sport.</b> 13 items on the Beliefs about Sport Scale (Jurg et al 2005)<br><b>Maternal Physical Activity.</b> One item (Jurg et al 2005)<br><b>Maternal Self-Efficacy to Stimulate to Participate in Sport.</b> 7 items (Jurg et al 2005)<br><b>Adolescents' Self-Efficacy,</b> 8 items from the Self-Efficacy Scale (Jurg et al 2005)<br><b>Adolescent's Beliefs About Sport Participation,</b> 14 items from the Attitude towards Sport scale (Jurg et al 2005). | <i>Maternal Sport-Specific Support</i> ; (4 items from the Dutch Sport-Specific Parental Support Scale (Jurg et al 2005); (e.g. "How often do you watch your child participate in sports?") and 2 items from Davison et al (2003) ("How often does your family use sport/physical activity as a form of familial recreation, e.g., going on bike rides together, hiking, ice skating?") and "How much do you use your own behavior to encourage your offspring to be physically active/ participate in sports?")<br>Reports on a 5-point Likert scale ranging from never/almost never (1) to every day (5).<br><b>Reliability</b><br>Cronbach's $\alpha$ of the six items was 0.63.<br><i>Maternal Beliefs About Offspring's Participation in Sport</i> ; 12 items from the Attitude towards Sport Scale (Jurg et al 2005). (e.g., "When I do not agree at all to (5) I completely agree."<br><b>Reliability</b><br>Cronbach's $\alpha$ 0.75.<br><i>Maternal Beliefs About Own Participation in Sport</i> ; 13 items on the Beliefs about Sport Scale (Jurg et al 2005) (e.g., "When I participate in sports, I become stronger"), and answers were measured on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree.<br><b>Reliability</b><br>Cronbach's $\alpha$ 0.78<br><i>Maternal Physical Activity</i> ; One item (Jurg et al 2005) ("I participate in physical activities like running, cycling (not in a sport club) and one item assessed participation in sport clubs (i.e., "Do you participate in a sport club?") Mothers who neither participated in physical activity nor participated in sport clubs were categorized as non-active (0) and parents who were either active in daily life or in sport clubs were categorized as active (1).<br><i>Maternal Self-Efficacy to Stimulate to Participate in Sport</i> ; 7 items (Jurg et al 2005) (e.g., "Do you find it easy or difficult to stimulate |

your child to participate in sports when you do not have much time?”). Responses measured on a 5-point Likert scale ranging from (1) very hard to (5) very easy. Higher scores indicated higher levels of self-efficacy.

**Reliability**

Cronbach's  $\alpha$  0.92

*Adolescents' Self-Efficacy*, 8 items from the Self-Efficacy Scale (Jurg et al 2005) (e.g., “Do you find it difficult or easy to participate in sport when there is a nice program on television?”) Responses measured on a 5-point Likert scale ranging from (1) very hard to (5) very easy.

**Reliability**

Cronbach's  $\alpha$  0.78.

*Adolescent's Beliefs About Sport Participation*, 14 items from the Attitude towards Sport scale (Jurg et al 2005). (e.g., “When I participate in sports, I have fun with my friends”). Responses were measured on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree.

**Reliability**

Cronbach's  $\alpha$  0.74.

**Hospital Anxiety and Depression Scale (HADS)**, Dutch version, Sigmund & Snaith, 1983

HADS; Dutch version, Sigmund & Snaith, 1983) Symptoms of anxiety (e.g. I feel tense or wound up) and depression (e.g. I look forward with enjoyment to things) were assessed with seven items measured on a four-point scale, with higher scores indicating more symptoms. For this study, anxiety and depression were combined into one scale (Spinhoven et al 1997)

**Reliability**

Cronbach's  $\alpha$  0.76 (2012), and 0.74 (2013).

**Adolescent Asthma Quality of Life Questionnaire (AAQOL)** (Rutishauser et al 2001; dutch version; Ven van de MOM et al 2007)

AAQOL; developed uniquely for adolescents with asthma. 6 subscales: symptoms (six items, e.g. “How bothered have you been by wheezing?” 2012  $\alpha$ =0.87, 2013  $\alpha$ =0.88); medication (five items, e.g. “How bothered or concerned have you been about taking medication for your asthma?” 2012  $\alpha$ =0.71, 2013  $\alpha$ =0.76); physical activities (six items, e.g. “How often did running make you cough or wheeze?” 2012  $\alpha$ =0.80, 2013  $\alpha$ =0.83); emotions (five items, e.g. “How often did you feel worried or concerned because of your asthma?” 2012  $\alpha$ =0.86, 2013  $\alpha$ =0.85); social interaction (five items, e.g. “How often did you feel worried or embarrassed when taking asthma medication in front of other people?” 2012  $\alpha$ =0.64, 2013  $\alpha$ =0.61); and positive effects (five items, e.g. “With regard to your asthma, how often have your friends been helpful and understanding?” 2012  $\alpha$ =0.78, 2013  $\alpha$ =0.80). Measured on a seven-point Likert scale from 1 to 7. An overall measure of QOL (total QOL;  $\alpha$ =0.91) was created without the positive effects domain because it could not be meaningfully added to the total score and without the symptom domain, because this domain had too much content overlap with asthma control.

*Perceived Stress Scale-10*; 10 items (e.g. In the last month, how often have you felt confident about your ability to handle your personal problems?) were measured on a five-point Likert scale ranging from 0 (never) to 4 (very often)

**Reliability**

Cronbach's  $\alpha$ =0.82.

**Physical Activity Enjoyment Scale** (PACES) (Motl et al., 2001), Spanish version (Moreno, González-Cutre, Martínez, Nestor, & López, 2008).

*Physical Activity Enjoyment Scale*; (Motl et al., 2001), Spanish version (Moreno, González-Cutre, Martínez, Nestor, & López, 2008). Consists of 16 items, preceded by the sentence “When I am active...”, and evaluates the enjoyment from the highest level (e.g., “I enjoy,” “It is very exciting,” “I find it enjoyable”) to the lowest (e.g. “I am bored,” “I do not like it,” “It frustrates me”). The answers were collected in a Likert scale whose punctuation ranks oscillate from 1 (totally disagree) to 5 (totally agree).

**Reliability**

Cronbach's alpha in this study was 0.907.

**Tiggelman et al. 2014b**

**Latorre-Roman et al. 2015**

|                                      |   |
|--------------------------------------|---|
| <p><b>Westergren et al. 2015</b></p> | <p><b>Self-perceived personal, social and environmental factors</b> were assessed by a paper-based validated self-report questionnaire.</p> <p><i>Self-perceived personal, social and environmental factors</i> were assessed by a paper-based validated self-report questionnaire (Ommundsen et al 2006; Ommundsen et al 2008; Bergh et al 2001) designed to capture theoretically derived relevant perceived personal, social and environmental factors shown to influence PA in children. To test the construct validity for the instrument exploratory <b>factor analysis</b> with varimax rotation was conducted. Cronbach's <math>\alpha</math> was used to assess the internal reliability of the instrument. In the parental practical support, teacher support and physical-social opportunity scales one item each with poor loading were removed to increase internal reliability.</p> <p>Social support questions (emanated from Bandura's social cognitive theory); Response format 1–4; 1=never or hardly ever, 2=once or twice a week, 3=almost every day and 4=every day</p> <p><i>Parental practical support</i> (2 items; e.g. "How often does your mother or father take you to exercise or play sports?")<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.59</math></p> <p><i>Parental emotional support</i> (2 items; e.g. "How often does your mother or father encourage you to play, exercise or do sports?")<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.68</math></p> <p><i>Peer support</i> (3 items; e.g. "How often do your friends exercise or play sports with you?")<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.82</math></p> <p><i>Teacher support</i> (2 items; e.g. "How often does your teacher talk about exercise in lessons?")<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.60</math></p> <p>Competence, enjoyment (emanated from Harter's competence motivation theory) and environment questions; response format 1–5; 1=does not suit for me, 5=suits for me.</p> <p><i>Competence-enjoyment</i> (5items; e.g. "I wish I could play more games and sports than I get chance to.")<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.73</math></p> <p><i>Safe environment</i> (4 items; e.g. "It is safe to walk or play alone in my neighborhood during the day.")<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.75</math></p> <p><i>Physical-social opportunity</i> (2 items; e.g. "There are other children nearby home to go out and play with »)<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.48</math></p> |
| <p><b>Tiggelman et al. 2015</b></p>  | <p><b>Maternal/paternal Sport-Specific Support</b> (4 items from the Dutch Sport-Specific Parental Support Scale (Jurg et al 2005); (e.g. "How often do you watch your child participate in sports?") and 2 items from Davidson et al (2003) ("How often does your family use sport/physical activity as a form of familial recreation, e.g., going on bike rides together, hiking, ice skating?" and "How much do you use your own behavior to encourage your offspring to be physically active/ participate in sports?")</p>  |

|   |   |
|---|---|
| <p><b>Maternal/paternal general beliefs about their child's sport participation</b> 13 items of the Attitude towards Sports Scale (Jurg et al 2005)</p> | <p>Reports on a 5-point Likert scale ranging from never/almost never (1) to every day (5).<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> of the six items was 0.84 for mothers and 0.89 for fathers.</p>  |
| <p><b>Maternal/paternal asthma-specific beliefs about their child's sport participation</b> 7 items (Lang et al 2004).</p>                              | <p><i>Maternal/paternal general beliefs about their child's sport participation</i>; 13 items of the Attitude towards Sports Scale (Jurg et al 2005) (e.g. When your child participates in sports, he/she has fun with his/her friends). Responses given on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree. An average was calculated with higher scores representing more positive beliefs.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math>=0.80 (mothers) =0.76 (fathers).</p> |
| <p><b>Maternal/paternal self-efficacy to encourage child's sport participation</b> 7 items (Jurg et al 2005)</p>  | <p><i>Maternal/paternal asthma-specific beliefs about their child's sport participation</i>; 7 items (e.g. When your child participates in sports, his/her asthma gets worse) (Lang et al 2004). Items measured on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree; an average across the seven items was calculated.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math>=0.75 (mothers) =0.70 (fathers).</p>   |
|   | <p><i>Maternal/paternal self-efficacy to encourage child's sport participation</i>; 7 items (e.g. Do you find it easy or difficult to encourage your child to participate in sports when you do not have much time?) (Jurg et al 2005) measured on a 5-point Likert scale ranging from (1) very hard to (5) very easy. An average was taken with higher scores indicating higher levels of self-efficacy.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> =0.88 (mothers) =0.92 (fathers).</p>                            |

Abbreviations: PA; physical activity, ICC; intraclass correlation coefficient

**Table 3** Socioeconomic factors associated with PA level, instrument used, and reported information about construction, validity and reliability of instruments from included quantitative studies (n=3).

| <b>Authors and year of publication</b>  | <b>Association with PA level</b>  | <b>Measurement of psychosocial and/or socioeconomic factor</b>   | <b>Construction and validation of measurement</b>  |
|---|---|--|--|
| Glazebrook et al. 2006, CC 7-14 year§†† | Professional/managerial occupation vs. other – not correlated   | National Statistics Socio-economic Classification (UK, 2000)   | Occupation; Professional/managerial, Intermediate, Routine or Student/unemployed.        |
| Stevens et al. 2010, CS 6-17 year††     | Poverty status, parent employment, and high school graduate – correlated  | Poverty status (≥200% of federal poverty level).<br>Parent education (high school graduate vs. less than high school).<br>Parent employment (worked at least 50 weeks last year) | No further information provided.   |
| Teng et al. 2014, CS 12-16 years        | High vs. low social class – Not correlated  | Five Social Classes (Hollingshead & Redlich, 1958) ranging from high (1) to low(5), divided into low (4 and 5, medium (3) and high (1 and 2) (Oguma et al. 2002).                | Five social Classes; based on occupation and education. No further information provided. |
| Vangeepuram et al. 2014, CS 6-8 year§§† | Caregiver education levels of bachelor's degree or more – correlated<br>Caregiver education levels of high school degree or more – not correlated | Self-reported level of caregiver education (less than or greater than a high school degree and less than and greater than a Bachelor's degree).                                  | No further information provided.   |

† Covariance/multiple regression analysis

‡ Reported by parents

§ Analysis of female participants only

Abbreviations: PA; physical activity, n; numbers, CS; cross-sectional design, CC; case-control design

**Table 4** Psychosocial issues in relation to PA level reported in qualitative research studies (n=13).

| <i>Authors and year of publication</i><br><i>Age of participants</i> | Enjoyment | Negative feelings | Self-esteem | Capability | Toughen up and downplay asthma | Modification | Being like peers | Belonging | Social support | Gendered roles | Number of issues reported in each study |
|--|-----------|-------------------|-------------|------------|--------------------------------|--------------|------------------|-----------|----------------|----------------|---|
| Williams 2000<br>15-18 years <sup>†‡</sup>                           | X         | X                 | X           | X          | X                              |              |                  |           |                | X              | 4                                       |
| Callery et al. 2003<br>9-16 years <sup>‡</sup>                       |           | X                 |             |            |                                |              | X                |           | X              |                | 3                                       |
| Rhee et al. 2007<br>12-18 years                                      | X         | X                 | X           | X          | X                              | X            | X                |           |                | X              | 6                                       |
| Walsh et al. 2008<br>8-17 years                                      |           | X                 |             |            |                                |              | X                |           |                |                | 2                                       |
| de Borja et al. 2009<br>9-10 years <sup>‡</sup>                      |           |                   |             | X          | X                              | X            | X                | X         | X              |                | 6                                       |
| Fereday et al. 2009<br>4-16 years <sup>¶</sup>                       |           |                   |             | X          |                                | X            | X                |           | X              |                | 4                                       |
| Protudjer et al. 2009<br>11 years                                    | X         |                   |             | X          | X                              | X            | X                | X         |                |                | 6                                       |
| Shaw 2010<br>8-12 years  | X         |                   |             | X          |                                | X            | X                | X         |                |                | 5                                       |
| Spencer-Cavaliere & Watkinson 2010<br>9 years <sup>¶</sup>           |           |                   |             |            |                                |              | X                | X         |                |                | 2                                       |

|  |       |       |      |        |       |       |        |       |       |       |       |
|--|-------|-------|------|--------|-------|-------|--------|-------|-------|-------|-------|
| <i>Williams et al. 2010</i><br>6-14 years £            | X     | X     | X    | X      | X     | X     | X      | X     | X     | 8     |       |
| <i>Protudjer et al. 2012</i><br>15-16 years            |       | X     | X    | X      | X     | X     | X      | X     | X     | 4     |       |
| <i>Westergren &amp; Lilleaas 2012</i><br>13-15 years β |       | X     | X    | X      | X     | X     | X      | X     | X     | 3     |       |
| <i>Hamer 2014</i><br>12-17 years β                     | X     | X     | X    | X      | X     | X     | X      | X     | X     | 6     |       |
| <b>Range of number of issues reported</b>              | 2-8   |       |      |        |       |       |        |       |       |       |       |
| <b>Age range covered</b>                               | 8-14  | 8-18  | 6-14 | 4-18   | 9-18  | 4-18  | 4-18   | 6-17  | 4-16  | 6-18  | 4-18  |
| <b>Number (%) of studies covered</b>                   | 3(23) | 5(38) | 1(8) | 10(77) | 6(46) | 7(54) | 11(85) | 7(54) | 4(31) | 5(38) | 5(38) |

‡ Parents participated in addition to children/adolescents

¶ Participants with other chronic conditions included in addition to asthma

£ Teachers/school staff participated in addition to children/adolescents and their parents

β Male participants only

Abbreviations: PA; physical activity, n; numbers

## **Appendix 1** Detailed search strategy for three major databases

*Medline via Ovid interface:*

((adolescen\* OR child\* OR schoolchild\* OR teenage\* OR young OR youth\*) AND ((exercise\* OR inactiv\* OR motor activ\* OR physical activ\* OR play\* OR sport\* OR training\*) ADJ4 (amount\* OR daily\* OR dose\* OR duration\* OR energy expenditure\* OR frequen\* OR hour\* OR insufficient\* OR intens\* OR less\* OR level OR minute\* OR moderate\* OR more\* OR participat\* OR sufficient\* OR vigorous\* OR week\*)) AND asthma\*).ti,ab,hw.

*SPORTDiscus and CINAHL via EBSCO Host interface:*

((adolescen\* OR child\* OR schoolchild\* OR teenage\* OR young OR youth\*) AND ((exercise\* OR inactiv\* OR motor activ\* OR physical activ\* OR play\* OR sport\* OR training\*) N4 (amount\* OR daily\* OR dose\* OR duration\* OR energy expenditure\* OR frequen\* OR hour\* OR insufficient\* OR intens\* OR less\* OR level OR minute\* OR moderate\* OR more\* OR participat\* OR sufficient\* OR vigorous\* OR week\*)) AND asthma\*)



Appendix 2 Extraction chart for papers included in the review (n=34).

| Author(s), year of publication, and country of origin/ country of study | Aim of the study  | Study population (recruitment strategy, gender, age, asthma status and definition, socioeconomic characteristics)  | Design                                 | Outcome assessment (PA level)   | Instrument used to assess (1) psychosocial or (2) socioeconomic factors  | Key findings: associations between PA level and (1) psychosocial and (2) socioeconomic factors   | Key findings: construction and validation of instruments used to assess associations between PA level and (1) psychosocial and (2) socioeconomic factors   | Key findings: psychosocial and socioeconomic issues related to participation in PA |
|---|---|--|--|---|--|--|--|--|
| Weston et al. 1989<br>New Zealand                                       | To determine the level of participation in PA of asthmatic schoolchildren and their peers. The attitudes of the children toward PA were also investigated to determine whether any differences in exercise behavior were a reflection of differences in motivation, physical self-concept, anxiety, or enjoyment. | Recruitment from five intermediate schools, randomly choosing 2-4 classrooms.<br>408 children 11-13 years old, 15.9% (n=65) asthmatics, 4.4% asthmatics in remission, 1.5% uncertain, 51% males.<br>Asthma: claimed by child based on parents' and/or doctors' opinion, use of medicine for asthma and days off school because of asthma during the last year (2 of 4 items fulfilled).<br>Frequency of asthma attacks from not at all to once or twice a day. | Cross-sectional population based study | Daily frequency of school activity (modest reliability; ICC =0.52)<br><br>Daily frequency of participation in PA and sports (beside school) from a list of 22 physical activities and sports.<br><br>Perceived activity (more, same, less than peers)<br><br>Reliability of all activity; ICC=0.68. | 1. <u>Psychosocial</u><br><b>Anxiety</b> (Sport Competition Anxiety Test (Martens, 1977))<br><br><b>Physical self-concept</b> (seven items from Harter's (1982) perceived competence scale).<br><br><b>Enjoyment</b> : partly from Children's attitudes towards PA (CATPA) inventory (Schutz et al 1985) in six dimensions: social interaction, fitness and health, competence, competition, asceticism and enjoyment per se.<br><br><b>Deterrence</b> , 11 items in 5-point scale<br><br><b>Motivation</b> (Gill et al. 1983) 13 items. | 1. <u>Psychosocial</u><br>Asthmatic status, enjoyment, physical self-concept and anxiety were significantly associated with level of PA and explained 18% of the variance.<br><br>Indication that the relationship between psychometric variables and PA were not different in children with and without asthma. | 1. <u>Psychosocial</u><br><b>Questionnaires completed by children themselves</b> in their classrooms by supervision of their teachers and one investigator.<br><br><b>Factor analysis</b><br><i>Enjoyment: fitness=health</i> ("keeping yourself physically fit", "keeping yourself healthy as well", "being physically active", "moving around a lot"; <i>competition-asceticism</i> ("seeing if you're better than others", "doing long and hard training"; competing against others", "pushing yourself hard"); <i>mastery</i> ("being good at it", doing it well")<br><br><i>Deterrence</i> : overall dislike of exercise ("it's too much effort", "I don't like exercise or sport", "I don't have enough energy"); <i>asthma/asthma symptoms</i> ("asthma", "feeling short of breath", "coughing")<br><br><i>Motivation</i> : <i>fitness=health</i> ("to keep fit", "It's good for me", "to keep myself healthy"); <i>competition</i> ("I like the competition", "it gives me something to do", "to get better at it"); <i>compulsion</i> ("I have to do it at school", "my parents say I should"); <i>social</i> ("to make new friends", "to have fun", "to be with my friends")<br><br><b>Reliability</b><br>Re-administration of questionnaires to 15% (n=61) students.<br><br>ICC of enjoyment, deterrence and motivation dimensions ranged from 0.53 (modest) to 0.93 (excellent) except from mastery which was excluded (ICC=0.40). | N.A.   |

|  |  |   |   |   |  |   |  |   |
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| <p>Kisantas &amp; Zimmerman, 2000<br/>New York City, USA</p> | <p>To examine asthmatic and non-asthmatic girls' lung self-efficacy perceptions regarding their participation in strenuous activities and physical fitness.</p>  | <p>Recruitment by inviting the entire student body of a parochial high school for girls serving multiethnic families.<br/><br/>Predominantly from middle class according to an index of occupations; 39% from families whose primary occupation were classified as professional, executive, and technical, 29% from other white-collar occupations, 8% from skilled blue-collar occupations, 18% from unskilled blue-collar jobs, and 6% receiving public service.<br/><br/>135 school-girls, aged 14-18 years (mean 15.92); 37 diagnosed with asthma (22%), 26 with incapacitating breathing problems (15%) and 72 without breathing problems.<br/><br/>3 girls with severe asthma, 30 with mild-to-moderate asthma and 4 unknown.</p> | <p>Cross-sectional population based study</p>   | <p>An activity log developed to measure the girls' levels of participation during a week. The same list of 25 physical activities from self-efficacy instrument was used. Girls could rate their answers with a 6-point rating scale. The girls were asked, "Before bed each night, record the time you spent in each activity or group of activities in terms of one of following categories: 0 = no participation, 1 = participating up to but not including 5 min, 2 = 5-20 min, 3 = 20-40 min, 4 = 40-60 min, and 5 = 60 min or more."</p> <p>The internal consistency of the activity log was 0.81 according to Cronbach's <math>\alpha</math> test.</p> | <p>1. <u>Psychosocial</u><br/><b>Lung self-efficacy:</b> response of self-beliefs related to 25 physical activities.</p> | <p>1. <u>Psychosocial</u><br/>Self-efficacy was the most potent predictor of activity level (<math>\beta=0.47</math>)<br/>Self-efficacy add 7% explained variance in activity level and modified the strength of asthma as predictor of activity level.</p> | <p>1. <u>Psychosocial</u><br/><i>Lung self-efficacy</i>; items developed from activities commonly used in quality of life questionnaires and from suggestions from pulmonologists.<br/>Question stated: "How sure are you that you can engage in the following activities <i>without</i> experiencing breathing problems?" with response alternatives in a 5-point Likert scale (5 (completely sure), 4 (slightly sure), 3 (undecided), 2 (slightly unsure), 1 (completely unsure)).<br/><br/><b>Reliability</b><br/>The interitem reliability Cronbach's <math>\alpha</math> of the self-efficacy scale was 0.94.</p> | <p>N.A.</p>   |
| <p>Williams 2000<br/>London, UK</p>                          | <p>To explore the interaction of gender with the management of chronic illness during adolescence, focusing on the ways in which the social constructions of</p> | <p>Twenty (10 male, 10 female) adolescents with diabetes (type 1, insulin-dependent with daily injections) and 20 (10 male, 10 female) with asthma (moderate to severe treated with anti-inflammatory inhalers and bronchodilators) aged 15-18 years and the parent</p>   | <p>Individual in-depth interviews, conducted as semi-structured 'guided conversations', taped and fully transcribed.<br/><br/>Transcripts coded by an open system according to Strauss and Corbin (1990) with a grounded theory approach, comparing the</p> | <p>N.A.</p>   | <p>N.A.</p>  | <p>N.A.</p>   | <p>N.A.</p>  | <p>Exercise is influenced by the construction of masculinities and femininities and advantage boys concerning exercise because of contemporary meanings of masculinities.<br/><br/>Boys pronounce emphasis on the importance of sport and exercise, and their health assessment was linked to the amount of sport played. Girls participated in little sport and exercise</p> |

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| Callery et al. 2003<br>Manchester, UK         | <p>femininities and masculinities affects how young people live with asthma or diabetes.</p> <p>To gain insights into the beliefs of a group of 25 young people aged nine to 16 years old and their carers about asthma and its management.</p> <p>To assess the health beliefs, perspectives and concerns of young people with asthma and their carers.</p> | <p>most involved in helping to manage the chronic illness. All social classes were represented, majority from middle-class.</p> <p>Twenty-five participants aged 9-16 years with asthma (and no other chronic lung condition) who were prescribed inhaled corticosteroids and their main carers. 17 were recruited through hospital after an un-scheduled visit 12-24 months previously and 8 from primary care who had seen their general practitioner the 12-24 months previously. All four steps of asthma severity according to British Guidelines on Asthma Management were represented, with most participants from step 2 indicating moderate asthma.</p> | <p>data for similarities and differences, sorted into broader conceptual themes which eventually became part of the larger theoretical framework.</p> <p>Open-ended conversational interview. Children interviewed alone, lasting about 1 hour, following a topic guide which were subsequently adjusted to reflect emerging themes (theoretical sampling).</p> <p>Analysis by principles of grounded theory. Transcripts of interviews; open coding – grouping into conceptual categories – patterns of similarity and difference – searching for cases who does not fit the emerging pattern to saturate and develop categories rather than force data into existing categories.</p> | N.A. | N.A. | N.A.   | <p>and expressed guilt about it, as the cause of unhealthiness. Boys perceive themselves in control by 'willpower' in contrast to girls, and thus possible also disparaged identity when not in control. Focus on control and health through exercise may act as a 'double edged sword' with an 'uneasy tension' between valued and disparaged identities.</p> <p>Concerns about "tolerable" asthma, and the effort to minimize symptoms – related to child feeling normal and to parents fear and anxiety;</p> <ul style="list-style-type: none"> <li>PA limitations – keep inactive to avoid symptoms – and feel normal.</li> <li>Reluctance to PA restrictions to not make children different from peers.</li> <li>Good days – feeling normal and like others – run like others, participate in PA without worrying about asthma – making asthma invisible.</li> <li>Bad days – when asthma become visible.</li> </ul> |
| Lang et al. 2004<br>Baltimore, Maryland, USA. | <p>To compare the activity levels of inner-city children with asthma to their peers and to evaluate the factors associated with the activity level of children with asthma.</p>  | <p>Recruitment at an urban, hospital-based primary care pediatric clinic, using billing records to identify any clinic enrollee 6-12 years old who had made a visit to the primary care clinic in the preceding 2 years.</p> <p>137 children with asthma (mean age 9.8, SD 1.7) and 106 controls (mean age 9.3, SD 1.7), similar in race, gender (58-63% males) and neighborhood attributes.</p> <p>Asthma: medical diagnosis and symptoms last 12 mon. according to Centers for Disease Control and Prevention in surveillance (<i>Morb Mortal Wkly Rep.</i> 1996).</p>   | <p>Case-control study</p>  | N.A. | N.A. | <p>1. Psychosocial</p> <p><b>Categorical (yes/no):</b></p> <p><i>Neighborhood safety</i></p> <p><i>Walking distance to recreation center</i></p> <p><i>Adult exercise with child</i></p> <p><i>Recall of physician concerning exercise.</i></p> <p><b>Scale:</b></p> <p><b>Health beliefs:</b> <i>benefits of exercise, appropriateness of exercise, feelings about exercise</i></p> | <p>1. Psychosocial</p> <p>Scale of health beliefs constructed as answer of questions/statements only (5-point Likert scale ranging from "strongly disagree" to "strongly agree").</p> <p>No factor analysis or reliability tests.</p> <p>Other factors were categorical, yes/no.</p> <p>Parents were responders and were asked to have their child present during interviews so children also could be asked the similar questions.</p>   |

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| <p>Planosi &amp; Davis, 2004<br/>Nova Scotia, Canada</p> | <p>To examine the relationships among weight, asthma severity, physical activity, and aerobic fitness in children with asthma.</p> | <p>Recruitment from a summer asthma camp. 58 (32 male) children with asthma (mild 34 (58%), moderate 20 (35%) and severe 4 (7%)) aged 8-12 years<br/>Asthma; physician diagnosed with impairment of asthma above zero.<br/>Asthma severity determined by spirometric indices, degree of bronchial hyper-responsiveness and amount of medications prescribed.</p>   | <p>Cross sectional study</p> | <p>Habitual activity level was assessed by the Hay Activity Evaluation Scale (HAES), (Hay et al 1995) designed to categorize daily physical activity (hours spent inactive, somewhat inactive, somewhat active, and active).</p> | <p>ICC of 0.97 and variability of 55% for minutes of activity and ICC of 0.83 and variability of 31% for days per week active.</p>   | <p><u>1. Psychosocial</u><br/><b>Perceived Competence Scale for Children</b> (Harter 1982), modified version.<br/><b>Children's Attitudes Toward Physical Activity (CATPA) questionnaire</b> (Schultz et al 1985).</p>  | <p><u>1. Psychosocial</u><br/>Perceived competence (<math>r=0.39</math>) and attitudes towards PA (summary score of CATPA) (<math>r=0.42</math>) correlated significantly with habitual PA. No differences related to asthma severity class.</p>   | <p>N.A.</p> |
| <p>Kelsay et al. 2005<br/>USA</p>                        | <p>To identify correlates of body dissatisfaction in youth with asthma.</p>  | <p>Recruitment through a larger National Heart, Lung and Blood Institute funded study assessing asthma symptom perception. 63 females and 60 males between 8-18 years (mean 12) from greater Denver community<br/>Asthma if documented treatment the previous 6 mon. and absence of other major chronic disease.<br/>Asthma severity based on National Heart, Lung and Blood Institute guidelines including pulmonary function results, medication history and symptoms rating.<br/>Among girls 2% had mild intermittent, 62% mild</p> | <p>Cross-sectional study</p> | <p>PA level assessed based on a 4-point scale from none to 4 hour or more per week.</p>  | <p><u>1. Psychosocial</u><br/><b>Body perception</b><br/>Color-a-Person<br/>Dissatisfaction test, Children's Version. (CAPT-C) (Breitenoder-Wehrung et al, 1998)<br/><b>Psychological status</b><br/>Multidimensional Anxiety Scale for Children. (MASC) (March et al, 1997)<br/>Children's Depression Inventory (CDI) (Kovacs, 1985)<br/><b>Asthma perception</b><br/>Children's Asthma Symptoms Checklist (CASCL), panic and</p> | <p><u>1. Psychosocial</u><br/>No significant correlation between level of PA (<i>analysis only in girls</i>) and CASCL panic and fear.<br/>Negative significant Pearson's r correlation between level of PA and Depression/CDI (<math>r=-0.39</math>), Anxiety/MASC (<math>r=0.34</math>) and Body perception/CAPT-C (<math>r=-0.51</math>) in girls.</p> | <p><u>1. Psychosocial</u><br/><i>Body perception</i>; coloring of frontal and side view of body figure (male or female) corresponding to very happy, happy, neutral or okay, unhappy and very unhappy. Child color the figure based on how they feel about their body. Score of 60 areas between 1 and 5 (1 indicating the greatest satisfaction. Coded by a student<br/><b>Reliability</b><br/>10% double coded by researcher, inter-reliability: 0.98.<br/>Anxiety; 39 items, 4-point scale from "never true about me" to "often true about me". Excellent internal reliability, good convergent validity and divergent validity (in other study; March et al 1997)<br/>Depression; 27 items where participant pick one out of three</p> | <p>N.A.</p> |

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| <p>Glazebrook et al. 2006<br/>East Midlands, UK</p> | <p>To identify barriers to physical activity in children with asthma and to compare their customary activity levels, BMI and emotional well-being with that of children with other medical conditions.</p> | <p>Recruitment among children aged 7-14 years attending outpatient appointments at 2 hospitals.<br/>56 children with asthma (mean age 10.67) and 61 children without asthma (mean age 10.97). Asthma diagnosed on the basis of wheeze and recorded bronchodilator responsiveness or peak flow variability as recommended by British Thoracic Society/Scottish Intercollegiate Guidelines Network guideline (2006).<br/>Rather more children in the non-asthma group had parents in professional or managerial occupations, but this difference was not significant.</p> | <p>Case-control study</p>     | <p>Children were asked to rate a range of activities, both active and sedentary, (55 items) in a 3-point scale (none, a little, a lot) at 3 time points (today before school, yesterday after school, yesterday at school) the previous 24h.<br/>Scores summed to total score of sedentary activities and total score of PA.</p> | <p>1. <u>Psychosocial</u><br/><b>Exercise beliefs Questionnaire</b><br/><b>Mental health</b> (Strengths and Difficulties Questionnaire (SDQ), Parent Version, Goodman, 1997)<br/><br/>2. <u>Socioeconomic</u><br/><b>Parental occupation</b><br/>National Statistics Socio-economic Classification (UK, 2000)</p> | <p>1. <u>Psychosocial</u><br/>Children with asthma with better mental health (lower SDQ score) participated in significantly more PA (<math>r = -0.35</math>).<br/><br/>2. <u>Socioeconomic</u><br/>Socioeconomic status (Professional/managerial occupation vs. other) was not associated with number of physical activities.</p> | <p>sentences that best describes them over the past 2 weeks including affective, social, attitudinal and vegetative symptoms of depression. Test-retest reliability between 0.74 and 0.77 and internal consistency estimated by coefficient alpha of 0.84 (in other study; Smucker et al 1986)</p>  | <p>N.A.</p> |
| <p>Hsu et al. 2006<br/>Taiwan</p>                   | <p>To assess the amount of PA children with asthma participate in and to explore the factors which influence their levels of PA.</p>   | <p>152 children age 8-11 years with asthma diagnosed by a physician, clinically stable, without any other chronic disease or major physical disabilities.</p>   | <p>Cross-sectional survey</p> | <p>Three day PA log (3-dPAL; Bouchard et al 1983). Recall of nine levels of PA in one weekday and one weekend day which were categorized in</p>  | <p>1. <u>Psychosocial</u><br/><b>Contemplation stage changing exercise behavior</b>; Five stages of Trans-theoretical Theory (Prochaska et al. 1997, Walton et al. 1999)<br/><b>Perceived health</b></p>  | <p>1. <u>Psychosocial</u><br/>None of the psychological factors influenced time spent in PA.<br/>Access to exercise facilities positively influenced MVPA (<math>\beta = 0.235</math>) and access to</p>   | <p>1. <u>Psychosocial</u><br/><b>Exercise beliefs</b>; asthma as a barrier and increased control as a facilitator reported. No information regarding construction of factors or questionnaire. Responses from both parents and children.<br/><b>Mental health (SDQ)</b>; 25 items divided into 5 subscales each of 5 items; conduct problems, hyper-reactivity/inattention, emotional symptoms, peer problems and prosocial behaviors. Internal consistency reported by Goodman, 2001; Cronbach's <math>\alpha</math> 0.73. The instrument has been reported to discriminate child mental health clinic attendees from community controls.<br/><br/>2. <u>Socioeconomic</u><br/>Occupation; Professional/managerial, Intermediate, Routine or Student/unemployed.</p> | <p>N.A.</p> |

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| <p>Rhee et al. 2007<br/>Central Virginia, USA</p> | <p>The purpose of this study was to explore psychosocial experiences and coping strategies of a sample of adolescents with asthma based on their own accounts. Specifically, this study attempted to capture adolescents' perception of physical and emotional reactions to asthma and to identify adolescents' attitudes toward dealing with the physical and psychosocial challenges posed by asthma.</p> | <p>Nineteen participants with asthma. Mean ages were 13.4 (SD=1.01) for participants in the younger groups (12-15 years) and 16.5 (SD=0.71) for those in the older groups (16-18 years).<br/><br/>Eight (42.1%) participants had parents with college graduate or higher.<br/><br/>Participants were recruited through the use of flyers posted in asthma and teen clinics, recruitment letters sent through local school nurses, and a community contact person. Interested participants contacted the study team by telephone and were screened via a return telephone call by a member of the study team. Eligibility criteria included having current asthma diagnosed by health care professionals, absence of other physical illnesses or cognitive-mental illnesses, and ability to communicate in English. Eligibility was determined based on self-report from teens and parents. School nurses confirmed eligibility for teens recruited from the schools. Asthma severity was not used in defining eligibility for study inclusion. All participants responded that they used at least one</p> | <p>Focus group study. Participants were divided by age groups, younger (12 through 15 years) and older (16 through 18 years). Each age group contained three subgroups (boys, girls, and mixed gender). Each participant attended one of the following six sessions (older girls; older boys; older mixed gender; younger girls; younger boys; younger mixed gender). The study team included focus group facilitators (nursing doctoral students in their candidacy) who were gender-matched to participants.<br/><br/>Participants completed a survey questionnaire collecting demographics and asthma-related information immediately before a 10-minute warm-up question and answer group session. Prior to each group session, participants were given a brief description of the study and a chance to ask any questions. Three general questions exploring teens' psychosocial experiences with asthma were used across all groups, providing a semi-structured group interview setting. The questions were: "What is it like to have asthma?" "What kinds of things does asthma stop you doing that you want to do?" and "When is not such a bad thing to have asthma?" Focus group facilitators supplemented</p> | <p>mild activity, moderate activity and vigorous activity. Pilot studied on 15 school-aged children with a test-re-test reliability of 0.78 and thereafter refined.</p> | <p>N.A.</p> | <p><b>status:</b> 4 items, from Perceived Health Status scale (Hunt et al 1980, Yoo et al 1997)<br/><b>Physical self-concept:</b> 29 items (Fox et al 1989, Marsh 1993, Chung 1996)<br/><b>Environmental factors</b> (no information provided)</p> | <p>sports team positively influenced VPA (<math>\beta=0.193</math>).</p> | <p><i>Physical self-concept:</i> 29 items with a 6-point Likert scale, high score represents positive self-concept. Items cover flexibility, endurance, appearance, agility, obesity and strength.<br/><b>Reliability</b><br/>Cronbach's <math>\alpha</math> 0.89.</p> | <p><i>Doing less with more effort:</i> Most of the participants reported that their involvement in physical activities or sports in various degrees was often less than their healthy peers and required extra effort on their part, which they often felt was unrecognized and underappreciated by others.<br/><br/><i>Missing out:</i> A sense of loss and/or unfairness was perceived when participants compared their situations with healthy peers.<br/><br/><i>Not all bad:</i> providing an excuse to eliminate themselves from undesirable situations such as running the mile or other physical activities. This was particularly true for the younger participants.<br/><br/><i>Perceptions and attitudes of others:</i> A couple of girls believed that "people just got tired of" them because they disappointed others (peers, coaches or parents) due to limited physical activities or caused others inconvenience. This perception appeared to be directly linked to the sense of guilt expressed by female participants. Participants of all age groups and genders voiced their belief that others (e.g., peers, family members, and other adults in the schools) lacked understanding about the adolescents' asthma, particularly the extra effort expended to keep up with their peers physically.<br/><br/><i>Toughening:</i> In responding to others' misunderstanding (e.g., accusations of faking or being wimpy), some adolescents "toughen up" themselves unrealistically. Strong motivation to be</p> |
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| <p>Walsh et al. 2008<br/>Chapel Hill, North Carolina and Temple,</p> | <p>To understand differences in patient-reported outcome domains between children with asthma and</p> | <p>Eight focus groups including 4-7 children in each (mixed gender). 2 groups including children with (n=13) and 2 without (n=8) asthma aged 8-12 years, 2 groups including adolescents with (n=7) and</p> | <p>Focus group led by a lead moderator and a co-work doctoral students. Semi-structured interview guide consisting of 4 major themes (physical, psychological/social, school</p> | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>viewed or treated as equal to peers appeared to cause them to disregard symptoms and to push themselves beyond their physical limitations. Participants, especially older boys, exhibited apparent downplaying of symptoms, denying any serious impact of asthma on their lives. Older girls were more explicit in exerting their needs in interacting with peers.</p> <p><i>Guardedness:</i> Having experienced serious consequences of asthma, some younger and older participants reported becoming more vigilant in monitoring and managing their symptoms. Any tendency to withdraw from physical or social activities as a result of this form of guarding could deprive these teens of normal adolescent experiences. On the other hand, adolescents who are "staying on guard the whole, the most of the time" can be meticulous in taking preventive and therapeutic measures when faced with potential or actual threats from their illness.</p> <p><i>Modifying:</i> Older groups spoke at length about lifestyle adjustment, realistic assessment of their conditions based on prior experiences, and personal decision to live their lives to the fullest despite the illness. Some activities were given up completely and replaced with more easily tolerated activities (e.g., swimming instead of softball). Adolescents also explored ways to continually engage in desired activities in spite of the asthma by modifying either the pace or intensity of the activities (e.g., jogging instead of sprinting), as well as adjusting self-expectations. Despite having asthma, most participants expressed efforts to stay active and engage in desired activities through adaptation.</p> |
|  |   |  |  | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>Children/adolescents with asthma experience more difficulties when participating in PA compared with their healthy peers, more anxiety about having asthma attacks, and insufficient energy to complete school activities, especially PA.</p>  |

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| Texas, USA                                | children from the general population.  | 2 without (n=13) asthma aged 13-17 years)  | and other). Audiotaped interviews, transcribed verbatim and thematic content analyses guided by themes from interview guide followed by grounded theory analysis.   | N.A. | N.A. | N.A. | N.A. | Children/adolescents with asthma exerted great effort to try to be "normal" and "to be just like everyone else". Experience of "discomfort" during sport more attributable to emotional or social discomfort.  |
| de Borba et al. 2009<br>Sao Paulo, Brazil | To understand the meaning the asthmatic child and his/her family attribute to the disease and the school implications. | Three children, a nine-year-old girl (serious asthma and chronic bronchitis), and two boys, one with nine (bronchospasm crisis from 1 years of age) and the other with ten years of age (serious asthma, chronic rhinitis, and atopic dermatitis), and their family members. | Qualitative case study that aims for a broad understanding of an organization or community, emphasizing the interpretation in context, and portraying reality in all its manifestations. Data were collected through participant observation, interviews, and therapeutic play. Each case analysis was separately accomplished and allowed the main axes and relationships that comprise the asthmatic child's social world to be identified: the relationships with the family; the relationships established in their healthcare providing institutions; the school relationships and their expectations and dreams concerning the treatment, the disease cure, and their future accomplishments. | N.A. | N.A. | N.A. | N.A. | <p>Three cases representing different issues influencing participation in PA.</p> <p><b>Milton case:</b> "At this school, he will have physical education classes three times a week. At home, he just stays in and plays the videogame. I wonder if he can practice sports; though, I wonder if his crisis won't be worse if he does, or if they'll be more frequent, because he constantly complains about a shortage of breath. [...] he is also afraid of having a shortage of breath, followed by a crisis" (Milton's mother).</p> <p><b>Marco Antônio case:</b> Given the stigma of a "sick" child that is attributed to him by his classmates, Marco Antônio created his own way in this social environment: because he is not able to rely on his classmates when needing help, when they ask him for help, he denies that to them. He used to receive the school teachers' support, for they knew about the asthma situation through the boy's father and complimented his performance and behavior, because he used to "do his homework, be a good student, behave himself, differently from the other students, and do well on the exams". The teacher used to even modify the type of game they played so that he could participate without having a crisis interrupting the game. After two years, in the end of the data collection, Marco Antônio presents now a better health, being able to practice several sport modalities, with no physical limitations, which has been changing his relationship with classmates and facilitating his acceptance in the group. "I played volleyball for a while, then basketball, now I play soccer twice a week. [...] I'm doing good at school, have</p> |



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| <p>Fereday et al. 2009</p> <p>South Australia</p>    | <p>To discover:</p> <ul style="list-style-type: none"> <li>• How South Australian children living with asthma, type 1 diabetes or cystic fibrosis describe their experiences and perceptions of physical activity, exercise, sport and play.</li> <li>• How these children view physical activity's barriers and enablers.</li> <li>• The perceptions of parents of children living with asthma, type 1 diabetes or cystic fibrosis about their children's participation in physical activity, exercise, sport and play.</li> </ul> | <p>Stage 1: Twenty-five children with diabetes type 1 (n=14), asthma or chronic respiratory illness (n=6) and cystic fibrosis (n=5). Twenty-five parents of children were also interviewed.</p> <p>The children's ages ranged from 4–16 years old with an average age of 9.5 years</p> <p>Stage 2: 12 students aged 5-12 years (8 with asthma, 2 with diabetes type 1 and 2 with other chronic disease)</p> | <p>Interpretive phenomenology; Stage 1: Focus group interviews, drawing maps (mapping), taking photos and designing 'traffic light' posters (photo-voice). Interviews were transcribed verbatim, read and coded, followed by clustering in themes sorted by common themes for all diagnose groups and specific themes for each diagnose group. Data sets were created for all participants linking data from interview, maps and posters with parent interview. Discussion and debate in the research group.</p> <p>Stage 2: Focus groups, recorded, transcribed and coded. Themes were then compared to the data and analysis from stage 1.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p><i>friends among my classmates, including the rowdy ones, and play with everybody."</i></p> <p><b>Gabriela case:</b> Having serious asthma, with frequent crisis, and countless restrictions, seems not to have interfered in Gabriela's school and sports' activities. The girl shows preference to the Olympic gymnastics school where she is enrolled now and expresses, in several moments, that she likes it a lot and aims to, one day, get a golden medal for it. Such conquest is, for Gabriela, a very important future accomplishment, and the effort she can make in order to reach it is unlimited.</p>   |
| <p>Protudjer et al. 2009</p> <p>Manitoba, Canada</p> | <p>To better understand how children with asthma develop strategies to</p>  | <p>Eleven girls and eleven boys (11 years old) with asthma (Canadian Asthma Consensus Guidelines) from the Manitoba Birth</p>   | <p>Semi-structured in-depth interview framed by an interview guide about living with asthma and compare that to healthy peers.</p>   | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>Participation in a wide range of PA (organized and play in school and home). Chronic disease does not hinder participation in PA.</p> <ul style="list-style-type: none"> <li>• Strong positive beliefs: Children may participate in anything (PA) that their peers did.</li> <li>• Parent believes they will do anything to enable this to happen.</li> </ul> <p>Being included but with reports of being treated differently than peers. Running, cold weather and allergy to grass could induce problems. Choosing to participate in sport where they may avoid these situations. Not wanting publicity while reporting a special friend of support.</p> <p>Parents "playing a juggling game a bit more" to help children with involvement in PA. Plan ahead bringing their 'puffer', subtle management to choose sports requiring less running and comprehensive practical support. Driven by desire to let their child be as normal as possible and being normal was participating in sports.</p> |

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| Walders-Abramson et al. 2009<br>Denver, Colorado, USA | <p>normalize their lives.</p> <p>(1) Do children with asthma have lower levels of objectively measured physical activity compared to otherwise healthy controls at baseline? (2) Will children with asthma demonstrate a smaller response to a brief, pedometer based activity intervention compared to controls? (3) What are the psychosocial, demographic, and physiologic</p> | <p>Cohort (n=723, 34% with asthma)</p> <p>A wide range of annual household incomes (\$30,000 to &gt;\$80,000 Canadian [CAD]), and parental education levels (less than high school to postsecondary/university) were represented. 11 of 16 families who reported their household income were in a high-income bracket (&gt;\$80,000 CAD), and 15 of 17 families who reported educational attainment had either postsecondary or university training.</p> | <p>Average interviews were 29 min (15 to 60 min) in duration. Transcripts were analyzed using thematic coding. Initial identification of patterns of interest (normalcy lens) culminating in reporting meaning of themes. Line by line was coded with an inductive approach then codes were developed and explored for the whole data set. Themes were then reviewed for consistencies with the relevant data and then clearly defined and named. Findings were related to research questions and existing literature, repeatedly looking for alternate explanations. Significance criteria determined by Patton (2002); consistency and coherence that evidence support findings, enhance and broaden understanding and usefulness of findings.</p> | <p>PA measured by pedometer (Omon Pedometer Model HJ-112<sup>®</sup>) recorded for 7 days pre- and post-intervention.</p> | <p><b>1. Psychosocial</b><br/><b>Psychosocial Correlates of Physical Activity</b><br/><b>interview - parent and child psychosocial correlates composite score;</b> (Saunders et al 1997; Mott et al 2000)</p> | <p><b>1. Psychosocial</b><br/>No group differences were found in physical activity attitudes, self-efficacy, or social support for physical activity between cases and controls. Youth with asthma had lower health belief scores (mean (SD) 72.9 (9.5), reflecting less positive health attitudes, compared to controls (mean (SD) 76.9 (9.1)). Despite this difference, health belief score did not relate to activity levels at baseline, follow-up or the change score (data not shown). Additionally, both groups demonstrated comparable psychosocial correlate</p> | <p><b>1. Psychosocial</b><br/><i>Psychosocial Correlates of Physical Activity Interview;</i> (Saunders et al 1997; Mott et al 2000) with strong psychometric properties and extensive previous use in literature. Mott et al 2000; Dishman et al 2002; Sallis et al, 2000)<br/><br/>One parent from each family and the identified child were asked to respond to a set of items using Likert-type scales, with interviews lasting approximately 45 min. A sample item included asking the youth to respond to the following question along a five-point Likert-type scale of how much they agree with the statement: "I can be physically active during my free time on most days."<br/><br/><b>Reliability</b><br/>A parent and child psychosocial correlates composite score was</p> | <p>Minimizing impact of asthma through a different focus, and main problems mentioned as being different<br/>Emphasizing abilities and minimizing differences compared with peers, downplaying impact of asthma.<br/><br/>Stressing normality stating that asthma does not limit things, even removing the asthma label entirely as a historical assessment in their life, and they have thereby nothing that prevents them from being physically active, also choosing not to use medications.<br/><br/>Emphasizing abilities by focus in skills (recreational and academic) advanced for their age, and helping others out with a goal to integrate in target group.<br/><br/>Adaptation in daily living : identifying interference with PA, low focus on prohibitions of PA and perceiving PA as a source of pleasure and camaraderie, sometimes substituting their current sport with another activity.<br/><br/>Adaption includes minimizing symptoms by use of medications despite the visible sign of disease through inhalers – alternating the associated costs.</p> |
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| Cheng et al. 2010<br>Chongqing, China | To investigate the current status of children with asthma taking part in exercise in China.                                      | Most families (66.1%) reported a total income of less than \$50,000.  | Case-control study   | Participation in PA; frequency and duration of PA. (days per week and minutes per day). | <p><u>1. Psychosocial</u></p> <p><b>The pediatric asthma quality-of-life questionnaire</b> (PAQLQ, Juniper et al, 1996)</p> <p><b>Questionnaire for children with asthma:</b></p> <p>Views about the relationship between asthma and exercise</p> <p>Parents' and teachers' attitudes towards asthmatic children taking part in sports and whether these adults had restricted children's exercise.</p> <p>Doctors' attitudes towards asthmatic children exercising and whether they had discussed physical activity with the children.</p> | <p><u>1. Psychosocial</u></p> <p>In children with asthma: Children with low PA (&lt;3 days per week or &lt;20min per day) significantly more frequently reported belief that exercise will make asthma worse and parents' and teachers' restriction of exercise and significantly less frequently reported that doctors approved them to participate in sports.</p> <p>Children with asthma and low PA reported significantly lower PAQLQ total scores and symptoms and emotional function domains compared with those with high PA.</p> | <p>composite scores, and these scores were not related to change in activity level.</p> | <p>generated to compile responses across domains of health beliefs, activity attitudes, self-efficacy, and social support for physical activity. Cronbach's <math>\alpha</math> for all measures ranged between 0.70 and 0.87 in the present study.</p>  | N.A. |
| Shaw 2010<br>Arizona, USA             | To explore the predominant categories and concepts involved with perceptions of exercise among school aged children with asthma. | Ten children (5 males, 5 females) with asthma aged 8-12 years.<br><br>Family income ranged from less than twenty thousand per year, up to greater than sixty thousand per year. | Grounded theory.<br>Theoretical sampling; interview of new participants and/or follow up interviews and observations of initial interviews. Unstructured and semi-structured interviews, building rapport encouraging play and drawing to ease storytelling process and gain credible data. Interview until saturation of themes. Interviews were tape-recorded and transcribed. Analysis according to Corbin & Strauss; | N.A.  | N.A.  | N.A.   | N.A.  | <p>Ongoing creation of perception of exercise in children with asthma are interwoven and influenced by:</p> <ul style="list-style-type: none"> <li>• Perceived benefits; fun, friends, health.</li> <li>• Striving for normalcy: keeping private, planning, continuing (adjusting, modifying, quitting, pausing).</li> <li>• Exercise interpersonal influences; parental (beliefs passed down to children), PE teachers (learning about PA), and health care providers (provides advice).</li> </ul> |      |

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| <p>Spencei-<br/>Cavalliere<br/>&amp;<br/>Watkinson<br/>2010<br/>Alberta<br/>and<br/>Manitoba,<br/>Canada</p>  | <p>To explore the perspectives of children with disabilities regarding the concept of inclusion in physical activity.</p>   | <p>Two girls, nine boys between 8-12 years with disabilities (cerebral palsy, fine and gross motor coordination disorder, muscular dystrophy, nemaline myopathy, brachial plexus injury and severe asthma (1 participant – extracted data related to 1 participant, 9 years of age).</p>   | <p>deconstructing in search of predominant concepts – beginning coding, comparative analysis, open coding, theoretical integration and theory refinement.</p> | <p>N.A.</p> | <p>Purposeful sampling with maximum variation, individual semi-structured interviews and reflective filed notes written immediately after interviews. Interviews were transcribed verbatim and analyzed according to Patton (2002). Initial tagging of 455 pieces of data, line-by-line analysis to group word, sentences and paragraphs until saturation was reached.</p>   | <p>N.A.</p>   |
| <p>Stevens et al. 2010<br/>USA</p>  | <p>To examine the relationship between medical home quality and daily life experiences among children with asthma.</p>  | <p>National Survey of Children's Health (2007), 6357 respondents with one child &lt;18 years (6-17 years, mean 11.6) with current asthma (57719 without asthma).<br/><br/>55% vs. 63% had a poverty status ≥200% of federal poverty level, 54% vs. 69% had a household member employed 50+ weeks per year and 92% vs. 90% of parents had a high school graduate or higher in children with vs. without asthma, respectively.</p> | <p>After School Activity<br/>Days past week exercise/sport/PA for 20+ min including sweat/breathe hard; participation last year in sports (yes/no).</p>       | <p>N.A.</p> | <p>1. Psychosocial<br/><b>Medical Home Total Score</b> (perceived, including five features; access, continuity, comprehensiveness, family-centered care and coordination of care.<br/><br/><b>Neighborhood environment;</b> availability of parks/playgrounds and recreation or community center; neighborhood safety (Likert scale of 2 items including safety of school and safety of community).</p>  | <p>1. Psychosocial<br/>Medical Home Total Score was associated with days last week in exercise/sports/PA (β 0.10 (0.01, 0.19)) but not with sports participation last year. The features of access (β=0.08 (C95%CI 0.03, 0.13)) and family-centered care (β=0.10 (C95%CI 0.04, 0.16)) were associated with days in exercise/sports/PA while access (OR 1.09 (95%CI 1.02, 1.16)) and coordination (OR 0.93 (95%CI 0.88, 0.98)) were associated with participation in sports last year.<br/><br/>Availability of parks/playgrounds and recreation/community center were not associated with days of exercise or participation in sports last year.<br/><br/>Safety of</p> |
| <p>Asthma influences; symptoms (numerous individual descriptions), triggers (identification of several irritants; exercise as one), tolerated activity level (individualized; related to duration and intensity of activity; creates modification of activity).</p> | <p>Gaining entry to play – feeling included; being invited and letting try out.<br/><br/>Feeling like a legitimate participant – feeling in a position to contribute.<br/><br/>Having friends – making you feel included in sports and games.</p> | <p>N.A.</p>  | <p>N.A.</p>   | <p>N.A.</p> | <p>1. Psychosocial<br/>Medical Home Total Score based on American Academy of Pediatrics seven features previously used (Bethell et al, 2004, Shi et al, 2004, Stevens et al, 2009).<br/><br/>Each question were assigned a score of 0-12 (12 correspond to the best score).<br/><br/>Factor analysis of Medical Home Total Score, indicating 4 features. 5 features still created.<br/><br/>Summary score of each feature divided on all non-missing questions.<br/><br/>Total score as average of the averages.<br/><br/>Neighborhood environment; no further information provided.</p> | <p>N.A.</p>   |

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| <p>Williams et al. 2010<br/>Tayside, Scotland</p> | <p>To explore the reasons for low physical activity levels among children with asthma and to identify strategies to improve activity.</p> <p>To explore the ways in which children's, parents', and school staff's beliefs about asthma and exercise influenced the child's willingness to engage in physical activity, in order to identify effective</p> | <p>Thirty children (15 males, 15 females) with asthma (moderate or severe according to British Thoracic Society definitions) aged 6-14 years and 38 parents of those children, 10 physical education teachers, seven primary teachers, 3 guidance teachers, 2 school nurses, 2 activity coordinators, 2 head teachers and deputy head teachers participated in the study.</p> | <p>Purposive sampling to increase heterogeneity of factors known to influence activity. Individual interviews of children followed by individual interview of parents. Drawings and games were used to build rapport with younger children. Topic guide based on theory with broad prompts to explore beliefs and knowledge about asthma, symptom perception, experience of treatment and attitude towards exercise. Modified guide for parents' interview. Children's interview lasted from 20 min to 1.5 hours and parents' interview lasted from 1 to 1.5 hours. School staff was interviewed in focus groups</p> | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p>school/community was associated with days of exercise (<math>\beta=0.28</math> (C95%CI 0.07, 0.50)) and participation in sports last year (OR 1.64 (C95%CI 1.37, 1.98))</p> <p><u>2. Socioeconomic</u></p> <p>No further information provided.</p>                 | <p>Beliefs about capability, safety and motivation most strongly influenced the child's willingness to participate in PA, and their parents' willingness to support it. Medical advice was used to explain and justify reduced participation in PA, and to stress that asthma should not prevent the child from engaging in PA.</p> <p><i>Capability</i> – belief that asthma places an actual physical limit on the intensity and duration, connected with interpretation of physical signals such as breathlessness as the sign of the limits.</p> <p><i>Safety</i> – exercise is a threat to be managed rather than something beneficial. Voiced particularly by older children and girls. Based on personal experience combined with medical information received, connected with beliefs of triggers (environmental and behavioral). Overexertion was the most common behavioral trigger, and girls were more likely to scale down activity.</p> |             |
|   |  |   |  | <p>N.A.</p> | <p>N.A.</p> | <p>N.A.</p> | <p><u>2. Socioeconomic</u></p> <p><b>Poverty status</b> (<math>\geq 200\%</math> of federal poverty level).</p> <p><b>Parent education</b> (high school graduate vs. less than high school).</p> <p><b>Parent employment</b> (worked at least 50 weeks last year)</p> | <p>school/community was associated with days of exercise (<math>\beta=0.28</math> (C95%CI 0.07, 0.50)) and participation in sports last year (OR 1.64 (C95%CI 1.37, 1.98))</p> <p><u>2. Socioeconomic</u></p> <p>Poverty status (OR 3.11 (2.39, 4.03)), employment 50+ weeks last year (OR 2.67 (95%CI 1.89, 3.78)), and high school graduate (OR 2.87 (95%CI 1.95, 4.29)) were associated with participation in sports last year.</p> <p>Poverty status was not, while employment 50+ weeks last year (<math>\beta=0.47</math> (95%CI 0.04, 0.90)), and high school graduate (<math>\beta=0.59</math> (0.08, 1.09)) were associated with days past week in exercise/sport/PA.</p>  | <p>N.A.</p> |

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| Correia et al. 2012<br>Recife, Brasil | To compare PA levels in asthmatic adolescents with and without EIB and the influence of mothers' beliefs of asthma worsening due to PA and attitudes in restraining their children's PA, asthma severity, severe EIB, or bronchospasm perception. | Recruitment through an allergy clinic where participants had their disease and severity classified.<br>134 adolescents with asthma aged 10-19 years, 82 with intermittent/mild asthma and 52 with moderate/severe asthma classified according to Global Initiative for Asthma.<br>31 with EIB and FEV <sub>1</sub> decrease >20%, 31 with =10 to <20% decrease in FEV <sub>1</sub> post exercise. | consisting of 5-8 participants and which lasted for 1 hour. Transcripts (10 at first) were analyzed with constant comparative analysis; first assigned initial categories and codes (familiarization), second categories were compared within and across transcripts, third categories and concepts were cross linked to generate new meaning through creation of charts, and finally new concepts were linked to produce new interpretation (mapping and interpretation). Analysis was assisted by NVivo software. Data collection and initial analysis occurred simultaneously, and continued until saturation; that is until additional data did not add to the developing theory. | Short version of <b>International Physical Activity Questionnaire (IPAQ)</b> . (Craig et al 2003) Include PA performed for at least 10 continuous minutes at any day on the previous week and its intensity. Participants classified as active if they reported PA >150 min/week and 30 min/day more than 5 days/week | <b>1. Psychosocial</b><br>Athletic competence and self-worth domains of the <b>Self-Perception Profile for Children</b> (Harter, 1982)<br>Mothers' anxiety levels with the <b>Hospital Anxiety and Depression Scale</b> (Botega et al 1995)<br><b>Attitudes and Beliefs towards PA</b> (Lang et al, 2004)<br>Additional questions towards mothers whether they could identify asthma or wheezing during or after PA and if they imposed restrictions. | <b>1. Psychosocial</b><br>46 (34,4%) reported that their mothers actively advised against PA – not associated with level of PA.<br>There was a significantly stronger sense of self-competence in the athletic domain of the Self-Perception Profile for Children who were inactive compared with active adolescents (mean score 15,5 vs. 14,0) but no difference in the self-worth domain.<br>97% of mothers believed that exercise is important, 78% believed that adolescent with asthma cannot participate in PA as much as their healthy peers, and 44% that | <b>1. Psychosocial</b><br>No further information given. | N.A. | Many believed their general practitioner supported PA with less intensity and a minority (n=7) did attempt to increase duration and intensity by using inhalers and rest periods.<br><br><i>Motivation</i> – using asthma as an excuse (teachers' opinion which was reported to be more common in girls and in secondary school). Children were motivated by personal and social benefits rather than health. Fun, community, belonging, acceptance and enhanced self-esteem were motivating but undermined by perceived triggers. |
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| Protudjer et al. 2012<br>Winnipeg, Manitoba, Canada | To gain insight into youths' perceptions of screen time and physical activity by asthma status.  | Twenty-two participants aged 15–16 years with (6 boys, 6 girls) and without (6 boys, 4 girls) asthma. Participants with asthma had asthma severity ranging from mild to moderate to severe based on methacholine challenges.   | Purposive sampling. Semi-structured focus groups consisting of 2–4 participants (n=18) and individual interviews (n=4) lasting from 32–90 minutes. Focus groups included only boys or only girls with the presence or absence of asthma.<br><br>Constant comparative method rooted in a pragmatic worldview; problem-centered approach oriented on real-world practice which allows for the expansion of data, recognizing multiple realities rather than single connections in the data. Data collection and analysis continued until constructs were deemed to be saturated (constructs ceased to be identified with subsequent interviews or focus groups). | N.A. | N.A. | exercise can be harmful. Those beliefs were not associated with level of PA in adolescents. | N.A. | Common to youth with and without asthma:<br><ul style="list-style-type: none"><li>• Sports are an integral part of youths' lives; (a) help you keep focused, (b) striving to improve in the chosen sport, (c) activity is a stress release and (d) choice of sport is a matter of interest.</li><li>• Screen time is important to youth; (a) much leisure time is screen time, (b) screen time is a source of communication and (c) a source of entertainment.</li></ul> Theme unique to youth with asthma:<br><ul style="list-style-type: none"><li>• PA used to be more difficult</li><li>• Being active and living with asthma: (a) asthma is not an excuse and (b) asthma can still get in the way.</li></ul> Control the disease enough to be socially accepted and selection of sports demanding less aerobic capacity. |
| Westergren & Lilleaas 2012<br>Norway                | To understand the gendered practices of male asthmatic adolescents in terms of living with and managing their chronic disease. To discover how participants interpreted their social worlds to create a sense of meaning in their everyday lives. To identify the gender-related practices of participants and | Five male participants aged between 13 and 15 years diagnosed with asthma during early childhood, who used inhalation medications for symptom management and disease control, and staying in a specialist center for asthmatic children and youths participating in a 4 week training/education/treatment program. | A combined ethnology (Bourdieu) and grounded theory design (Strauss & Corbin).<br><br>Semi-structured multistage focus group interviews (Hummelvoll) with 2 interview sessions within 24 hours. The first interview (43 minutes) focused on how the participants lived and coped with their disease, and the second interview (51 minutes) focused on their future expectations as 25-year-old men.<br><br>A grounded theory   | N.A. | N.A. |   | N.A. | PA supported participants' aim of being men and non-asthmatic, as well as supported their treatment goals.<br><br>Physical activity is concerned with being strong, satisfied with physical achievements and identifying with sporting models.  |

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| Basso et al. 2013<br>Sao Carlos, Brazil. | To determine whether the quality of life of adolescents with asthma correlates with parameters obtained prior to and after the six-minute step test (6MST); spirometric results after the 6MST; and level of physical activity.   | Recruitment through active community surveillance. 19 (15 boys) adolescents with asthma between 11 and 15 yrs. Asthma: clinical and/or spirometric diagnosis, confirmed with pre- and post-bronchodilator. Clinically stable, and with no other disease preventing them from proposed tests. All mild intermittent to mild persistent asthma according to criteria from GINA (2007).   | approach was used during the analysis.<br><br>Cross-sectional study | The short version of the <b>International Physical Activity Questionnaire</b> (IPAQ, Portuguese Brazilian version; Matsudo et al 2001)<br><br>7 open questions which provide information to estimate weekly time spent in different activities (duration and frequency of moderate to vigorous activities and in walking). Participants are classified as sedentary, insufficiently active, active or very active. | <b>1. Psychosocial</b><br><b>The pediatric asthma quality-of-life questionnaire</b> (PAQLQ, La Scala et al, 2005) | <b>1. Psychosocial</b><br>Weekly time spent in walking correlated significantly with symptom domain of PAQLQ (0.45). Weekly time spent in VPA (0.50) and total weekly time in PA (0.51) with the activity limitation domain of PAQLQ. | <b>1. Psychosocial</b><br>PAQLQ: 23 items in three domains (symptoms – 10 items, activity limitation – 5 items, emotional function – 8 items). Children report how they feel the previous week in a 7-point scale ranging from extremely bothered (1) to not bothered at all (7). Scores for each domain are summed and total score by summing the individual domain scores. | N.A. |
| Dantas et al. 2014<br>Pernambuco, Brazil | To investigate whether mothers try to impose limitations on the physical activity (PA) of their asthmatic children/adolescents; identify associated factors; and explore if this attitude has any impact on children's PA levels. | Recruitment among children previously diagnosed with asthma and referred to the Pulmonary Function Laboratory to investigate EIB. 115 pairs of mothers and their offspring. Children were 13.06 years (mean) and 67 were males. 70 (61%) had intermittent or mild persistent and 45 (39%) had moderate to severe asthma. Asthma severity classified according to GINA (2009). Of the 115 mothers, 10% were illiterate, 63% had | Cross-sectional study   | <b>International Physical Activity Questionnaire</b> (IPAQ, children) translated into Portuguese and validated in Brazil (Guedes et al 2005)<br><br>Participants divided in 2 groups: active (very active or active) and inactive (irregularly active  | <b>1. Psychosocial</b><br><b>Questionnaire towards mothers regarding PA prevention.</b>                           | <b>1. Psychosocial</b><br>37% of mothers impose restrictions on their children's PA which were not associated with level of PA in children.   | <b>1. Psychosocial</b><br><i>Questionnaire towards mothers regarding PA prevention:</i> "Do you prevent your child from taking part in sports or games because of asthma in the period when he/she is not having an attack?"   | N.A. |



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| <p>Hamer 2014<br/>Chrischurch, New Zealand</p>        | <p>The aim of this study was to explore how male adolescents understand and manage their asthma symptoms.</p>                                  | <p>Recruitment initiated by contacting school-staff, followed by contacting students through school notices, school newsletters, posters, social media, and e-mailing. Snowball sampling of participants who spoke English, attended high school (12-19 years old), and lived in Christchurch, New Zealand. Fifteen male participants experiencing asthmatic symptoms, which had affected their life within the last years, aged 12-17 years from three different high schools with students from higher socioeconomic communities.</p> | <p>A qualitative descriptive study design was selected to investigate the experiences of male adolescents, focusing on their perceptions of societal and masculine influences on their asthma management. Individual semi-structured interviews (ranging from 7-20 minutes) were undertaken to capture data about their perceptions of masculinity, asthma management, interpersonal relationships, and their physical wellbeing.</p> <p>Interviews audiorecorded and transcribed verbatim.</p> <p>Thematic analysis with a semantic approach. Six analytical phases consisted of: 1) familiarising with the data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) producing the report.</p> | <p>N.A.</p>  | <p>N.A.</p>  | <p>N.A.</p>   | <p>N.A.</p>   | <p>To counteract feeling different, isolated and marginalized, participants maintain control, and seek normality in front of peers.</p> <p>The ideal male is sporty, healthy and nice with a good job or tall, athletic, strong, masculine, and tough.</p> <p>Sport provides opportunities to live a normal, independent and healthy life, and role models support that. Sport both gives a sense of belonging and increased self-esteem and allows isolation of the less athletic team members.</p> <p>Hence, participants toughen up and downplay asthma symptoms to avoid being different and soft, and maintain their desired identity of being independent, competitive, and strong.</p> |
| <p>Latorre-Roman et al. 2014<br/>Andalusia, Spain</p> | <p>The aim of this study is to test the psychometric properties of the Physical Activity Employment Scale (PACES) in children with asthma.</p> | <p>185 students (mean age 11.8) between 10-15 yrs, 107 with severe asthma diagnosed by an allergy specialist according to criteria from GINA (2005) and 78 healthy children with similar age and BMI.</p>   | <p>Case-control design</p>  | <p><b>Physical Activity Questionnaire for Children (PAQ-C)</b> (Kowalski et al, 1997; Spanish version Marfines-Gómez et al, 2009).<br/>Registers the PA completed in 7 days before</p> | <p><u>1. Psychosocial</u><br/><b>Physical Activity Employment Scale (PACES)</b> (Mott et al, 2001; Moreno et al, 2008)</p> | <p><u>1. Psychosocial</u><br/>Spearman's <math>r</math> coefficient between average PAQ-C and PACES was 0.378..</p> | <p><u>1. Psychosocial</u><br/>PACES: 16 items, preceded by the sentence "When I am active..." evaluating the enjoyment from the highest level to the lowest. Answers are given in a 5-point Likert scale.<br/>Factor analysis reveal 2 factors; PA enjoyment and PA boredom. Confirmatory factor analysis results show an acceptable goodness of fit confirming the factorial structure of the scale of enjoyment. Further, the scale</p> | <p>N.A.</p>   |

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| Teng et al. 2014<br>Taiwan            | To compare the amount of physical activity between asthmatic and non-asthmatic adolescents in Taiwan, as well as to investigate the influential factors associated with insufficient physical activity in asthmatic adolescents. | Purposeful sampling from eight junior high schools. 286 adolescents with asthma and 588 without between 12-16 years. Asthma: diagnosed by a physician at least 5 months before the study. Adolescents with and without asthma were not different in socio-economic status score. 38% of boys vs. 33% girls with asthma had low socio-economic status. Medium status was recorded in 46% vs. 60% and high status in 17% vs. 7% in boys vs. girls with asthma, respectively. | Cross-sectional population based study | administration. Cronbach's $\alpha$ in the present study of 0.726.  | <p><u>1. Psychosocial</u><br/><b>Family support</b> (Lee's social support for PA scale (2000)).</p> <p><u>2. Socioeconomic</u><br/><b>Five Social Classes</b> (Hollingshead &amp; Redlich, 1958) ranging from high (1) to low(5), divided into low (4 and 5, medium (3) and high (1 and 2) (Oguma et al 2002).</p> | <p><u>1. Psychosocial</u><br/>Adolescents with low family support were significantly more often inactive (&lt;300min MVPA/week, 45% vs. 17.1%) and were significantly less in MVPA compared with adolescents with high family support (504 (<math>\pm</math>514) min/week vs. 831 (<math>\pm</math>646) min/week).<br/>Adjusted OR of high family support (0.39 (95% CI 0.20, 0.74) versus low (1.0) for being in insufficient PA (&lt;300min MVPA/week).</p> <p><u>2. Socioeconomic</u><br/>No statistical significant association between level of PA and social class.</p> | <p>revealed convergent validity with PA.</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha</math> in the study was 0.907.</p> <p><u>1. Psychosocial</u><br/><i>Family support</i>; high score indicate stronger family support.<br/><b>Reliability</b><br/>Cronbach's <math>\alpha</math> 0.83 and test-retest reliability 0.89.<br/>Then classified into two groups by 50<sup>th</sup> percentile; below and above 50<sup>th</sup>.</p> <p><u>2. Socioeconomic</u><br/>Five social Classes; based on occupation and education. No further information given.</p> | N.A. |
| Tiggelman et al. 2014a<br>Netherlands | To test the direct associations between maternal sport-specific factors participation of early adolescents with asthma and the indirect effect through adolescent's sport-specific cognitions.                                   | Recruitment from 213 primary schools and 73 secondary schools, and magazine announcement. 261 families with one adolescent (mean age 11.9 years) diagnosed with asthma by a physician and who had used asthma medication at least once during the last 12 months and with adequate Dutch language skills. Mothers' educational level   | Cross-sectional population-based study | <b>Adolescent' Participation in Sport Clubs.</b> Adolescents could write down three sports in which they participated at a sport club and indicate the frequency with which they engaged in these activities weekly. To calculate | <p><u>1. Psychosocial</u><br/><b>Maternal Sport-Specific Support</b> (4 items from the Dutch Sport-Specific Parental Support Scale (Jurg et al 2005) and 2 items from Davison et al (2003)<br/><b>Maternal Beliefs About Offspring's Participation in Sport.</b> 12 items from</p>                                 | <p><u>1. Psychosocial</u><br/>Maternal sport specific support (<math>\beta=0.21</math>) and her self-efficacy (to stimulate sport participation in offspring) (<math>\beta=0.26</math>) accounted for 19.5% of the variance in adolescents sport participation.<br/>Adolescents' self-efficacy significantly mediated the effect of maternal self-efficacy on</p>   | <p><u>1. Psychosocial</u><br/><i>Maternal Sport-Specific Support</i>; (4 items from the Dutch Sport-Specific Parental Support Scale (Jurg et al 2005); (e.g. "How often do you watch your child participate in sports?") and 2 items from Davidson et al (2003) ("How often does your family use sport/physical activity as a form of familial recreation, e.g., going on bike rides together, hiking, ice skating?" and "How much do you use your own behavior to encourage your offspring to be physically active/ participate in sports?")</p>                     | N.A. |

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|  |  | <p>was lower (elementary, lower vocational: 10%), Intermediate (intermediate general, intermediate vocational: 40%), and higher (higher general, higher vocational, university: 50%).</p> |  | <p>adolescents' sport club participation, MET-scores, from the Compendium of Physical Activities (Ainsworth et al, 2011) for each sport, which were then multiplied by the frequency with which the adolescents participated in this sport.</p> | <p>the Attitude towards Sport Scale (Jurg et al 2005).<br/> <b>Maternal Beliefs About Own Participation in Sport.</b><br/> 13 items on the Beliefs about Sport Scale (Jurg et al 2005)<br/> <b>Maternal Physical Activity.</b> One item (Jurg et al 2005)<br/> <b>Maternal Self-Efficacy to Stimulate to Participate in Sport.</b> 7 items (Jurg et al 2005)<br/> <b>Adolescents' Self-Efficacy.</b> 8 items from the Self-Efficacy Scale (Jurg et al 2005)<br/> <b>Adolescent's Beliefs About Sport Participation.</b> 14 items from the Attitude towards Sport scale (Jurg et al 2005).</p> | <p>adolescent sport participation (indirect effect; <math>\beta=0.09</math>, <math>SE=3.01</math>), and when adolescents' self-efficacy (<math>\beta=0.28</math>) and beliefs (n.s.) were included, 25.2% of the variance in adolescent sport participation was explained.</p> | <p>Reports on a 5-point Likert scale ranging from never/almost never (1) to every day (5).<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> of the six items was 0.63.<br/> <b>Maternal Beliefs About Offspring's Participation in Sport.</b> 12 items from the Attitude towards Sport Scale (Jurg et al 2005). (e.g., "When your child participates in sports, he/she has fun with his/her friends"). Responses on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> 0.75.<br/> <b>Maternal Beliefs About Own Participation in Sport.</b> 13 items on the Beliefs about Sport Scale (Jurg et al 2005) (e.g., "When I participate in sports, I become stronger"), and answers were measured on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> 0.78<br/> <b>Maternal Physical Activity:</b> One item (Jurg et al 2005) ("I participate in physical activities like running, cycling (not in a sport club)" and one item assessed participation in sport clubs (i.e., "Do you participate in a sport club?") Mothers who neither participated in physical activity nor participated in sport clubs were categorized as non-active (0) and parents who were either active in daily life or in sport clubs were categorized as active (1).<br/> <b>Maternal Self-Efficacy to Stimulate to Participate in Sport.</b> 7 items (Jurg et al 2005) (e.g., "Do you find it easy or difficult to stimulate your child to participate in sports when you do not have much time?"). Responses measured on a 5-point Likert scale ranging from (1) very hard to (5) very</p> |
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| <p>Tiggelman et al. 2014b Netherlands</p> | <p>To examine whether habitual PA could predict changes in psychosocial outcomes (i.e., symptoms of anxiety and depression, quality of life (QOL) and stress) and asthma control over time in adolescents with asthma and whether gender moderated these relationships.</p> | <p>Recruitment from 213 primary schools and 73 secondary schools, and magazine announcement. Participants; Families with one adolescent (mean age 13.9 yrs.) diagnosed with asthma by a physician and who had used asthma medication at least once during the last 12 months and with adequate Dutch language skills. In 2012, 258 families (98.9%) with 265 adolescents participated and in 2013, 253 families (96.9%) participated with 260 adolescents.</p> | <p>Longitudinal population-based study</p> | <p>Adolescents reported up to five habitual activities (e.g. soccer, wii and school gym) in which they participated and the time spent engaging in that particular activity. Adolescents also reported whether they rode a bike or walked to school, the distance to school and the time it takes them to get to school from home.</p> | <p>1. Psychosocial<br/> <b>Hospital Anxiety and Depression Scale (HADS)</b>, Dutch version, Sigmund &amp; Snaith, 1983)<br/> <b>Adolescent Asthma Quality of Life Questionnaire (AAQOL)</b> (Rutishauser et al 2001; dutch version: Ven van de MOM et al 2007)<br/> <b>Perceived Stress Scale-10</b> (Dutch version, Cohen et al 1983)</p> | <p>1. Psychosocial<br/> Habitual PA was not correlated with any of the psychosocial variables.</p>  | <p>easy. Higher scores indicated higher levels of self-efficacy.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> 0.92<br/> <b>Adolescents' Self-Efficacy</b>, 8 items from the Self-Efficacy Scale (Jurg et al 2005) (e.g., "Do you find it difficult or easy to participate in sport when there is a nice program on television?") Responses measured on a 5-point Likert scale ranging from (1) very hard to (5) very easy.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> 0.78.<br/> <b>Adolescent's Beliefs About Sport Participation</b>, 14 items from the Attitude towards Sport scale (Jurg et al 2005). (e.g., "When I participate in sports, I have fun with my friends"). Responses were measured on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> 0.74.</p> | <p>N.A.</p> |
|   |   |  |  |  |  | <p>1. Psychosocial<br/> <b>HADS</b>; Dutch version, Sigmund &amp; Snaith, 1983) Symptoms of anxiety (e.g. I feel tense or wound up) and depression (e.g. I look forward with enjoyment to things) were assessed with seven items measured on a four-point scale, with higher scores indicating more symptoms. For this study, anxiety and depression were combined into one scale (Spinhoven et al 1997)<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> 0.76 (2012), and 0.74 (2013).<br/> AAQOL: developed uniquely for adolescents with asthma. 6 subscales: symptoms (six items, e.g. "How bothered have you been by wheezing?"; 2012 <math>\alpha</math>=0.87, 2013 <math>\alpha</math> =0.88); medication (five items, e.g. "How bothered or concerned have</p> |   |             |

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|   |   |   |   | <p>habitual activities, school transportation and instruments played) were given a MET-score based on the Compendium of Physical Activities (Ainsworth et al 2011), and these MET-scores were then multiplied by the minutes that the adolescents spent on participating in these activities every week. These scores were then summed to create a total PA score.</p> | <p>2. <u>Socioeconomic</u><br/><b>Self-reported level of caregiver education</b> (less than or greater than a high school degree and less than and greater than a Bachelor's degree).</p> | <p>2. <u>Socioeconomic</u><br/>Girls with asthma with caregiver education levels of bachelor's degree or more had significantly more daily pedometer steps (11355 vs. 9139, <math>p=0.02</math>) compared to girls with asthma with lower caregiver education than bachelor's degree. In terms of non-scheduled activity differences were marginally significant (8.08 vs. 5.92, <math>p=0.05</math>).</p> | <p>you been about taking medication for your asthma?" 2012 <math>\alpha =0.71</math>, 2013 <math>\alpha =0.76</math>); <b>physical activities</b> (six items, e.g. "How often did running make you cough or wheeze?" 2012 <math>\alpha =0.80</math>, 2013 <math>\alpha =0.83</math>); <b>emotions</b> (five items, e.g. "How often did you feel worried or concerned because of your asthma?" 2012 <math>\alpha =0.86</math>, 2013 <math>\alpha =0.85</math>); <b>social interaction</b> (five items, e.g. "How often did you feel worried or embarrassed when taking asthma medication in front of other people?" 2012 <math>\alpha =0.64</math>, 2013 <math>\alpha =0.61</math>); and <b>positive effects</b> (five items, e.g. "With regard to your asthma, how often have your friends been helpful and understanding?" 2012 <math>\alpha =0.78</math>, 2013 <math>\alpha =0.80</math>).</p> <p>Measured on a seven-point Likert scale from 1 to 7. An overall measure of QOL (total QOL; <math>\alpha =0.91</math>) was created without the positive effects domain because it could not be meaningfully added to the total score and without the symptom domain, because this domain had too much content overlap with asthma control.</p> <p><i>Perceived Stress Scale-10</i>; 10 items (e.g. In the last month, how often have you felt confident about your ability to handle your personal problems?) were measured on a five-point Likert scale ranging from 0 (never) to 4 (very often)</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha=0.82</math>.</p> |
| <p>Vangeepuram et al. 2014<br/>New York, California and Ohio, USA</p> | <p>To investigate the association between asthma diagnosis and physical activity and to examine differences in these associations by race/ethnicity, weight status and caregiver education.</p> | <p>1182 girls (399 from NY, 339 from Ohio, 444 from California) between 6-8 yrs. (mean 7.3)<br/><br/>Asthma diagnosis (16%) was assessed using the Brief Pediatric Asthma Screen (BPAS; Wolf et al, 2003) with a positive answer on 1 of 4 asthma questions and a report of physician diagnose of asthma.<br/><br/>One-third of all respondents reported highest level of</p> | <p>Cross-sectional population-based study</p> | <p>PA was assessed with a step counter diary (completed by girls from the California and New York sites; Yamax SW-200 Digi-walker pedometer)<br/>Average of pedometer steps per day for at least 4 days.<br/>Other activities; queried in diary for seven</p>  | <p>2. <u>Socioeconomic</u><br/><b>Self-reported level of caregiver education</b> (less than or greater than a high school degree and less than and greater than a Bachelor's degree).</p> | <p>No further information given.</p>   | <p>N.A.</p>  |

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| Latorre-Roman et al. 2015 Andalusia, Spain   | To analyze the effects of physical activity program on sport enjoyment, physical activity participation, physical self-concept, and quality of life in children with asthma.   | 105 students (mean age 11.53 years; 58 intervention group, 47 control group) with asthma. Asthma: diagnosed by a specialist in hospitals. Treated for at least 6 months and in a stable phase (no exacerbations last 6 months, no musculoskeletal problems or mental disabilities). Severity of disease assessed by criteria from GINA (2011). | Quasi-experimental study | <p>Physical Activity Questionnaire for Children (PAQ-C) (Kowalski, Crocker, &amp; Kowalski, 1997). Appropriate for school children (8-14 years old), registers the physical activity performed 7 days prior its administration.</p> | <p>1. Psychosocial<br/><b>Physical Activity Enjoyment Scale</b> (PACES) (Motl et al., 2001). Spanish version (Moreno, González-Cutre, Martínez, Nestor, &amp; López, 2008).</p> | <p>1. Psychosocial<br/>The increase of the enjoyment (mean 0.67 (SD 0.71) vs. 0.04 (SD 0.72)) positively correlates with increase in total PAQ-C (<math>r=0.383</math>), item 2 ("in the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping, throwing)?" (<math>r=0.258</math>) and item 3 ("in the last 7 days, what did you do</p> | <p>1. Psychosocial<br/><b>Physical Activity Enjoyment Scale</b>; (Motl et al., 2001). Spanish version (Moreno, González-Cutre, Martínez, Nestor, &amp; López, 2008). Consists of 16 items, preceded by the sentence "When I am active..." and evaluates the enjoyment from the highest level (e.g., "I enjoy," "It is very exciting," "I find it enjoyable") to the lowest (e.g. "I am bored," "I do not like it," "It frustrates me"). The answers were collected in a Likert scale whose punctuation ranks oscillate from 1 (totally disagree) to 5 (totally agree).</p> | N.A. |  |
| <p>caregiver education as high school or less, one-third as some college and one-third as a bachelor's degree or higher.</p> | <p>consecutive days. Parents were also asked questions about the girls' physical activities (questionnaire self-administered at the Cincinnati site and administered by an interviewer at the other sites). Standard questions for usual activities (hours per week and months per year), MET values assigned according to Ainsworth et al (2000) and converted to METhr per week of MVPA. Nonscheduled activities, active hours and hours spent weekly in physical education were also reported in the questionnaire. Time spent each day in sedentary activities was included.</p> | <p>No significant findings when using less than or greater than a high school degree as the cutoff for level of parent education.</p>  |                          |   |   |  |  |      |  |

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| Westergren et al. 2015<br>Oslo, Norway | To investigate if self-perceived competence, enjoyment, support from others and social-physical environment were associated with vigorous physical activity (VPA) and secondarily to assess if such associations were modified by asthma and asthma severity | Enrollment of 3754 children from a general urban population at birth.<br><br>One-hundred and seventy four adolescents (mean age 13.6 (12.8, 14.3), 95 (66 boys) with current asthma at 10 or 13-year inclusion and 79 (41 boys) without asthma. At 13-year inclusion, four adolescents without asthma from 10-year follow-up had current asthma. Asthma, the presence of at least two of the following three criteria: (a) dyspnea, chest tightness and/or wheezing, (b) doctors diagnosis of asthma and/or (c) use of asthma medication (β2-agonists, sodium cromoglycate, corticosteroids, leukotriene antagonists and/or aminophylline).<br><br>Current asthma: defined asthma (as above), plus at least one of the following three criteria fulfilled: (a) dyspnoea, chest tightness and/or wheezing in the last 12 months, (b) use of asthma medication (β2-agonists, sodium cromoglycate, corticosteroids, leukotriene antagonists and/or aminophylline) in the last 12 months and/or (c) a positive exercise-induced asthma test (conducted at | Nestled case-control study | Teenager version of Martínez-Gómez et al. (2009) translated into Spanish and updated from its children's version. Cronbach's alpha in this study was 0.726. | PA levels were recorded using the <b>SenseWear Pro2 Armband</b> and computed at one-minute intervals, randomly starting on a Wednesday or on a Sunday and including three week-days and one weekend-day PA data were adjusted for the mean hours each day the Armband was worn, to acquire 24-h units. Days were the Armband was worn less than 19.2 h (80%) were excluded from analysis. VPA was defined as PA above 6 Metabolic Equivalents (METs). Moderate physical activity (MPA) was defined as PA with cut of points between three and six METs.  | most of the time at intervention compared with baseline. | Reliability<br>Cronbach's alpha in this study was 0.907.   | N.A. |
|  |  |   |                            | 1. Psychosocial<br><b>Self-perceived personal, social and environmental factors</b> were assessed by a paper-based validated self-report questionnaire.     | 1. Psychosocial<br>No significant differences between adolescents with and without asthma were identified in terms of VPA, competence-enjoyment, support from others and social-physical environment. Peer support ( $\beta=0.29$ (95%CI 0.05, 0.52)) and competence-enjoyment ( $\beta=0.23$ (95%CI 0.01, 0.44)) were significantly and positively associated with VPA, and teacher support ( $\beta=-0.26$ (95%CI -0.50, -0.02)) were inversely associated. The model explained 25% of the variance in VPA.<br><br>There were no significant association between MPA and either factor included. |  | 1. Psychosocial<br><i>Self-perceived personal, social and environmental factors</i> were assessed by a paper-based validated self-report questionnaire (Ommundsen et al 2006; Ommundsen et al 2008; Bergh et al 2001) designed to capture theoretically derived relevant perceived personal, social and environmental factors shown to influence PA in children.<br><br>To test the construct validity for the instrument exploratory factor analysis with varimax rotation was conducted.<br><br>Cronbach's $\alpha$ was used to assess the internal reliability of the instrument.<br><br>In the parental practical support, teacher support and physical-social opportunity scales one item each with poor loading were removed to increase internal reliability.<br><br>Social support questions (emanated from Bandura's social cognitive theory); Response format 1—4; 1=never or hardly ever, 2=once or twice a week, 3=almost every day and 4=every day<br><br><i>Parental Practical support</i> (2 items; e.g. "How often does your mother or father take you to exercise or play sports?")<br><br><b>Reliability</b><br>Cronbach's $\alpha=0.59$<br><br><i>Parental Emotional support</i> (2 items; e.g. "How often does your mother or father encourage you to play, exercise or do sports?") |      |

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| Tiggelman et al. 2015 Netherlands | To examine whether baseline maternal and paternal beliefs, support and parenting were associated with changes in sport participation of adolescents with | Recruitment from 213 primary schools and 73 secondary schools, and magazine announcement. Participants: Families with one adolescent (mean age 13.9 years) diagnosed with asthma by a physician and who had used asthma | Population-based longitudinal study | Adolescents' sport participation was assessed using a self-report instrument enabling participants to report all physical activity | 1. Psychosocial<br><b>Maternal/paternal Sport-Specific Support</b> (4 items from the Dutch Sport-Specific Parental Support Scale (Jurg et al 2005) and 2 items from Davison et al | 1. Psychosocial<br>At baseline: Father's support ( $r=0.17$ ), father's general beliefs ( $r=0.27$ ), mother's general beliefs ( $r=0.29$ ), father's asthma specific beliefs ( $r=0.26$ ), mother's asthma specific beliefs ( $0.27$ ), father's | <p><b>Reliability</b><br/>Cronbach's <math>\alpha=0.68</math></p> <p><i>Peer support</i> (3 items; e.g. "How often do your friends exercise or play sports with you?")</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha= 0.82</math></p> <p><i>Teacher support</i> (2 items; e.g. "How often does your teacher talk about exercise in lessons?")</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha= 0.60</math></p> <p>Competence, enjoyment (emanated from Harter's competence motivation theory) and environment questions; response format 1–5; 1=does not suit for me, 5=suits for me.</p> <p><i>Competence-enjoyment</i> (5 items; e.g. "I wish I could play more games and sports than I get chance to.")</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha= 0.73</math></p> <p><i>Safe environment</i> (4 items; e.g. "It is safe to walk or play alone in my neighborhood during the day.")</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha= 0.75</math></p> <p><i>Physical-social opportunity</i> (2 items; e.g. "There are other children nearby home to go out and play with.")</p> <p><b>Reliability</b><br/>Cronbach's <math>\alpha=0.48</math></p> | N.A. |
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| <p>asthma, and investigate the moderating effect of sex.</p> | <p>medication at least once during the last 12 months and with adequate Dutch language skills. In 2012, 257 families with adolescents participated and in 2013, 253 families (151 male adolescents, 102 female adolescents) participated.</p> | <p>in which they usually participated during the week. Adolescents could report up to five physical activities (as free text) and the minutes/week of they participated in the activity. Only PA aimed at maintaining or improving physical fitness and skills were included and were assigned MET-scores (Ainsworth et al 2011). These MET-scores were then multiplied by the duration of participation in hours (METhr). Scores were summed to obtain a measure of total sport participation.</p> | <p>(2003)<br/> <b>Maternal/paternal general beliefs about their child's sport participation</b> 13 items of the Attitude towards Sports Scale (Jurg et al 2005)<br/> <b>Maternal/paternal asthma-specific beliefs about their child's sport participation</b> 7 items (Lang et al 2004).<br/> <b>Maternal/paternal self-efficacy to encourage child's sport participation</b> 7 items (Jurg et al 2005)</p> | <p>self-efficacy (<math>r=0.36</math>) and mother's self-efficacy (<math>r=0.27</math>) correlated significantly with adolescents sports participation.<br/> At 1-year follow up:<br/> Father's support (<math>r=0.15</math>), father's general beliefs (<math>r=0.19</math>), mother's general beliefs (<math>r=0.18</math>), father's asthma specific beliefs (<math>r=0.19</math>), mother's asthma specific beliefs (<math>r=0.26</math>), father's self-efficacy (<math>r=0.21</math>), mother's self-efficacy (<math>r=0.21</math>) and sports participation at baseline (<math>r=0.44</math>) correlated significantly with adolescents sports participation<br/> Path analyses for fathers (model fit indices: CFI=0.912; RMSEA=0.171) showed that none of the sport-specific parenting variables predicted changes in adolescent sport participation over time, except asthma specific beliefs which significantly predicted change in girls' participation from baseline to follow-up (<math>\beta=0.25</math>). For mothers (CFI=0.932; RMSEA=0.153), positive asthma-specific beliefs (<math>\beta=0.22</math> for total group and <math>\beta=0.21</math> for males and <math>\beta=0.36</math> for females) about sport participation significantly predicted an increase in sport participation of adolescents with asthma over time. Multi-group analyses showed that the set of predictors were similar across gender.</p> | <p>form of familial recreation, e.g., going on bike rides together, hiking, ice skating?" and "How much do you use your own behavior to encourage your offspring to be physically active/participate in sports?"<br/> Reports on a 5-point Likert scale ranging from never/almost never (1) to every day (5).<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha</math> of the six items was 0.84 for mothers and 0.89 for fathers.<br/> <b>Maternal/paternal general beliefs about their child's sport participation</b>; 13 items of the Attitude towards Sports Scale (Jurg et al 2005) (e.g. When your child participates in sports, he/she has fun with his/her friends). Responses given on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree. An average was calculated with higher scores representing more positive beliefs.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.80</math> (mothers) <math>=0.76</math> (fathers).<br/> <b>Maternal/paternal asthma-specific beliefs about their child's sport participation</b>; 7 items (e.g. When your child participates in sports, his/her asthma gets worse) (Lang et al 2004). Items measured on a 5-point Likert scale ranging from (1) I do not agree at all to (5) I completely agree; an average across the seven items was calculated.<br/> <b>Reliability</b><br/> Cronbach's <math>\alpha=0.75</math> (mothers) <math>=0.70</math> (fathers).<br/> <b>Maternal/paternal self-efficacy to encourage child's sport participation</b>; 7 items (e.g. Do you find it easy or difficult to encourage your child to participate in sports when you do not have much time?) (Jurg et al 2005) measured on a 5-point Likert scale ranging from (1) very hard to (5) very easy. An average was taken with</p> |
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**Active play exercise intervention in children with asthma: a PILOT STUDY.**

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# BMJ Open Active play exercise intervention in children with asthma: a PILOT STUDY

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## ABSTRACT

**Objective:** Increased physical activity (PA) may be beneficial for children with asthma. Knowledge about how to intervene and encourage children with asthma to be physically active is required. In the present study, we aimed to pilot a 6-week exercise intervention designed as active play and examine attendance rate, exercise intensity and children's perceptions of participating.

**Methods:** 6 children with asthma (4 boys, 2 girls) aged 10–12 years, participated in 60 min of active play exercise twice weekly. A mixed-methods design was applied. The data analysed included attendance rate, exercise intensity assessed by heart rate (HR) monitoring during exercise sessions, registration and description of the active play exercise programme, 3 semistructured focus groups, field observations of 5 exercise sessions, and preintervention and postintervention testing.

**Findings:** The average attendance rate was 90%. Intensity  $\geq 80\%$  of maximal HR ( $HR_{max}$ ) was recorded for a median (IQR) time of 22 (8) out of 60 min per session. Median (IQR) HR during the sessions was 146 (9; 74% of  $HR_{max}$ ) bpm. Children reported increased health-related quality of life (HRQoL) post-test compared with baseline. Children enjoyed participating and reported no limitations by asthma or serious asthma attacks. Instead, they perceived that their asthma and fitness had improved after the programme. The instructors created an inclusive atmosphere that was characterised by easy-to-master games, fair competition, humour and mutual participation.

**Conclusions:** The exercise intervention pilot focusing on active play had a high attendance rate, relatively high exercise intensity, and satisfaction; the children perceived that their fitness and asthma had improved, and reported increased HRQoL. A randomised controlled trial of active play exercise including children with asthma should be conducted to evaluate effect on PA level, physical fitness, asthma control and HRQoL.

## INTRODUCTION

Children with asthma, particularly those who are newly diagnosed and/or have poor disease control, may be less physically active than healthy children.<sup>1</sup> Physical activity (PA)

## Strengths and limitations of this study

- To our knowledge, this study is the first of its kind with a mixed-methods design combining attendance rate and exercise intensity with a qualitative in-depth exploration of children's perceptions and interactions.
- The active play exercise sessions are described comprehensively, and relations with measurements and children's perceptions are outlined and discussed.
- In-depth information about crucial elements of designing a randomised controlled trial of active play exercise in children with asthma is offered.
- The study has a limited number of participants, and we may not generalise about the effectiveness of the intervention.
- Participating children with asthma may not be representative of other children participating in future interventions.

is recommended for children with asthma,<sup>2 3</sup> and a physically active lifestyle is feasible when the disease is controlled by the optimal use of asthma medication.<sup>4</sup> Increased PA is associated with enhanced psychological functioning and quality of life, improved cardio-respiratory fitness, and decreased morbidity.<sup>2 5</sup> If untreated, up to 90% of children with asthma will experience symptoms of asthma during vigorous PA, a condition called exercise-induced bronchoconstriction (EIB).<sup>6</sup> Increasing physical fitness may be beneficial for children with asthma by increasing exercise tolerance and capacity and, as a consequence, the threshold for inducing EIB.<sup>7</sup>

Physical fitness level may increase after exercise intervention in children with asthma.<sup>2 3</sup> Improvements in maximal oxygen uptake ( $VO_{2max}$ ) of up to 20% have been reported.<sup>8</sup> However, the reports of exercise interventions vary methodologically in terms of asthma severity in the study group, and the mode, intensity, frequency and duration of exercise.<sup>9</sup> The reports of these interventions often lack details about the exercise



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programme, including the structure, types of exercise and description of the intensity level.<sup>10–12</sup> General information about adherence and whether the children enjoyed taking part in the intervention are often reported insufficiently.<sup>8 10 13–15</sup> Only one intervention has included children's opinions of the exercise programme and whether they enjoyed taking part,<sup>11</sup> and no reports a comprehensive qualitative exploration in combination with physical measurements.

Children with asthma may experience frustration because of the limitations imposed by their disease, and they wish to have peer support and young role models to enhance their ability to participate in regular PA and to live a normal life.<sup>16</sup> Previous research suggests that the interpretation of normal breathlessness during exercise as being dangerous asthma symptoms may prevent children from being physically active.<sup>17</sup>

Active play is considered as an opportunity for increased PA in children through gross locomotor movement that are engaging and amusing.<sup>18</sup> Knowledge on how active play exercise could be implemented in an intervention targeting children with asthma is, however, needed. In the present study, we aimed to pilot a 6-week exercise intervention designed as active play for children with asthma. We quantitatively measured the exercise intensity and attendance rate, recorded cardiorespiratory fitness and health-related quality of life (HRQoL) pre-intervention and postintervention, and qualitatively explored children's perceptions of participating.

## METHODS AND PARTICIPANTS

### Study design

The study had a convergent parallel mixed-methods design.<sup>19</sup> We used systematic text condensation<sup>20</sup> to analyse the outcomes of semistructured focus groups and field observations in relation to calculations of the attendance rate records, measures of exercise intensity during the exercise sessions, and registration and description of the active play exercise programme. The Regional Committee for Medical Research Ethics in South East Norway approved the protocol (2013/1274). Written informed consent was obtained from guardians of all participating children, and accommodated written and oral information was offered to the participants.

### Participants

Participants were recruited through a Norwegian regional hospital's outpatient clinic at a regular follow-up consultation between July and October 2013. The inclusion criteria, with reference to asthma diagnosis criteria of Global Initiative for Asthma including a history of variable respiratory symptoms and confirmed variable expiratory airflow limitation<sup>21</sup> were: (1) age 10–12 years; (2) a diagnosis of asthma; (3) use of asthma medication ( $\beta_2$ -agonists, corticosteroids, leukotriene antagonists, and/or combination formulation of long acting  $\beta_2$ -agonists and corticosteroids) during the past

month; (4) dyspnoea, chest tightness and/or wheezing during the past month; and (5) reversible airflow limitation measured during the past year as measured by a 10% increase in forced expiratory volume in 1 s (FEV<sub>1</sub>) 15 min after inhalation of 0.2 mg salbutamol per 10 kg body mass (maximum 0.8 mg).

A total of 23 children returned for the follow-up consultation. Ten children did not meet the inclusion criteria for asthma, and five children did not want to participate in the intervention. Reasons for declining were not registered. Eight children (6 boys and 2 girls) were included in the study. Two children (boys) withdrew before the test procedures started without report of motives.

## Methods

### Anthropometrics and lung function

The children's body mass (Seca 713, Birmingham, UK) and height (stadiometer) were recorded. Overweight was adjusted for age and gender and defined according to Cole *et al.*<sup>22</sup> Lung function was determined by measuring FEV<sub>1</sub>. The predicted values of Zapletal *et al.*<sup>23</sup> were used for comparison. The response to inhaled salbutamol (VentolinDiskus, Glaxo Smith Kline Inc, Ontario, Canada) was measured. A  $\geq 10\%$  increase in FEV<sub>1</sub> 20 min after inhalation of salbutamol compared with baseline value was defined as a reversible airflow limitation.<sup>24</sup>

### Cardiorespiratory fitness

Cardiorespiratory fitness was assessed by measuring VO<sub>2max</sub> during maximal treadmill running (Woodway ELG55, Weil am Rhein, Germany) according to the method of Berntsen *et al.*<sup>25</sup> starting at 5 km/h (5.3% inclination). After 5 min running, speed increased with 2 km/h and thereafter 1 km/h each minute until 11 km/h. Thereafter, inclination of the treadmill raised 1% each minute until exhaustion. Minute ventilation (V<sub>E</sub>), respiratory exchange ratio and oxygen consumption (VO<sub>2</sub>) were measured using an oxygen analyser (Oxycon, Jaeger (BeNeLux Bv, Breda, the Netherlands). The highest VO<sub>2</sub> maintained during the last minute was defined as VO<sub>2max</sub>. The highest measured heart rate (HR; Polar S610i, Polar Electro OY, Kempele, Finland) was defined as HR<sub>max</sub>.

### Quality of life and asthma control

HRQoL was recorded using the Paediatric Asthma Quality of Life Questionnaire (PAQLQ) developed by Juniper *et al.*<sup>26</sup> The questionnaire comprises 23 items divided into three domains: activity limitation, symptoms and emotional function. All items use a seven-point Likert response scale, where 1=extremely bothered and 7=not bothered. Asthma control was recorded using the Asthma Control Questionnaire (ACQ) developed by Juniper *et al.*<sup>27 28</sup> The interviewer-administered form of the questionnaires was used. A total ACQ score  $>1.5$  (cut-off point) was defined as having not well-controlled

asthma.<sup>27</sup> Both questionnaires were administered to the participating children only.

### Physical activity

Habitual PA was recorded using the SenseWear Pro mini Armband activity monitor (BodyMedia Inc, Pittsburgh, Pennsylvania, USA) according to the method of Berntsen *et al*,<sup>25</sup> and energy expenditure were computed at 1 min intervals. The children received the monitor after their visit to the laboratory and were instructed to wear the monitor continuously for the following 7 days, except during water activity. The cut-off point for defining moderate-to-vigorous-intensity PA (MVPA) was three metabolic equivalents.

### The active play intervention pilot

The 1 h guided active play sessions took place twice weekly for 6 weeks from October to December 2013. Active play exercises were designed and directed by experienced sport instructors from the University of

Agder. The training location was an indoor gym (300 m<sup>2</sup>) at a secondary school in Kristiansand, Norway. The children were instructed to use  $\beta_2$ -agonists as recommended by the doctor before sessions and, if needed, during the sessions. Equipment used in the active play programme were soft balls, Swiss balls, cones, beanbags, balloons, small mats, gymnastic mats, jumping ropes, vaulting boxes, benches and 'paintball bunkers'. Each session started with a 10–15 min warm-up, including various ball games and games of 'tag'. The main session (30–35 min) included more endurance-type activities such as team games, relays and tag. The last 5–10 min were a cool-down, during which the children played low-intensity games or relaxed by listening to music while sitting or lying on a mat. Descriptions of the exercises used in the programme are given in [table 1](#).

To record exercise intensity, the children wore a HR monitor (Polar S610i, Polar Electro OY, Kempele, Finland) during each session. Three instructors were present at every training session—one instructor to

**Table 1** Description of elements in the active play exercise

|                             | Exercise           | Description   |
|-----------------------------|--------------------|---|
| Warm-up<br>(10–15 min)      | Frozen tag         | With variations on how to be 'unfrozen' (eg, crawl between legs, perform 10 squats)   |
|                             | 10 ball            | There are two teams. Each team makes 10 passes without losing the ball. The other team tries to get the ball  |
|                             | Tail tag           | A 'tail' (small rope) is attached to each child's pants. Each child tries to grab the tail from the other participants  |
|                             | Chip and Dale      | Two persons (Chip and Dale) sit back to back. When Chip is called, she/he must run a certain distance with Dale in chase, and vice versa  |
|                             | Cleaning up        | 'Garbage' (15 beanbags) is placed on each side of a 'fence'. Two teams. Each team 'cleans' up by throwing as much 'garbage' as possible over the fence to the other team. Time: 30 s  |
| Main section<br>(35–40 min) | Naval battle       | Two teams (ships) on each side of the room. Area between is 'water' with a 'canon' (Swiss ball). Each team throws soft balls to try to push the 'canon' on to the other team's 'ship'.  |
|                             | Tarzan tag         | All kinds of equipment (benches, mats, 'paint ball bunkers', hula hoops) are spread around the room. One tagger chases the others, and the children must avoid being tagged by moving between equipment without touching the floor  |
|                             | Bus relay          | One child is the 'driver' who runs around in the room with a long rope, picking up 'passengers' who hold onto the rope and run with the driver  |
|                             | Deck of card relay | Two teams. Each team collects spades, hearts, diamonds, or clubs, and must perform various 'penalty loops' when they get the wrong card   |
|                             | Team game          | Two teams. Different stations (10 jumps on a bench, crawling on the floor, 10 high jumps on a gymnastic mat, jumping ropes) in a circuit. On the last station, pieces from a puzzle or monopoly money are collected. The team that completes the puzzle or gets the most money first wins |
|                             | Flipping cones     | Two teams. 30 cones are spread around the room. One team runs and puts up cones and the other team turns them over. Time: 30 s  |
|                             | Hunting beanbags   | Two teams; five beanbags in each corner of the room. Each team has to 'protect' the beanbags in two corners, while at the same time taking beanbags from the other team   |
|                             | Gym mat relay      | Two teams. Relay with gymnastic mats to be pushed, rolled over, or lifted a certain distance  |
|                             | Obstacle relay     | Two teams. An obstacle course with 'obstacles' to jump over, crawl under, balance on, etc   |
|                             | Station relay      | Stations: jumping rope, squat jumps on a gymnastic mat, stepping on a bench, etc  |
| Cool-down<br>(5–10 min)     | Untie the knot     | Children stand in a circle holding hands and walk over/under arms and legs to make a 'knot'. One subject 'unties'.  |
|                             | Relaxation         | Lying on a mat listening to quiet music   |
|                             | Shoe relay         | A pile of children's shoes lie in the middle of the room. Two teams. Each child must find their own shoes, tie them, and run back to the starting position  |
|                             | Waking up          | Lights out. Individuals lie on mats. One calmly wakes the other individuals up  |



organise the exercises and the other two instructors to participate in the sessions and encourage the children.

### Focus group interviews

To promote reflection and openness, all six participants were involved in three focus groups<sup>29</sup> conducted at the beginning of the 6-week exercise intervention pilot stage and after 3 and 5 weeks. The groups were moderated by the same researcher. The interview guide comprised questions about the participants' experiences and behaviours in relation to asthma, habitual PA and the intervention. All interviews were audiotaped and transcribed verbatim in Norwegian. Translation to English was done only in quotations reported in the manuscript.

### Field observations

Field observations focused on the aerobic fitness testing and five exercise sessions observed during the intervention. The first author, whose previous experience includes paediatric nursing and volunteering as an exercise instructor at a local sports club, conducted all observations and moderated all focus groups. The objective of the observations was to observe the children's interaction with their peers, parents and instructors. The aspects of their interaction and discussions that might influence their exercise were explored,<sup>30</sup> including for example, their level of participation in different activities, symptom expressions, expressions about activities and individuals attending, or references from different social contexts.

During the field observations, the researcher assumed an 'observer-participant'<sup>30</sup> role by participating in the activities to make the participants comfortable with his presence. The researcher did not interfere with the instructions, and observed sessions included different warm-ups, main endurance parts and cool-down activities to represent the variety between sessions. To minimise interference, field notes including analytical notes, memos and the journal of fieldwork were written immediately after the sessions.<sup>30</sup> Observed behaviours and interactions were considered and discussed during the focus groups, and issues identified during the groups influenced the focus of subsequent observations.

### Analysis of data

Quantitative data were calculated by median and/or range due to the limited number of participants, and further statistical analysis was not conducted.

Analysis of qualitative data from focus groups and field notes from observations was performed continuously throughout the study. Data were imported into the software *QSR International NVivo V10* and analysed according to the method of Malterud.<sup>20</sup> First, the text was read as a whole while identifying emerging themes. Second, meaning units were identified and coded close to the participants' own experiences and descriptions. Meaning units were then condensed and regrouped more distant to the participants' own words concerning the underlying

meaning, context, comparison between meaning units and symbols, and concealed motivations and interests of the participants. Finally, the condensed meaning units were synthesised into the following three main categories: 'interaction towards independence and normality', 'being different and being limited by asthma', and 'a new context of independence and normality'.

## FINDINGS

### Baseline and postintervention records

The baseline characteristics of the included participants are described in [table 2](#). All children were classified as having well-controlled asthma. The total PAQLQ score was recorded with a range between 5.0 and 6.9, which means that the children experienced some degree of impairment ranging from a 'little bothered' to 'not bothered at all' on to the seven-point Likert scale ranging from 'extremely bothered' (=1) to 'not bothered at all' (=7) in the questionnaire. The domains of activity limitation (range 4.2–7.0), symptoms (range 4.7–6.9) and emotion function (range 5.4–7.0) also showed a small-to-moderate degree of impairment because of asthma, which ranged from 'quite bothered' to 'not bothered at all'. Participating girls reported the two lowest values in all three domains. One child was classified as overweight. The children reported asthma symptoms in relation to infections, cold air, pollen and exhaustion, and two children reported that asthma restricted their PA level.  $VO_{2max}$  ranged from 24.7 to 56.7 mL/kg/min. Four of six children (all boys) participated in MVPA above the recommended 60 min/day

**Table 2** Baseline characteristics of participants (n=6)

|  |                    |
|--|--------------------|
| Boys*, n   | 4                  |
| Age (year), median (min, max)                          | 10.5 (10, 12)      |
| FEV <sub>1</sub> (% of predicted) †, median (min, max) | 78 (74, 87)        |
| PAQLQ‡, median (min, max)                              | 6.3 (5.0, 6.9)     |
| Activity scale, median (min, max)                      | 6.1 (4.2, 7.0)     |
| Symptoms scale, median (min, max)                      | 5.8 (4.7, 6.9)     |
| Emotion scale, median (min, max)                       | 6.8 (5.4, 7.0)     |
| ACQ§, median (min, max)                                | 0.7 (0.4, 1.0)     |
| Use of ICS, n  | 5                  |
| Daily, regular use of $\beta_2$ -agonists, n           | 6                  |
| Overweight, n  | 1                  |
| MVPA (min/day), median (min, max)                      | 68.6 (46.2, 125.2) |
| $VO_{2max}$ (mL/kg/min), median (min, max)             | 48.7 (24.7, 56.7)  |

\*With reference to girls.

†Missing data in one participant.

‡Possible score between 0 (severe impairments of asthma) and 7 (no impairments).

§Possible score between 0 (totally controlled) and 6 (extremely poorly controlled), missing data for one participant.

ACQ, Asthma Control Questionnaire; FEV<sub>1</sub>, forced expiratory volume in 1 s; ICS, inhaled corticosteroids; max, maximum; min, minimum; MVPA, moderate-to-vigorous intensity physical activity; n, number; PAQLQ, Paediatric Asthma Quality Of Life Questionnaire;  $VO_{2max}$ , maximal oxygen uptake in mL/kg/min.



(range 64–125). The two girls participated in MVPA for 46 and 56 min/day, respectively.

Five children increased, and one maintained, their PAQLQ score postintervention testing ranging from 5.9 to 6.9. Three children (both girls) increased with  $\geq 0.5$  which is the established clinical Minimal Important Difference (MID) of PAQLQ.<sup>26</sup> Girls increased their score  $\geq 1.0$  in the activity and emotion domains, and one boy increased his score in the activity (+0.6) and symptom (+0.8) domain. Additionally, one boy increased his symptom domain with 0.6 but did not achieve a total MID  $\geq 0.5$  because of a non-MID decrease in the emotion domain.

Three children, similar to those increasing their HRQoL above MID, increased their  $VO_{2max}$  and post-test ranged from 31.6 to 57.9 mL/kg/min.

### The intervention pilot—attendance and HR

The attendance rate during the intervention pilot was 90%. Two children completed all 12 sessions. One child missed three sessions, one child missed two sessions, and two children missed one session each. Exercise intensity  $\geq 80\%$  of  $HR_{max}$  was recorded for a median (IQR) time of 22 (8) out of 60 min/session (table 3). Median (IQR) HR during the sessions was 146 (9) bpm, which was equivalent to 74% of  $HR_{max}$  (table 4). The median (IQR)  $HR_{max}$  during active play was 198 (12) bpm (table 3). The active play exercises with the highest median intensity were the endurance-based and interval-based activities ‘flipping cones’, ‘10 ball’, ‘breaking balloons’, ‘naval battle’, ‘obstacle relay’, ‘bus relay’, ‘gymnastic mat relay’, ‘hunting beanbags’ and ‘Tarzan tag’ (descriptions in table 1). These exercises were included mainly in training sessions 2, 3 and 4 (table 3). The median (IQR) intensity in these sessions was 152 (19), 151 (6) and 151 (31; 76% of  $HR_{max}$ ) bpm, respectively (table 4).

### Interaction towards independence and normality

The main theme describing the participants’ experiences of everyday life and participation in the 6-week intervention pilot was ‘interaction towards independence and normality’. They did not want their friends to care about their asthma.

They (my friends) say I can start ahead of them...I just say, no thanks. (girl, 11 years)

In the interviews, all participants reported performing a variety of leisure activities including climbing, soccer, handball, swimming, track and field, jujitsu, dancing, choir, singing lessons, and Boy Scouts. Afternoon time was described as being busy, filled with school homework and leisure activities with meals in between.

### Being different and being limited by asthma

Participants described their everyday life as being limited by asthma. Their asthma restricted their

Table 3  $HR_{max}$  registrations and minutes per session at intensity  $\geq 80\%$  of  $HR_{max}$

| Participant number | $HR_{max}$ (TR) | $HR_{max}$ (TS) | Active play sessions |         |         |         |         |         |         |         |         |         |        |         | Total |
|--------------------|-----------------|-----------------|----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|---------|-------|
|                    |                 |                 | 1                    | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11     | 12      |       |
| 1                  | 212             | 208             | 14 (26)              | 22 (37) | —       | —       | 16 (30) | 12 (21) | 17 (30) | 9 (21)  | 18 (36) | 18 (30) | —      | —       | 17    |
| 2                  | 197             | 194             | 11 (17)              | 25 (42) | 24 (40) | —       | 22 (36) | 21 (32) | —       | 26 (43) | 25 (42) | —       | —      | 29 (48) | 25    |
| 3                  | 218             | 220             | 13 (24)              | 27 (45) | 16 (30) | 11 (19) | 15 (26) | 8 (19)  | 18 (36) | —       | 17 (28) | —       | —      | 18 (33) | 16    |
| 4                  | 199             | 198             | 12 (20)              | 35 (58) | 31 (52) | 32 (53) | 21 (35) | 19 (32) | 19 (32) | 22 (37) | 29 (48) | 26 (43) | 8 (28) | 22 (37) | 22    |
| 5                  | 197             | 197             | 5 (9)                | 29 (48) | 24 (44) | 24 (40) | 21 (35) | 16 (28) | 10 (37) | 22 (37) | 14 (24) | —       | —      | 26 (43) | 21    |
| 6                  | 187             | 196             | —                    | —       | —       | —       | 23 (43) | 29 (48) | 24 (40) | 15 (25) | 28 (47) | —       | —      | 21 (36) | 23    |
| Median             | 198             | 198             | 12                   | 27      | 24      | 24      | 21      | 18      | 18      | 22      | 22      | 22      | 22     | 22      | 22    |
| IQR                | 19              | 16              | 6                    | 9       | 11      | 21      | 7       | 12      | 8       | 12      | 12      | 8       | 8      | 12      | 8     |

Missing values because of equipment error or non-attendance. HR, heart rate;  $HR_{max}$ , maximal heart rate (bpm); TR, treadmill running; TS, training sessions.

**Table 4** Median HR for each participant and median (IQR) HR for all children at each session

| Participant number | Active play sessions |          |         |          |         |          |          |         |         |         |         |         |
|--------------------|----------------------|----------|---------|----------|---------|----------|----------|---------|---------|---------|---------|---------|
|                    | 1                    | 2        | 3       | 4        | 5       | 6        | 7        | 8       | 9       | 10      | 11      | 12      |
| 1                  | 139                  | 152      | –       | –        | 151     | 139      | 146      | 137     | 150     | 148     | –       | –       |
| 2                  | 115                  | 140      | 148     | –        | 148     | 143      | –        | 147     | 146     | –       | 149     | –       |
| 3                  | 138                  | 164      | 158     | 174      | 156     | 169      | 165      | –       | 148     | –       | 152     | –       |
| 4                  | 132                  | 157      | 151     | 151      | 148     | 146      | 145      | 143     | 150     | 146     | 146     | 140     |
| 5                  | 127                  | 143      | 150     | 143      | 146     | 137      | 143      | 141     | 139     | –       | 148     | 147     |
| 6                  | –                    | –        | –       | –        | 141     | 155      | 144      | 139     | 146     | –       | 146     | 147     |
| Median (IQR)       | 132 (18)             | 152 (19) | 151 (8) | 151 (31) | 148 (8) | 145 (20) | 145 (12) | 141 (7) | 147 (6) | 147 (2) | 148 (5) | 147 (7) |

Missing values because of equipment error or non-attendance.  
HR, heart rate.

participation in PA because they became rapidly exhausted. One of the participants said:

...I always have to stop...to...breathe... (girl, 10 years)

Asthma was described as the reason for not attending physical education classes and as something that causes pain in the chest and heart. According to the participants, having asthma and using medications were associated with unwanted attention. The children described how parents alternated between a minimum focus on asthma and medication and then challenging their independence:

Occasionally she (mother) somewhat disagrees...if I say it went well (managing medications and symptoms), she suddenly says 'no, it might have gone badly,' even if it went well. (boy, 12 years)

### The intervention pilot—a new context of independence and normality

During field observations, the exercise intervention pilot appeared as an instructor-defined context of intense PA in which having asthma was considered normal. Parents were asked to leave the training facilities during sessions, and participants appreciated being acknowledged as competent:

They (the instructors) want us to be really good. (boy, 12 years)

Despite observed wheeze and occasional asthma symptoms during the exercise sessions, participants did not report exercise limitations. Instead, they reported satisfaction and even improvements in their asthma.

...you get better lungs...at least I can feel it...I just feel that I have good fitness. (boy, 12 years)

Several of the participants perceived that they could run faster. When they felt exhausted, this was interpreted as normal and not caused by asthma. The children enjoyed the activities, even though they considered

them intense. They all stated that participating in the project had been fun and increased their effort:

It is easier for me to push myself when it is fun. (girl, 11 years)

The boys were especially enthusiastic about the different ball games such as 10 ball, dodgeball and naval battle. Tarzan tag and the various obstacle courses (table 1) were also reported as fun.

During observations, the children seemed to be inspired by the competitions and adult instructors who joined in:

I think it is fun when they are, when we are playing naval battle, they (instructors) are competing... (boy, 10 years)

They described the instructors as encouraging and kind. The participants also considered that the instructors' use of humour was a way to make the situation harmless and on the children's terms:

...encouraging if we are doing wrong, and joking a lot. (boy, 12 years)

During competitive activities, the children were grouped by the instructors to create balanced teams. The instructors tried to include every child, and the participants increased their efforts when running near the adult instructors:

When (name of the instructor) says; come on, you can do it...then I manage... (boy, 10 years)

By contrast, we observed decreased enjoyment when one of the teams lost repeatedly or when balls were thrown too hard, and some of the children became afraid of being hit.

Field observations revealed how interactions between participants during the exercise sessions were mainly about creating responses of acceptance of each other through joking, cheering and bonding. Instructors paid little or no attention to negative statements or lack of contribution.

## DISCUSSION

The children enjoyed participating without reporting limitations by asthma or serious asthma attacks, and they perceived that their asthma and fitness had improved. Attendance at exercise sessions was 90% and there were no drop-out. Exercise intensity was relatively high with a median time of 22 min at  $\geq 80\%$  of  $HR_{max}$  and a median HR during the entire sessions of 74% of  $HR_{max}$ . Highest intensity was recorded during endurance-based and interval-based activities. Children reported increased HRQoL post-test compared with baseline. Children appreciated being acknowledged as competent, and the intervention was placed within a context in which having asthma was considered normal. The instructors ensured that the activities were of high intensity and provided satisfaction while including games that were easy to master; they ensured fair competition and used humour, and also participated in the games.

Previously published exercise interventions for children with asthma have described various exercise modes, of which swimming,<sup>8 14 31</sup> running<sup>13 32</sup> and cycling<sup>15 33 34</sup> were used most frequently. None of these studies reported whether the children enjoyed taking part in these interventions or which interactions the children found most enjoyable. The mixed-methods design of the present study, however, enabled such reports.

We may assume that reported satisfaction and enjoyment motivated participants to exercise at a high intensity and contributed to the high attendance rate and zero drop-out during the intervention period. To our knowledge, only one study has reported on children's perspectives on exercise interventions; that study reported the children's perception of an increased ability to handle their asthma during exercise.<sup>11</sup> Unfortunately, the types of exercise and adherence were not reported.

The rates of attendance and drop-out during an intervention may give an indication of the children's motivation to take part and their preference for the modes of exercise. In interventions for children with asthma, drop-out rates of 22% in a 6-week individualised training on cycle ergometer<sup>34</sup> and 13% in a 4-month running programme<sup>32</sup> have been reported. Far lower drop-out rates were reported in a 3-month programme of regular group exercises with different activities in a gymnasium and home exercise (4%)<sup>11</sup> and in an 8-week basketball training intervention (3%).<sup>10</sup> The latter two studies were group based, which we assume included mutual support between participants. Peer support has been shown to be associated with level of vigorous PA regardless of asthma.<sup>35</sup> However, the reasons for dropping out were not described in any of the studies.

In the present study, we found a high attendance rate (90%) throughout the intervention. Graff-Lonnevig *et al*<sup>12</sup> reported a similar attendance rate in their controlled active play intervention. Their training group comprised children living close to the training location,

which might have influenced attendance. In our study, the small study sample may have contributed to a stronger sense of commitment to attend the sessions than if the intervention had included a larger study sample. By contrast, Fitch *et al*<sup>36</sup> found an attendance rate of 68% in their intervention of running exercise for a relatively small study sample of 10 children. However, children with asthma may perceive running exercise as having different interactions and enjoyment compared with indoor play-based exercise, as used by Graff-Lonnevig *et al*<sup>12</sup> and the present study.

According to a recent systematic review of exercise training for children with asthma, intensity rather than the mode of endurance-based activity is one of the most important factors for improving physical fitness after an exercise intervention.<sup>3</sup> The reports from the children in the present study indicate that active play and enjoyment may be essential to increasing the effort and thereby intensity. In children without asthma, exercise at the anaerobic threshold or at an intensity  $>80\%$  of  $HR_{max}$  induces greater improvements in physical fitness compared with lower intensity exercise.<sup>37</sup>

In the present study, the children exercised at a HR  $\geq 80\%$  of  $HR_{max}$  for a median time of 22 min. The overall intensity level during each session might have been lower because of the less active periods needed to organise the games and activities, including fitting and adjusting the HR monitors. Physical fitness improved in three of the children, and the baseline fitness levels in the three who did not improve were relatively high. The limited number of participants precludes us from drawing statistical conclusions. Nevertheless, qualitative data from the present study support an interpretation of increased perceived ability to manage intensive PA, either by enhanced perceived competence or increased perception of fitness.

The importance of feeling normal and competent for children with asthma and of children's adjustment to social norms is well documented.<sup>16 38</sup> Our study shows that instructors can create enjoyable, intense exercise programmes with high participation rates by focusing on the children's normality and independence, and by creating and defining the social norms within the group. One may suggest that these aspects of the instructor role and the exercise intervention are as important as the practical organisation including scheduling and leading and designing exercises. These findings are supported by studies suggesting that motivation and engagement in exercise are dependent on leadership; the supporting structure; and the basic psychological need for autonomy, relatedness and competence.<sup>39</sup> Our intervention design of active play-based exercise seemed to enhance enjoyment and mastery, and worked together with the instructors' deliberate creation of fair competition and emphasis on mastery, enjoyment, fellowship and treating the participants as competent. The findings of the limitations induced by asthma away from the intervention scene and the participants' desire to be normal despite



having asthma may reflect the interaction and experiences within the intervention. The instructors' deliberate emphasis on treating the participants as normal competent children may thus have appeared to these children with asthma as encouraging them to exercise and enjoy the programme despite the obvious presence of asthma.

Physical limitations may arise from physiological barriers caused by disease<sup>1 4 40</sup> or by poor psychological adjustment to the disease.<sup>5</sup> The present qualitative findings support the idea that physical limitations in addition depend on the situation and may change with the social context. Children and adolescents with asthma may experience frustration, embarrassment and low self-confidence because of their disease-related limitations.<sup>16 41</sup> They may also withdraw from PA because of their parents' fear and protectiveness.<sup>17</sup> Participants in the present study seemed to overcome those barriers and limitations, and the parents also supported their children's independence by being absent during intervention sessions. The participant's reports of perceived improvements in fitness, well-being and asthma symptoms highlight the benefits of creating different social situations and norms for interventions with children with asthma. Moreover, the girls' increase in HRQoL and VO<sub>2max</sub>, particularly, support the possibility for change through intervention in girls who, with increased age, are reported to engage in less PA initiated and organised by themselves,<sup>42</sup> and have a decreased HRQoL compared with boys.<sup>43</sup>

The present intervention may be perceived as resource demanding. However; PA is associated with several positive outcomes in asthma,<sup>2 5</sup> and may possibly save indirect costs raised by morbidity and mortality and direct healthcare expenditures which range between 1% and 2% of total healthcare costs in developed countries.<sup>44</sup>

### Strengths and limitations

The main strengths of the present study are the mixed-methods design including the exploration of children's perceptions and the objective measurements of each child's intensity level during sessions using HR monitors. No children dropped out during the intervention, and the attendance rate of 90% indicated strong adherence to the programme. We aimed to explore specific themes in depth and were able to return to these themes repeatedly during the study by triangulating those data with the physical records. In qualitative research, the researcher as interviewer, observer and analyser relates and interacts with the research field and the participants.<sup>30</sup> Qualitative empirical work is considered as interpretative and thus may not always be generalisable, but the information may be transferable through the interpretations of the reader.<sup>45</sup> We made an effort to enhance reflexivity during the analysis and interpretation of whether the findings relate to the data, and we have ensured that no extraordinary or unusual reports

from participants were used to over-rule the issues noted repeatedly by participants.

The main limitation was the small study sample, which comprised only six children. A small exercise group made it more challenging to design feasible active play exercises of high intensity, especially when one or more children were absent during sessions. Three instructors were present at each session (2 participating actively), which might have influenced the children's participation level to a greater extent than if there had been larger groups. In addition, children in the present study reported that they enjoyed PA and had well-controlled asthma, a relatively high PA level, and physical fitness similar to that of children without asthma.<sup>25</sup> These children's views of the intervention and the active play exercises may not be representative of children with less experience with PA or with more severe asthma. However, the findings may be relevant to health practice by providing an understanding of how physical limitations and activity may be changeable and how exercise interventions may be designed to maximise enjoyment and exercise intensity for children with asthma.

### CONCLUSIONS

The exercise intervention pilot focusing on active play had a high attendance rate, relatively high exercise intensity, and satisfaction; the children perceived that their fitness and asthma had improved, and reported increased HRQoL. A randomised controlled trial of active play exercise including children with asthma should be conducted to evaluate effect on PA level, physical fitness, asthma control and HRQoL.

Additional implications for clinical practice may be to more consciously create social situations in which children and adolescents with asthma are treated by the health or exercise instructors as competent and normal young people who are motivated to exercise because of the enjoyment and sense of mastery and fellowship.

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**Contributors** All authors contributed in the design of the study, and in writing, critically revising and finally approving the manuscript. Furthermore; TW contributed with collection and data analysis of qualitative data; LF contributed with analysis and interpretation of qualitative data; TN contributed with conducting exercise sessions, and collecting and analysing quantitative data; KH contributed with analysis of quantitative data; OBK contributed with recruitment of participants and collection and analysis of baseline data; and SB was the principal investigator of the project, and contributed with collection and analysis of quantitative data.

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**Ethics approval** The Regional Committee for Medical Research Ethics in South East Norway (2013/1274).

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**Data sharing statement** No additional data are available.



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## **Appendix 1**

Ethical approval of the ECA 10-year follow-up study

Informed consent form from the study (paper 1)





# REGIONAL KOMITE FOR MEDISINSK FORSKNINGSETIKK

## Helseregion Øst

Overlege dr.med. Karin C. Lødrup Carlsen  
Barnesenteret  
Ullevål sykehus

Deres ref.:

Vår ref.: 110-01034

Dato: 22. mars 2001

### Miljø og Barneastma del 2 (MBA-2)

Regional komite for medisinsk forskningsetikk, helseregion Øst, vurderte prosjektet i sitt møte 15.03.01.

Komiteen har ingen innvendinger mot at prosjektet blir gjennomført.

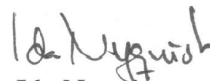
I prosjektet skal det tas blodprøver av friske barn. Komiteen kan akseptere dette, da barna det dreier seg om, vil være gamle nok til å kunne reservere seg mot blodprøvetakingen. Komiteen mener imidlertid det bør fremgå tydeligere av informasjonsskrivet til barna at det er frivillig å delta, og at man kan trekke seg når som helst uten begrunnelse.

Informasjonsskrivet til barna bør ha større skrift.

Med vennlig hilsen



Sten Sander  
professor dr.med.  
formann



Ida Nyquist  
sekretær



Ullevål  
sykehus

## Miljø og Barneastma studien del 2

### MBA-2

Barnesenteret, Kvinne-Barn Klinikken, Ullevål Sykehus

Kjære tidligere deltager i Miljø og Barneastma (MBA) studien

Ullevål Sykehus, 2001

Det er nå 9 år siden det store MBA prosjektet startet i Oslo i 1992. Dere har tidligere mottatt en rapport om funn fra 2 års oppfølging fra prosjektet. Ved Ullevål Sykehus, Barnesenteret ønsker vi nå å invitere til en ny undersøkelse av alle de barna som ble undersøkt ved Ullevål Sykehus i forbindelse med MBA studien i løpet av de første to årene.

Studien er vurdert og akseptert av regional etisk komitee for medisinsk forskning, og av datatilsynet.

Nedenfor følger først en forklaring på hvorfor vi ønsker å gjøre denne studien som vi kaller MBA del 2 (MBA-2), og hvem vi er som ønsker å gjøre undersøkelsen. Deretter kommer en beskrivelse av hvilke undersøkelser vi ønsker å gjennomføre og hva dette innebærer for deres barn.

Til slutt er det eget ark med en samtykke erklæring. Dersom dere, etter å ha lest dette skrevet kunne tenke dere å la barnet deres delta i oppfølgingsundersøkelsen eller ønsker å høre mer om studien ber vi dere fylle ut siste side og returnere dett til oss. Vi vil uansett ta kontakt med dere innen 1 måned etter at dette brevet er sendt. Dersom dere IKKE vil at vi skal ringe dere, ber vi dere om å gi oss beskjed om dette (fyll ut nederst på siste side) i vedlagte svar konvolutt (evt. telefax).

Det er ikke gjort noen tilsvarende undersøkelse som MBA noe annet sted i verden, med lungefunksjonsundersøkelser ved fødsel. Det er derfor ikke mulig å få den kunnskap MBA 2 vil kunne gi oss, noe annet sted. Siden det kun er de barna som var med i MBA som er aktuelle for MBA 2, er det svært viktig for oss at flest mulig av disse barna blir med slik at konklusjonene fra undersøkelsen trekkes på et best mulig grunnlag. Det er derfor like viktig at ditt barn blir med uansett om det er friskt eller har astma, allergi eller annen sykdom.

Dersom dere skulle ha spørsmål av noen art er dere hjertelig velkommen til å ringe eller sende e-post til oss. Adresse og telefon finner dere på siste side.

Vi håper dere kunne tenke dere å la barnet deres delta i denne studien, som vil gi oss ny innsikt i hvorfor så mange barn får astma og allergi.

Med vennlig hilsen

Geir Håland  
Lege, stipendiat

Karin C. Lødrup Carlsen  
prosjektleder, overlege dr. med

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KIRKEVEIEN 166

## Hvorfor gjennomføre MBA-2?

Astma er den hyppigste kroniske sykdommen blant barn, og er kjennetegnet ved en kronisk betennelsesprosess i luftveiene. I Norge har ca. hvert 10. barn astma. Tross ulike oppfatninger om hvor stor økningen er, er det liten tvil om at flere barn har astma sammenlignet med for 20-30 år siden. Dette sees i hele den vestlige verden, og i Storbritannia er det nylig rapportert at så mange som 4 av 10 skolebarn hadde astma symptomer siste år.

I den første studien (MBA) stilte vi spørsmålet ”er det noen sammenheng mellom forurensning/miljø og utvikling av astma?”

MBA ga mye ny kunnskap om tidlig utvikling av astma lignende sykdom (heretter kalt obstruktiv lungesykdom (OAD)). OAD er en gruppe sykdommer av sannsynlig ulike årsaker (ukjent hvilke) der astma er best kjent. Det er de senere år blitt klart at omtrent halvparten av barn med gjentatte episoder med astma lignende symptomer (OAD) de 2-3 første leveår ikke har astma senere. I MBA studien fant vi at gruppen med barn født av mødre som røkte i svangerskapet hadde redusert lungefunksjon ved fødsel, og at barn født med redusert lungefunksjon hadde økt risiko for tidlig OAD. Det var også en sammenheng mellom en betennelsesmarkør (funnet i blodet) og ømfintlighet i luftveiene (som kan tyde på tidlige betennelsesprosess der) allerede ved starten av OAD. Men kan ikke de første leveår si noe sikkert om hvilke barn som fortsatt har astma og hvem som blir kvitt sine symptomer innen skolealder.

Da vi i 1995 ikke fant noen sammenheng mellom (ute)luftforurensning og astma kan dette skyldes at vi ved 2 års alder ikke kunne identifisere de barna som virkelig har astma (i motsetning til forbigående OAD). Den samme begrunnelsen gjelder nær sagt alle spørsmål som dreier seg om årsaker til astma og allergi utvikling, med unntak av matvareallergi som er hyppigst de to første leveår. Vi vet også for lite om hvorfor noen får OAD allerede like etter fødsel og noen får astma først senere i skolealder .

Alle opplysningene vi fikk om barnet fra fødsel til 2 års alder er svært viktige for å hjelpe oss å forstå hvorfor noen barn får tidlig OAD uten senere astma, hvorfor noen ikke har OAD tidlig, men utvikler astma i skolealder mens andre barn har astma som vedvarer fra første leveår.

I MBA-2 (når barna nå er i skolealder) vil vi kartlegge hvem som har astma, hvilke type astma, kjennetegn ved astmatiske betennelsesprosesser hos den enkelte, samt undersøke om barnet har allergier og eventuell betydning av dette for astma og annen allergisk sykdom (høysnue og eksem). Ved å sammenholde undersøkelser i skolealder med tidligere opplysninger (sykehistorie, allergi testing, lungefunksjonsmålinger og miljøundersøkelser) kan vi definere tidlige risikofaktorer for å utvikle astma og mulig betydning av enkelte miljøfaktorer.

**Betydningen** av en slik oppfølging vil være meget stor;

1. Kanskje kan vi innen barnet er 2 år skille mellom tidlig astma og annen OAD? I så fall kan det i stor grad bli en mer målrettet og individualisert behandling for det enkelte barn.
2. Kan vi, ved hjelp av tilgjengelige opplysninger på et svært tidlig tidspunkt (innen fylte to år) forutsi utviklingen av astma slik at forebyggende tiltak kan iverksettes tidlig?
3. Kanskje kan vi avdekke så klare risikofaktorer (i miljøet og sosialt) på et svært tidlig tidspunkt (før utvikling av OAD), at spesielle forebyggende tiltak kan iverksettes for det enkelte barn og i samfunnet. .

## Hvem er vi som ønsker å gjennomføre MBA-2

Studien er et samarbeid mellom barneleger og sykepleiere ved Barnesenteret Ullevål Sykehus, forskere innen allergologi og immunologi ved Avdeling for Miljømedisin ved Folkehelse og barneleger ved Voksentoppen senter for astma og allergi.

Dere vil møte oss som jobber ved Barnesenteret og eventuelt en stipendiat fra Voksentoppen.

### Ved Ullevål Sykehus, Barnesenteret:

Doktorgrads stipendiat **Geir Håland**, Barnelege som vil undersøke barnet og være behjelpelig med eventuell oppstart av behandling eller henvisning til videre behandling dersom dette er ønskelig.

Sykepleiere **Jorun Wikstrand** og **Solveig Knudsen**, som vil gjennomføre allergi testing, ulike lungefysiologiske undersøkelser og ta blodprøver. De vil også gjøre time avtaler med dere og hjelpe til med spørreskjemaer.

Prosjektleder, overlege dr. med **Karin C. Lødrup Carlsen**, (for øyeblikket forsker ved Universitetet i Oslo (UiO)) var ansvarlig for den kliniske del av den opprinnelige MBA studien fra 1992-1995 og er nå prosjektleder for MBA-2.

I tillegg vil kan det være at dere møter andre leger og annet helsepersonell ved Seksjon for Allergologi og Pulmonologi (Barnesenteret). Etersom dette er et tre-årig prosjekt er det mulig at dere vil møte også andre personer de som er presentert her.

### Øvrige personer i MBA-2:

Ved Voksentoppen Senter for barn med astma, allergi og kronisk lungesykdom:  
Professor dr.med, **Kai-Håkon Carlsen**, avdelingsoverlege og sykehusdirektør som var en av initiativtagerne til MBA studien i 1992-95 og er aktivt med i planlegging og gjennomføring av MBA-2. Ansvarlig for ”behandlings delen” av prosjektet.

Professor dr. med **Asbjørn Langslet**, fung. Avdelingsoverlege Barneintensiv avdeling Ullevål Sykehus og undervisningsleder ved UiO som er med i planlegging og gjennomføring av prosjektet.

Ved Staten Institutt for Folkehelse, Avdeling for miljømedisin: Prosjektleder allergologisk/immunologisk del: Seksjonsoverlege, **Martinus Løvik**, forsker **Berit Granum**, forsker **Geir Hetland**, som alle er ansvarlig for analyser av blodprøver og miljøundersøkelser (allergener fra støvprøver og lignende).

Vi kan kontaktes ved Klinisk Forskningsenhet på  
telefon nr.  
telefax nr.  
e-post:

### Hva vil deltagelse i studien medføre for ditt/deres barn?

Barnet vil bli invitert til å være med på ulike undersøkelser, besvare spørreskjema, og dere vil bli bedt å ta en prøve av støv (støvsuging av et lite område) etter standardiserte metoder hjemme. Dere som har ansvaret for barnet vil også bli bedt om å besvare et spørreskjema. Nedenfor er de ulike undersøkelsene beskrevet. Undersøkelsene vil fordele seg på to ulike dager, helst innen en uke. Vi vil være fleksible for å finne tidspunkter som passer for dere.

#### Lungefunksjons undersøkelser:

*Spirometri* er en vanlig undersøkelse som innebærer at barnet blåser inn i et munnstykke slik at maksimal utpust og innpust kan registreres. Undersøkelsen medfører ikke ubehag. Dersom barnet har noe redusert lungefunksjon vil barnet puste inn (inhalasjon) astma medisin som utvider luftrørene (bronkodilaterende) (ventolin) via forstøverapparat og gjenta spirometrien etter 15 minutter. Noen opplever å bli litt "skjelvende" etter ventolin, men dette er helt ufarlig og går fort over. Denne undersøkelsen er vanlig prosedyre ved vår poliklinikk.

#### Undersøkelser for bronkial hyperreaktivitet ("ømfintlighet") i luftveiene:

1) *Tredemølltest*: Barnet skal først gjøre en spirometri undersøkelse, deretter løpe i 6 minutter på en tredemølle for så å gjenta spirometrien umiddelbart etter løping og inntil 15 minutter etter avsluttet løping. Dersom barnet får astma symptomer vil vi gi ventolin og gjenta spirometri etter nye 15 minutter. Denne undersøkelsen er vanlig ved vår poliklinikk for å vurdere om barn har anstrengelses utløst astma. Barnet vil bli litt sliten og svett og vil få anledning til å dusje rett etter undersøkelsen.

2) *Metacholin test*: Denne testen gjennomføres på en annen dag enn tredemølle testen. Metacholin er et medikament som inhaleres via forstøver apparat, og som kan fremprovosere et fall i lungefunksjon (tendens til astmasymptomer) hos personer med hyperreaktive (overømfintlige) luftveier. Barnet utfører først en spirometri, og vil deretter vekselvis inhalere metacholin (først i svært lav dose) og blåse spirometri. Metacholin dosen dobles for hver inhalasjon. Testen stopper enten når det oppstår et fall i lungefunksjon på 20 % eller dersom en viss dose metacholin er nådd uten 20 % fall i lungefunksjon. Noen opplever å bli litt irritert i halsen (lett ubehag) og enkelte vil få tendens til astma symptomer under testen. Dersom det blir astmasymptomer eller et fall i lungefunksjon på mer enn 10 % vil barnet få en ventolin inhalasjon. Denne testen er også vanlig ved vår poliklinikk, og forteller oss om barnet har hyperreaktive lufteier. Hele testen tar opp til ca. 30 minutter.

#### Undersøkelser for å vurdere allergisk/astma betennelse:

1) *Nitrogen i utåndingsluft*: Denne undersøkelsen består i at barnet puster rolig i et munnstykke, og den andelen av utåndingsluften som er nitrogen måles. Testen er rask (ca et par minutter) og meget enkel å gjennomføre, og medfører ikke ubehag. Denne testen utføres før tredemølle eller metacholin testen.

2) *Urinundersøkelse*: Barnet vil få med seg et glass hjem til urinundersøkelse. Urinprøven skal taes ved første toalett besøk om morgenen, og settes kaldt inntil levering samme dag til oss. I denne prøven vil vi undersøke mengden av stoffer (leukotriener og eosinofile mediatorer) som utskilles i urin hos personer med allergisk sykdom.

Allergi utredning / Blodprøver:

*Prikktest for allergier* i huden (foran på underarmen) er en svært vanlig undersøkelse, og innebærer at overfladiske små prikk i huden settes gjennom dråper med ulike allergener. Enkelte av disse prikkene vil klø litt. Dette er rutineundersøkelse for barn ved vår poliklinikk.

Vi vil gjerne ha *en blodprøve* av barnet ved en av undersøkelsene. Dette skal undersøkes på ulike faktorer, som alle dreier seg om kroppens immun respons (forsvars verk) til ulike stoffer, deriblant allergier. For barnet innebærer dette ett stikk der vi fyller ca. fire glass (til sammen ca. 3 spiseskjeer) med blod. Dersom barnet ønsker bedøvelseskrem vil dette naturligvis være tilgjengelig slik at barnet ikke opplever smerte ved undersøkelsen. Mengden blod som taes vil ikke ha noen betydning for barnet, og er ikke mer enn det som ofte tappes i forbindelse med utredning av ulike sykdommer.

**Samtykke erklæring**

Selv om du skriver under på denne samtykke erklæringen kan du og ditt barn når som helst trekke dere fra enkelte eller alle undersøkelsene i MBA-2 uten at dette vil få konsekvenser for dere for eventuell senere utredning, behandling eller oppfølging.

.....  
Jeg samtykker i at mitt barn

..... født. ....

kan delta i MBA-2 undersøkelsene som beskrevet i dette informasjonsskrivet.

Jeg samtykker samtidig i at de opplysninger som ble registrert for mitt barn fra fødsel til to års alder (i den opprinnelige MBA studien fra 1992-1995) kan benyttes for videre analyser i MBA-2.

MBA studien, med MBA-2 oppfølgingen gir et meget viktig grunnlag for å lære mer om faktorer tidlig i livet som kan ha betydning for senere astma og allergi. Vi ønsker derfor å ha muligheten til å gjøre en ny oppfølgings undersøkelse etter noen år (innen 15 år) for å kunne besvare dette også for ungdom og ung voksen alder.

Som foresatt gir jeg tillatelse til at mitt barn kan motta informasjon om senere oppfølgingsundersøkelse og invitasjon til eventuell ny deltagelse.

Alle innsamlede opplysninger vil oppbevares forsvarlig i denne tiden.

Sted..... Dato .....

Navn .....

Navn.....

Vi er takknemlig om du/dere kan fylle ut dette arket og returnere det i vedlagte svarkonvolutt eller på telefax. Dersom dere ønsker å spørre om noe kan dere ringe

**MBA-2, Klinisk forskningsenhet på telefon**

**Til dr. Geir Håland**

Klinisk Forskningsenhet

Barnesenteret, Kvinne-Barn Klinikken, Ullevål Sykehus,

Evt. TELEFAX **22 11 86 63**

Jeg / vi ønsker ytterligere informasjon om MBA-2 på vegne av vårt barn

Navn

Født:

Navn på foresatt

Telefon jobb

Telefon privat

Mobil telefon

Jeg / vi ønsker ikke å bli kontaktet videre om MBA-2 på vegne av vårt barn

Navn

Født:





## **Appendix 2**

Ethical approval of the ECA 13-year follow-up study

Informed consent forms from the study (parent and adolescent) (paper 2)





# UNIVERSITETET I OSLO

DET MEDISINSKE FAKULTET

Professor Kai-Håkon Carlsen  
UiO

Regional komité for medisinsk forskningsetikk

Sør- Norge (REK Sør)

Postboks 1130 Blindern

NO-0318 Oslo

Telefon: 228 44 666

Telefaks: 228 44 661

E-post: [rek-2@medisin.uio.no](mailto:rek-2@medisin.uio.no)

Nettadresse: [www.etikkom.no](http://www.etikkom.no)

**Dato:** 15.12.04

**Deres ref.:**

**Vår ref.:** S-04331

## **ASTMALIV- Astma, Trening, Mat og LIVsstil (en oppfølgingsstudie av Miljø og Barneastma)**

Komiteen behandlet prosjektet i sitt møte 13.12.04.

Komiteen har ingen merknader til prosjektsøknaden.

Komiteen har følgende merknad til pasientinformasjon og samtykkeerklæring:

1. Siden samtykkeskjemaene er utformet som de er, kan det være en fordel at begrepet frivillig kommer inn også på disse, f.eks. på denne måten: "Jeg har lest informasjonen og vet at det er frivillig å delta, og at jeg kan trekke meg når jeg vil uten å oppgi grunn." Komiteen ber om at samtykkeerklæringene får denne tilføyelsen.

### Vedtak:

"Komiteen tilrår at prosjektet gjennomføres."

Vi ønsker lykke til med prosjektet!

Med vennlig hilsen

Sigurd Nitter-Hauge  
Professor dr.med.  
Leder

Tone Haug  
Rådgiver  
Sekretær



# ASTMALIV

- Astma, Trening, MAT og LIVsstil

## Hva er ASTMALIV? Her følger mer informasjon om prosjektet.

ASTMALIV er en del av Miljø og Barneastma, som dere alle er en del av. ASTMALIV er undersøkelse om astma, kosthold og kondisjon. Forskningsprosjektet foregår på *Norges idrettshøgskole* hvor man i snart 30 år har jobbet med fysisk aktivitet og helse.

Prosjektet ledes av professor Kai-Håkon Carlsen, som er ansatt ved Voksentoppen senter for astma og allergi/Rikshospitalet og Norges idrettshøgskole, doktorgradsstipendiat Sveinung Berntsen, Ullevål universitetssykehus og Norges idrettshøgskole, førsteamanuensis Sigmund A. Anderssen, Norges idrettshøgskole, og seksjonsoverlege Karin C. Lødrup Carlsen, Ullevål universitetssykehus.

Hvis du/dere bestemmer dere for ikke å delta i prosjektet, får dette selvfølgelig ingen følger for dere ved seinere henvendelser til enten Ullevål universitetssykehus eller Norges idrettshøgskole. Det samme gjelder naturligvis dersom du/dere først sier ja, men så velger å trekke deg/dere ut etter at prosjektet har startet opp. Du/dere har full rett til når som helst å si at du/dere ikke ønsker eller har anledning til å være med i prosjektet videre. Eventuelle opplysninger registrert vil da kunne bes om å slettes.

### Prosjektets innhold og varighet

Barnet skal etter inkludering i forskningsprosjektet gjennomgå testing ved arbeidsfysiologisk laboratorium ved Norges idrettshøgskole en gang. Vi ønsker også at du/dere svarer på noen spørsmål om astma og allergi. I tillegg ønsker vi at det registreres hva barnet spiser i løpet av fire dager samt aktivitetsvaner.

*Testen starter* med at barnet får målt sin lungefunksjon. Her skal barnet puste i et spesielt apparat i noen sekunder. Barnet har vært gjennom dette tidligere. Etter målingen av barnets lungefunksjon skal barnet løpe på tredemølle til det ikke orker mer, i ti til femten minutt. Her skal maksimalt oksygenopptak bestemmes. Hastigheten på tredemøllen økes underveis og barnet løper i oppoverbakke på tredemøllen. Løpshastigheten blir individuelt tilpasset hvert enkelt barn avhengig av kondisjon. Barna gjennomgår tilvenning til tredemøllen samt oppvarming i forkant av testen. Denne løpetesten likner på hva barnet gjorde ved forrige besøk på Ullevål universitetssykehus men løpetesten er noe "snillere". Dette er samme type test som toppidrettsutøverne i Norge benytter. Før og etter løpetesten skal barnet også puste i et rør hvor vi samler opp lufta som pustes ut. Dette foregår ved at barnet puster helt vanlig i ti til femten minutt. Luften fryses og lagres for senere analyse. I den forbindelse registreres det også hvor mye nitrogenoksid som finnes i lufta som pustes ut. Dette ble også gjennomført ved forrige anledning. Vi ønsker også at det registreres hva barnet spiser i løpet av fire dager. Dette gjøres på et standardisert skjema. I tillegg ønsker vi at dere svarer på et enkelt spørreskjema om astma og allergi. Barnet skal også gå med en aktivitetsmåler (en liten boks som de har i beltet) i fire dager. Boksen måler all bevegelse. Verken målingen av lungefunksjon, "luftprøven" eller løpetesten medfører ubehag.

### Hvorfor gjør vi denne studien?

Overvekt hos barn og unge blir mer og mer alminnelig i Norge og ellers i verden. Årsakene til overvekt kan være mange, men lite fysisk aktivitet kan være en av forklaringene. Forskning har blant annet vist at vi beveger oss mindre nå enn for bare få tiår siden. Kostvanene våre har i mindre grad endret seg. Overvekt hos barn kan føre til helsemessige problemer seinere i livet. Forskning har også vist at barn og unge som er lite fysisk aktive og har et "usunt" kosthold har større risiko for å utvikle astma. En gruppe leger og forskere ved Ullevål universitetssykehus, Rikshospitalet og Norges idrettshøgskole samarbeider nå om dette forskningsprosjektet hvor vi ønsker å finne ut hvorfor og hvordan livsstilsfaktorer påvirker astma.

## Hva er målet med prosjektet?

Vi ønsker å finne ut hvordan inaktivitet, overvekt og kosthold påvirker risikoen for å utvikle astma. I tillegg ønsker vi å finne ut mer om mekanismene bak dette.

## Hvilke fordeler kan en ha ved å være med i prosjektet?

Det utbetales intet honorar for å være med. I tillegg får barna noe drikke samt frukt etter testingen. Barna lærer mye om sin egen kropp og gjennomfører samme type tester som toppidrettsutøvere gjør. Dette synes de fleste barn er morsomt og spennende. Generelt sett kan resultatene fra forskningsprosjektet bidra til å gi en bedre forståelse av sammenhengen mellom fysisk aktivitet, kosthold og astma.

## Personvern og frivillig deltakelse

Regional etisk komité har ingen innvendinger mot gjennomføring av prosjektet. Alle opplysninger er konfidensielle og oppbevares etter retningslinjer fra datatilsynet. Forsøkspersonenes navn oppbevares ikke sammen med resultatene. Hvert barn får et forsøksnummer, og koblingen mellom navn og forsøksnummer blir oppbevart innlåst i et arkivskap. Disse opplysningene oppbevares ut 2016. Bortsett fra vi som steller med prosjektet og forsøkspersonene selv, får ingen andre innsyn i resultatene vedrørende det enkelte barn. Du/dere kan også få innsyn i de lagrede opplysninger. Ved senere oppfølging sendes det ut ny informasjon hvor du kan reservere deg/ditt barn mot å delta.

Du/dere kan på et hvilket som helst tidspunkt trekke deg/dere ut av undersøkelsen uten å oppgi grunn. Eventuelle opplysninger registrert vil da kunne bes om å slettes. Dette vil ikke få noen konsekvenser for din/deres videre behandling, forholdet til behandlende lege eller forholdet til Ullevål universitetssykehus eller Norges idrettshøgskole.

## Sikkerhet

Alle barna er forsikret mot skade/bivirkninger gjennom forsikringsavtaler. Under testene stilles strenge krav til barnas sikkerhet og lege er alltid i nærheten.

## Videre behandling av forsøksresultatene

Resultatene formidles til barna og foreldre/foresatte ved ønske om dette. I tillegg samles resultatene (uten personlige pasientdata) og utgis i en eller flere forskningsrapporter og blir dermed brakt ut til leger og forskere for å heve kunnskapsnivået på feltet.

## Har dere spørsmål?

Da kan du kontakte professor Kai-Håkon Carlsen, Voksentoppen senter for astma og allergi (Rikshospitalet), telefon 22 13 65 00, seksjonsoverlege Karin C. Lødrup Carlsen, telefon 22 11 87 65 ved Ullevål universitetssykehus eller doktorgradsstipendiat **Sveinung Bermtsen**, telefon **23 26 24 19** eller e-post [sveinung.bermtsen@nih.no](mailto:sveinung.bermtsen@nih.no) ved Ullevål universitetssykehus og Norges idrettshøgskole. Samtykkeerklæringen (gult ark) returneres til **Solveig Knutsen** ved Ullevål universitetssykehus på følgende adresse: Ullevål universitetssykehus, divisjon Kvinne-barn, Barnesenteret, 0407 Oslo.

# Samtykke

## Til foreldre/foresatte

Jeg/vi har lest informasjonsskrivet om forespørsel om å delta i forskningsprosjektet:

"**ASTMALIV**-Astma, Trening, MAT og LIVsstil", og gir min/vår tilslutning til at barnet kan delta i undersøkelsen. Jeg/vi er kjent med at vi når som helst kan trekke oss fra prosjektet uten å måtte oppgi grunn for det. Jeg/vi er klar over at de innsamlede data utelukkende brukes til forskning.

Jeg/vi samtykker i å bli kontaktet på et senere tidspunkt og få tilbud om å være med i oppfølgende undersøkelser og at det etter godkjenning fra Datatilsynet, kan innhentes opplysninger om barnet fra Medisinsk fødselsregister og fra norske sykehus.

Barnets navn (skrives med blokkbokstaver): .....

Jeg/vi kan nås på telefon (dagtid): Tlf:.....

Bostedsadresse:.....

Vennligst oppgi hvilken skole barnet går på høsten/våren 2005/06.

Skole: .....

Dato: ...../.....-.....

Foresattes underskrift: .....

**Til deg som er barn/ungdom**

Jeg har lest informasjonen og vet at jeg kan trekke meg når jeg vil uten å oppgi grunn.  
Jeg vil være med i prosjektet.

Dato: ...../.....-.....

Din underskrift: .....

**Samtykket returneres til Ullevål universitetssykehus *innen en uke* i den ferdig adresserte konvolutten. Porto er betalt.**

### **Appendix 3**

Ethical approval of the active play exercise intervention pilot study

Informed consent forms from the study (parent and adolescent) (paper 4)





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|                               |   |                             |                                  |   |
|-------------------------------|---|-----------------------------|----------------------------------|---|
| <b>Region:</b><br>REK sør-øst | <b>Saksbehandler:</b><br>Silje U. Lauvrak | <b>Telefon:</b><br>22845520 | <b>Vår dato:</b><br>12.09.2013   | <b>Vår referanse:</b><br>2013/1274/REK sør-øst<br>D |
|                               |   |                             | <b>Deres dato:</b><br>25.06.2013 | <b>Deres referanse:</b>                             |

Vår referanse må oppgis ved alle henvendelser

Til Sveinung Berntsen Stølevik

## 2013/1274 Fysisk aktivitet og astma blant barn med astma

**Forskningsansvarlig:** Universitetet i Agder

**Prosjektleder:** Sveinung Berntsen Stølevik

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst) i møtet 22.08.2013. Vurderingen er gjort med hjemmel i helseforskningsloven (hfl.) § 10, jf. forskningsetikklovens § 4.

### Prosjektomtale

*Deltakelse i regelmessig fysisk aktivitet anbefales barn med astma. God fysisk form og god behandling kan føre til bedre kontroll med astmasykdommen og øke livskvaliteten. Man vet imidlertid lite om determinanter og barrierer for deltakelse i fysisk aktivitet eller om barn med astma tar sine medisiner i henhold til anbefalingene. Man vet også lite om hvordan deltakelse i lystbetont aktivitet har betydning for videre fysisk aktivitetsnivå. Hensikten med den omsøkte studien er å utforske hvordan barn og ungdommer lever med sin astma med fokus på samhandling med jevnaldrende, familiemedlemmer og helsepersonell, og hvordan samhandlingen innvirker på fysisk aktivitet og bruk av foreskrevne medisiner. Det skal inkluderes 30 barn med astma i alderen 10-13 år, som skal randomiseres til kontroll- eller aktivitetsgruppe. Aktivitetsgruppen skal utføre lystbetont fysisk aktivitet to ganger per uke over 6 uker. Fysisk form og objektivt målt fysisk aktivitetsnivå skal registreres for alle barna før og etter aktivitetsperioden. Det skal gjøres fokusgruppeintervju og observasjon av aktivitetsøktene for å få barnas innspill til hvordan deltakelse i aktivitetstilbudet oppleves, og for å samle informasjon om bruk av medisiner. Barna i kontrollgruppen får tilbud om deltakelse i aktivitet i etterkant.*

### Vurdering

Komiteen har vurdert søknaden og har ingen innvendinger mot studien som sådan. Komiteen har imidlertid noen kommentarer til informasjonsskrivet:

- 1) Hensikten med studien, å undersøke om man øker oksygenopptaket med systematisk trening, må beskrives ytterligere i informasjonsskrivet.
- 2) Det oppgis i søknaden at ansvarlig barnelege vil være tilgjengelig for veiledning i tilfelle uventede akutte situasjoner oppstår ved test eller aktivitetsopplegget. Denne informasjonen må også inn i informasjonsskrivet.
- 3) Da barna er under 16 år er det kun de foresatte, og ikke barnet selv, som skal undertegne.

På denne bakgrunn setter komiteen følgende vilkår for godkjenning:

- Informasjonsskrivet skal revideres i henhold til komiteens kommentarer og ettersendes til orientering.

**Vedtak**

Med hjemmel i helseforskningsloven § 9 jf. 33 godkjenner komiteen at prosjektet gjennomføres under forutsetning av at ovennevnte vilkår oppfylles.

I tillegg til vilkår som fremgår av dette vedtaket, er godkjenningen gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad og protokoll, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Tillatelsen gjelder til 31.12.2016. Av dokumentasjonshensyn skal opplysningene likevel bevares inntil 31.12.2021. Forskningsfilen skal oppbevares aidentifisert, dvs. atskilt i en nøkkel- og en opplysningsfil. Opplysningene skal deretter slettes eller anonymiseres, senest innen et halvt år fra denne dato.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriften kapittel 2, og Helsedirektoratets veileder for «Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse og omsorgssektoren».

Dersom det skal gjøres vesentlige endringer i prosjektet i forhold til de opplysninger som er gitt i søknaden, må prosjektleder sende endringsmelding til REK.

Prosjektet skal sende sluttmelding på eget skjema, senest et halvt år etter prosjektstutt.

**Klageadgang**

Du kan klage på komiteens vedtak, jf. forvaltningslovens § 28 flg. Klagen sendes til REK sør-øst D. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst D, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Vi ber om at alle henvendelser sendes inn på korrekt skjema via vår saksportal: <http://helseforskning.etikkom.no>. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: [post@helseforskning.etikkom.no](mailto:post@helseforskning.etikkom.no).

Vennligst oppgi vårt referansenummer i korrespondansen.

Med vennlig hilsen

Finn Wisløff  
Professor em. dr. med.  
Professor

Silje U. Lauvrak  
Rådgiver

**Kopi til:** [sveinung.berntsen@uia.no](mailto:sveinung.berntsen@uia.no); [post@uia.no](mailto:post@uia.no)

## Forespørsel om deltakelse i et forskningsprosjekt

### “PLAY”

#### *(Physical Activity and Asthma in Youth)*

#### **Bakgrunn og hensikt**

Fysisk aktivitet er viktig for alle barn med astma, blant annet fordi god fysisk form er med på å kontrollere sykdommen og gi god helse. Hva som skal til for at barna opprettholder fysisk aktivitet over lengre tid, vet man derimot for lite om.

Dette er derfor et spørsmål til deg om å la ditt barn delta i en forskningsstudie for å undersøke hva som innvirker på barnets deltakelse i fysisk aktivitet og bruk av astmamedisiner. Vi ønsker å finne ut hvordan vi i fremtiden kan gi bedre behandling til barn og unge med astma. Fakultet for helse- og idrettsvitenskap ved Universitetet i Agder er ansvarlig for studien som gjennomføres i samarbeid med Barnesenteret ved Sørlandet Sykehus. Leder av prosjektet er Førsteamanuensis Sveinung Berntsen ved Universitetet i Agder (UiA).

#### **Hva innebærer studien?**

En barnelege ved Sørlandet sykehus, Kristiansand vil være medisinsk ansvarlig for studien. Barnet skal først gjennomgå en kondisjonstest. Denne testen utføres på Arbeidsfysiologisk testlab på Spicheren (UiA) i 2. etg., første gang i løpet av uke 38-39. Testen går ut på at barnet skal løpe 10-15 minutter på en tredemølle, samtidig som det puster gjennom en ventil på størrelse med en snorkel. Mot slutten av testen vil barnet bli ordentlig sliten. Vi måler da barnets maksimale oksygenopptak, som er et mål på kondisjon. Hele besøket på testlabben tar ca en time.

Barnet får også utlevert en måler som skal bæres rundt overarmen i 4 sammenhengende dager. Denne registrerer barnets daglige energiforbruk. Vi ønsker også at barnet registrerer hvilke medisiner som brukes. Barnet vil gjennomgå kondisjonstesten på nytt og ha måleapparatet på i 4 dager, etter de første seks ukene og helt tilslutt i studien.

Deretter vil alle barna som er med i studien tilfeldig deles inn i to grupper med ca 10-12 barn i hver gruppe. Den ene gruppen vil delta i en aktivitetsgruppe to ganger i uken (mandager og onsdager 1800-1900) over en periode på seks uker. Etter disse seks ukene vil den andre gruppen delta på samme måte i fire uker. Aktivitetsøktene vil bli ledet av forskere og studenter ved Universitetet i Agder. Fokuset er at barna skal ha det gøy når de er i aktivitet. Øktene vil være lystbetonte og lekpreget, men likevel ha en høy intensitet. Øktene vil foregå innendørs i Havlimyrhallen, Havliveien 8, Kristiansand.

En forsker vil være tilstede og observere testing og aktivitet, og vil også intervju ditt barn sammen med andre barn i grupper på inntil fem ved tre anledninger. Samtalene finner ikke

## PLAY-prosjektet

sted i gymsalen. Disse samtalene vil bli tatt opp på bånd, og forskeren vil gjøre notater fra sine observasjoner.

### **Mulige fordeler og ulemper**

Det utbetales ingen honorar for å være med i studien, og tilbudet er gratis.

Gjennom studien vil barnet få muligheten til å være i aktivitet sammen med andre barn med astma, og forbedre sin fysiske kondisjon gjennom lystbetonte aktiviteter.

Intervjuene som gjennomføres vil også åpne for refleksjon om egen situasjon og egen helse.

Samtidig kan slike samtaler bli personlige. Det er derfor viktig at ditt barn selv er bevisst på hva hun/han deler og ikke. Du og ditt barn vil også bruke tid på å være med i studien. I tillegg til de to ukentlige øktene over seks/fire uker vil dere bruke opp til en time i forbindelse med tester før og etter studien, og opp til en time til intervju ved tre tilfeller i løpet av perioden.

Intervjuene vil bli samordnet med øktene og/eller testingen.

### **Hva skjer med testresultatene og informasjonen om ditt barn?**

Testresultatene og informasjonen som registreres skal kun brukes slik som beskrevet i hensikten med studien. Alle opplysningene vil bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter ditt barns opplysninger til en navneliste. Samtalene som blir tatt opp på bånd, vil bli skrevet ut som en tekst, og i den forbindelse samt i notater vil alle navn bli byttet ut. Det vil ikke være mulig å gjenkjenne barnet ved navn eller stemme uten og direkte høre på båndopptaket.

Det er kun autorisert personell knyttet til prosjektet som har adgang til båndopptaket, eller til navnelisten, og som kan finne tilbake til ditt barn.

Det vil ikke være mulig for utenforstående å identifisere ditt barn i resultatene av studien når disse publiseres. Opptak og andre opplysninger som kan knyttes til ditt barn vil slettes senest 31.12.2017.

### **Frivillig deltakelse**

Det er frivillig å delta i studien. Du eller ditt barn kan når som helst og uten å oppgi noen grunn trekke deres samtykke til å delta i studien. Dette vil ikke få konsekvenser for barnets videre behandling eller oppfølging ved Sørlandet Sykehus. Dersom du ønsker at ditt barn skal delta, undertegner du og ditt barn samtykkeerklæringen på siste side. Om du nå sier ja til at ditt barn kan delta, kan du senere ombestemme deg og trekke tilbake ditt samtykke uten at det påvirker din eller ditt barns øvrige behandling. Hvis ditt barn underveis velger å trekke seg fra aktivitetsopplegget men likevel opprettholder sitt samtykke til å være med på intervjuene er det tilrettelagt for det. Dersom du eller ditt barn senere ønsker å trekke dere eller har spørsmål til studien, kan dere kontakte prosjektleder Sveinung Berntsen, tlf 38141045 (e-post: sveinung.berntsen@uia.no) eller Thomas Westergren, tlf 37233142, ved Fakultet for helse- og idrettsvitenskap, Universitetet i Agder, eller Tonje Nilsen, tlf 38073030 ved Sørlandet Sykehus.

PLAY-prosjektet

**Ytterligere informasjon om studien finnes i kapittel A – utdypende forklaring av hva studien innebærer.**

**Ytterligere informasjon om personvern og forsikring finnes i kapittel B – Personvern, økonomi og forsikring.**

**Samtykkeerklæring følger etter kapittel B.**

PLAY-prosjektet

## **Kapittel A- utdypende forklaring av hva studien innebærer**

### **Kriterier for deltakelse**

Barn i alderen 10-13 år som deltar i studien skal fylle en eller flere av følgende kriterier:

- astmadiagnose med pustebesvær, tetthet og/eller hvesing
- bruk av astmamedisiner
- forbedring av luftstrømmen (økning av FEV<sub>1</sub> på minst 10%) etter inhalasjon av Salbutamol (vil bli testet)

Hvis barnet har andre sykdommer i hjerte og kretsløp eller muskler og skjelett kan de ikke delta. De kan heller ikke delta om de har hatt en infeksjon i luftveiene i løpet av de siste fire ukene og har brukt andre medisiner en de vanligvis gjør. Barnet kan bruke sine vanlige astmamedisiner som de pleier under hele studien.

### **Tidsskjema – hva skjer og når skjer det?**

I siste del av september -2013 vil det bli gjennomført forhåndstesting av barnets kondisjon ved Arbeidsfysiologisk testlab på Spicheren (UiA).

Aktivitetsperioden vil starte fra andre uke i oktober (uke 41) til midten av november (tom uke 46).

I uke 47 gjennomføres på ny testing av fysisk kondisjon.

For andre gruppe vil aktivitetsstart være tredje uke i november (uke 47) og i fire uker fremover (tom uke 50), med fysiske etter-tester uken før jul.

Det vil bli gjennomført intervjuer ved oppstart og avslutning av aktivitetsperioden, og i midten av perioden. Underveis i perioden vil barnet også bruke et måleapparat i fire dager for å måle daglig energiforbruk.

### **Mulige fordeler og ulemper**

Se ovenfor.

### **Ditt barns og ditt ansvar**

Barnet, og du som foreldre har et ansvar for å følge tester, trening og intervjuer som beskrevet over, men dere kan velge å trekke dere fra studien uten å oppgi noen grunn. Det vil være mulig å delta i intervjuer selv om dere trekker dere fra tester og aktivitetsøkter.

### **Forskernes ansvar for å gi nødvendige opplysninger**

Du og ditt barn vil bli orientert om vi får informasjon som kan innvirke på deres villighet til å delta i studien. Det kan f. eks. være observasjon av mistriivsel, eller observasjon av nedsatt helse i forbindelse med aktivitetsøktene.

PLAY-prosjektet

## Kapittel B - Personvern, biobank, økonomi og forsikring

### Personvern

Opplysninger som registreres (ved inklusjon og underveis i studien) om ditt barn er:

- Alder
- Kjønn
- Telefonnummer
- Høyde
- Vekt
- Lungefunksjon (med reversibilitet)
- Bruk av astmamedisiner og symptomer i forbindelse sykdommen
- Kondisjonstest og daglig fysisk aktivitet
- Deltagelse i aktiviteten
- Observasjoner av ditt barn ved testing og trening
- Det ditt barn selv sier ved intervjuene

Disse opplysningene vil ikke kunne knyttes til ditt barn eller deg av noen som ikke er tilstede under trening, testing eller intervjuer, og ditt barn vil i tekstene og i presentasjon av forskningen ha et fingert navn. Studien vil heller ikke påvirke eller knyttes tilbake til ditt barns journal på sykehuset.

Universitetet i Agder ved administrerende direktør er databehandlingsansvarlig, og utlevering av materiale eller opplysninger til andre vil ikke forekomme.

### Rett til innsyn og sletting av opplysninger om deg og sletting av testresultater

Hvis du sier ja til å la ditt barn delta i studien, har du og barnet rett til å få innsyn i hvilke opplysninger som er registrert om ditt barn. Dere har videre rett til å få korrigert eventuelle feil i de opplysningene vi har registrert. Dersom dere trekker deg fra studien, kan dere kreve å få slettet innsamlede prøver og opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige publikasjoner.

### Økonomi og Universitetet i Agder og Sørlandet sykehus sin rolle

Studien er finansiert gjennom forskningsmidler fra Universitetet i Agder, Fakultet for helse- og idrettsvitenskap, og Barnesenteret ved Sørlandet Sykehus. Bidragsyterne gjør det mulig å leie treningslokale, utføre tester og å arbeide med studien for de involverte forskerne.

### Forsikring

Universitetet i Agder er en statlig institusjon og er således selvassurandør.

### Informasjon om utfallet av studien

Ditt barn og du vil få utlevert informasjon om egne testresultater. Ytterligere informasjon om resultatene i studien kan fås gjennom Sveinung Berntsen og Thomas Westergren, Fakultet for helse- og idrettsvitenskap, Universitetet i Agder, tlf 38141045/37233142. Som deltaker og foresatt

## PLAY-prosjektet

til deltaker har dere rett til informasjon knyttet til egen deltakelse studien hvis dere ønsker det, og det vil også avholdes et informasjonsmøte for alle deltakere med foresatte i etterkant av studien.



PLAY-prosjektet

## Samtykke til deltakelse i studien

### Til foreldre/foresatte:

- Jeg/vi har lest informasjonsskrivet om forespørsel om å delta i forskningsprosjektet: «PLAY», og gir min/vår tilslutning til at barnet kan delta i undersøkelsen.
- Jeg/vi er kjent med at vi når som helst kan trekke oss fra prosjektet uten å måtte oppgi grunn for det.
- Jeg/vi er klar over at de innsamlede data utelukkende brukes til forskning.

Barnets navn: .....

Barnets alder: .....

Jeg/vi kan nås på telefon (dagtid): .....

E-post adresse: .....

Dato: .....

Foresattes underskrift: .....

### Til deg som er barn/ungdom:

- Jeg har lest informasjonen om forskningsprosjektet «PLAY», og vet at jeg kan trekke meg når jeg vil uten å oppgi grunn.
- Jeg ønsker å være med i prosjektet.

Dato:.....

Din underskrift:.....

## Forespørsel om deltakelse i et forskningsprosjekt

### **“PLAY”**

#### *(Physical Activity and Asthma in Youth)*

#### **Hvorfor gjør vi dette?**

Dette er et spørsmål til deg som har astma om å delta i en undersøkelse om hva som påvirker barns deltakelse i fysisk aktivitet og bruk av astmamedisin. Vi ønsker å finne ut hvordan vi kan gi bedre behandling til barn og unge med astma. Fakultet for helse- og idrettsvitenskap ved Universitetet i Agder (UiA) er ansvarlig for prosjektet som gjennomføres i samarbeid med Barnesenteret ved Sørlandet Sykehus.

#### **Hva skal du gjøre?**

Det første som skjer hvis du blir med er at du skal gjennomføre en test (på Spicheren treningssenter (UiA), Kristiansand) hvor du skal løpe på en tredemølle i ca. 10-15 minutter. På slutten av testen blir du skikkelig sliten. Når du løper måler vi kondisjonen din ved at du puster gjennom en ventil, som likner på en snorkel. Videre vil du få utdelt en måler som du skal ha rundt den ene overarmen. Denne måler den daglige aktiviteten din, og du skal ha den på deg i 4 dager etter hverandre og gjøre det du pleier å gjøre. Før du går hjem fra testen skal du også fylle ut et spørreskjema. Vi ønsker også at du registrerer hvor ofte du bruker medisinene dine.

Deretter skal alle barna som vil være med i studien deles i to grupper. Den ene gruppa skal være med i en aktivitetsgruppe to ganger i uken i seks uker. Den andre gruppa skal være med i en aktivitetsgruppe to ganger i uken i fire uker. Etter aktivitetsperiodene er slutt skal alle barna løpe på tredemølla og testes en gang til.

Aktivitetsgruppa du skal være med i vil bestå av 10-12 andre barn, og aktiviteten vil foregå inne i Havlimyrhallen, Kristiansand, mandager og onsdager 1800-1900.

Aktivitetene vil være gøyale samtidig som du blir sliten. Aktivitetene blir ledet av trenere fra Universitetet i Agder.

En forsker som ikke er trener vil være tilstede for å bli litt kjent med deg og aktivitetene du er med på. Han vil også gjennomføres samtaler med deg og andre barn/ungdommer i grupper på fem. Disse samtalen finner ikke sted i gymsalen. Det vil bli gjort lydopptak av disse samtalen. Målinger som er gjort på sykehuset vil også benyttes dersom du blir med på prosjektet.

#### **Mulige fordeler og ulemper**

Gjennom studien vil du få muligheten til å være i aktivitet sammen med andre barn/ungdom med astma, og forbedre din kondisjon gjennom gøy aktivitet.

PLAY-prosjektet

Samtalene med forskeren i grupper vil handle om din opplevelse av å leve med astma. Slike samtaler kan bli personlige. Det er derfor viktig at du selv bestemmer hva du vil fortelle til de andre og til forskeren.

Du vil bruke tid på å være med i studien. I tillegg til trening to kvelder i uken i seks eller fire uker vil det ta omtrent en time når vi skal teste din kondisjon før og etter aktivitetsperioden. Hver gruppesamtale med forskeren vil vare i en time og vi skal ha tre samtaler i løpet av perioden. Samtalene vil være rett før eller etter en av treningene.

### **Hva skjer med det vi får vite om deg?**

Det vi får vite om deg skal kun brukes for å finne ut hvordan vi kan få til best mulig aktivitet og behandling for barn og ungdommer med astma. Alle opplysninger vi får vite om deg vil registreres med et kodenummer, ikke navn og fødselsnummer. I et låst arkivskap oppbevares informasjon om hvem som har hvilket kodenummer. I samtalene som blir tatt opp på bånd vil alle navn bli byttet ut når vi skriver ut samtalene som tekst. Det vil heller ikke være mulig å gjenkjenne din stemme uten og direkte høre på båndopptaket.

Det er kun forskere i prosjektet som har adgang til båndopptaket, den hemmelige koden og til navnelisten som kan finne tilbake til deg. Det vil ikke være mulig for andre enn forskerne å finne igjen deg i resultatene av studien når disse skal presenteres. Men alle som er med vil kanskje kunne huske å kjenne igjen ting hvis dere leser om det etterpå. Opptak og andre opplysninger som kan knyttes til deg vil slettes senest 31.12.2017.

### **Vil du være med?**

Det er frivillig å være med. Om du ombestemmer deg og finner ut at du ikke har lyst å være med lenger, er det helt greit. Det vil ikke ha noe å si for din oppfølging på sykehuset. Dersom du ønsker å delta, skriver du ditt navn på siste side i skjemaet som dine foreldre/foresatte har fått. Om du slutter på aktivitetene men vil være med på samtalene i gruppe kan du det. Hvis du har spørsmål til oss, kan du gjerne ringe eller sende e-post. Telefonnummer og e-post står nederst på arket.

Vennlig hilsen,

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Thomas Westergren (forsker)  
Tlf 37233142

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Sveinung Berntsen (prosjektleder)  
Tlf 38141045  
e-post [sveinung.berntsen@uia.no](mailto:sveinung.berntsen@uia.no)

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Tonje Nilsen (fysioterapeut)  
Tlf 38073030



## **Appendix 4**

Questionnaire for structured interviews (paper 1, 2 and 4)



Intervjuskjema Miljø og Barneastma - del 2  
Familie/sosial/fritid

1.Kode

2.Alder  år  mnd

3.Kjønn:  1.Gutt  
 2.Jente

Utfylt av:

4.Dato første undersøkelse

.  .   
dd mm åå

5.Dato andre undersøkelse

.  .   
dd mm åå

6.Hvem følger ved intervju:  1.Mor  
 2.Far  
 3.Mor og far  
 4.Andre

Familie

7.Hvor mange søsken har barnet?

a

Helsøsken

b

Halvsøsken

8.Hvilken alder har barnets søsken som det bor sammen med nå?

a

b

c

d

e

9.Hvem bor barnet sammen med >50% av tiden?

- 1.Mor og far  
2.Mor  
3.Far  
4.Likedelt mor og far  
5.Andre

10.Hvor gammelt var barnet da mor og far evt. skilte lag?

år

11.Hvor gamle var foreldrene da barnet ble født?

Mor  år  
a

Far  år  
b

12.Hvor gammelt var barnet da andre evt. overtok omsorgen?

år

13.Hva slags etnisk bakgrunn har foreldrene? 14.I hvilken kommune var barnets besteforeldre født?

- a Mor:  1.Kaukasisk  
 2.Afrikansk  
 3.Asiatisk  
b Far:  4.Sør-Amerikansk  
 5.Samisk  
 6.Blandet  
 7.Annet

Mors mor: \_\_\_\_\_ Mors far: \_\_\_\_\_

Fars mor: \_\_\_\_\_ Fars far: \_\_\_\_\_

15.Hva var familiens totale brutto yrkesinntekt siste år?

- 1.<350.000    2. 350-560.000  
 3. 560-750.000    4 >750.000

16.Hva er høyeste gjennomførte skolegang?

- a Mor:  1.Ikke gjennomført grunnskole  
 2.Grunnskole  
b Far:  3.Videregående  
 4.Høyskole/Universitet inntil 3 år  
 5.Høyskole/Universitet 4 år eller mer

17.Hva er foreldrenes grad av yrkesaktivitet?

- |                               | Mor                        | Far                        |
|-------------------------------|----------------------------|----------------------------|
| Yrkesaktiv heltid             | a <input type="checkbox"/> | f <input type="checkbox"/> |
| Yrkesaktiv deltid             | b <input type="checkbox"/> | g <input type="checkbox"/> |
| Skoleelev/Student             | c <input type="checkbox"/> | h <input type="checkbox"/> |
| Hjemmeværende                 | d <input type="checkbox"/> | i <input type="checkbox"/> |
| Uføretrygdet(helt el. delvis) | e <input type="checkbox"/> | j <input type="checkbox"/> |









## Røykevaner

1.Kode

 - 

90. Har mor, far eller andre husstandsmedlemmer røkt under svangerskapet?

 1. Ja  
 2. Nei

91. Hvis ja, hvem røkte?

 1. Mor 2. Far  
 3. Mor og far  
 4. Andre  
 5. Andre + mor og far

92. Ble det røkt innendørs?

 1. Ja  
 2. Nei

93. Hvor mange sigaretter ble røkt daglig?

 mor a  far b 

94. Har mor, far eller andre husstandsmedlemmer røkt i barnets førskolealder?

 1. Ja  
 2. Nei

95. Hvis ja, hvem røkte?

 1. Mor 2. Far  
 3. Mor og far  
 4. Andre  
 5. Andre + mor og far

96. Ble det røkt innendørs?

 1. Ja  
 2. Nei

97. Hvor mange sigaretter ble røkt daglig?

 mor a  far b 

98. Har mor, far eller andre husstandsmedlemmer røkt i barnets skolealder?

 1. Ja  
 2. Nei

99. Hvis ja, hvem røkte?

 1. Mor 2. Far  
 3. Mor og far  
 4. Andre  
 5. Andre + mor og far

100. Ble det røkt innendørs?

 1. Ja  
 2. Nei

101. Hvor mange sigaretter ble røkt daglig?

 mor a  far b 

117. Røyker barnet selv?

 a  0. nei  
 1. Ja, fast  
 2. Ja, av og til

Hvis ja, alder ved røykestart

 b  år Antall per dag c 

Snuser barnet?

 d  0. nei  
 1. Ja, fast  
 2. Ja, av og til

Hvis ja, alder ved start

 e  år Antall snus per dag f 

221. Har lege noen gang snakket med dere om tobakksrøyking i forhold til astma?

 1. Ja  
 2. Nei

## Kosthold

102. Har barnet blitt ammet?

 1. Ja  
 2. Nei

104. Hvor gammelt var barnet da det fikk annen føde enn morsmelk?

103. Hvis ja, hvor lenge ble barnet ammet?

 måneder

 måneder

105. Følger barnet en spesiell diett?

 1. Ja  
 2. Nei

106. Hvis ja, hvilken diett?

 1. Biodynamisk dyrket 2. Vegetar  
 3. Kumelkfri 4. Annet 5. Mer enn en

107. Har barnet i løpet av siste 12 mnd fått mineral-/vitamintilskudd?

 1. Ja  
 2. Nei

108. Hvis ja, hvilket tilskudd?

 a  C-vitamin b  Sanasol c  Biovit  
 d  Multivitamin tablett e  Tran  
 f  D-vit g  Omega 3 h  Annet

## Intervjuskjema Miljø og Barneastma - del 2 Vaksinasjoner/Tidligere sykdommer

Kode

### Vaksinasjoner

118. Har barnet fulgt vanlig vaksinasjonsopplegg?  1. Ja  2. Nei
119. Hvis nei: 1. Mangler en eller flere HIB doser?  Hvilke: \_\_\_\_\_  
2. Andre mangler/avvik
120. Tuberculose (BCG vaksine)  1. Ja  2. Nei Hvis ja, alder:   år Omslager, alder:   år  
a b c
121. Har barnet fått reisevaksiner?  1. Ja  2. Nei Hvis ja, hvilke: \_\_\_\_\_
122. Har barnet fått influensavaksiner:  1. Ja  2. Nei

### Tidligere sykdommer Infeksjoner

Har barnet gjennomgått noen av følgende sykdommer?

- | <u>Virale:</u>                            | 1. Ja                    | 2. Nei                   | Alder                                     | 1. Ja                                 | 2. Nei                                    | Alder                                     | 1. Ja                                     | 2. Nei                               | Alder                                     | 1. Ja                                 | 2. Nei                                    | Alder                                  |                          |                          |   |
|---|--------------------------|--------------------------|---|---------------------------------------|---|---|---|--------------------------------------|---|---------------------------------------|---|--|--------------------------|--------------------------|---|
| 123. Vannkopper                           | <input type="checkbox"/> | <input type="checkbox"/> | <input type="text"/> <input type="text"/> | 126. Herpes simplex                   | <input type="checkbox"/>                  | <input type="checkbox"/>                  | <input type="text"/> <input type="text"/> | 129. Røde hunder                     | <input type="checkbox"/>                  | <input type="checkbox"/>              | <input type="text"/> <input type="text"/> | 131. Meslinger                         | <input type="checkbox"/> | <input type="checkbox"/> | <input type="text"/> <input type="text"/> |
|   | a                        |                          | b   |                                       | a   |   | b   |                                      | a   |                                       | b   |  | a                        |                          | b   |
| 124. Helvetesild (Varicella Zoster)       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="text"/> <input type="text"/> | 127. Kysse-syken (Mono nucleose)      | <input type="checkbox"/>                  | <input type="checkbox"/>                  | <input type="text"/> <input type="text"/> | 130. 4. barne sykdom (Exant subitum) | <input type="checkbox"/>                  | <input type="checkbox"/>              | <input type="text"/> <input type="text"/> | 132. Hånd, munn, fot (coxsackie virus) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="text"/> <input type="text"/> |
|   | a                        |                          | b   |                                       | a   |   | b   |                                      | a   |                                       | b   |  | a                        |                          | b   |
| 125. Kusma                                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="text"/> <input type="text"/> | 128. Hepatitt A, B, C                 | <input type="checkbox"/>                  | <input type="checkbox"/>                  | <input type="text"/> <input type="text"/> |                                      |   |                                       |   |  |                          |                          |   |
|   | a                        |                          | b   |                                       | a   |   | b   |                                      |   |                                       |   |  |                          |                          |   |
| 133. Falsk krupp (Laryngitt)              | <input type="checkbox"/> | Antall                   | <input type="text"/> <input type="text"/> | Alder første gang                     | <input type="text"/> <input type="text"/> | Alder siste gang                          | <input type="text"/> <input type="text"/> |                                      |   |                                       |   |  |                          |                          |   |
|   | a                        |                          | b   |                                       | c   |   | d   |                                      |   |                                       |   |  |                          |                          |   |
| 134. Forkjølelse (Rhinitt, rennende nese) | <input type="checkbox"/> | Antall første leveår     | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5 | Gj.snitt antall 2-3 leveår                | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5     | Antall siste år                      | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5 |   |  |                          |                          |   |
|   | a                        |                          | b   |                                       |   | c   |   |                                      | d   |                                       |   |  |                          |                          |   |
| 135. Tonsilit                             | <input type="checkbox"/> | Antall første leveår     | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5 | Gj.snitt antall 2-3 leveår                | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5     | Antall siste år                      | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5 |   |  |                          |                          |   |
|   | a                        |                          | b   |                                       |   | c   |   |                                      | d   |                                       |   |  |                          |                          |   |
| 136. Otitis media (mellom ørebet)         | <input type="checkbox"/> | Antall første leveår     | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5 | Gj.snitt antall 2-3 leveår                | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5     | Antall siste år                      | <input type="text"/> <input type="text"/> | 1. Aldri<br>2. 1-2<br>3. 3-5<br>4. >5 |   |  |                          |                          |   |
|   | a                        |                          | b   |                                       |   | c   |   |                                      | d   |                                       |   |  |                          |                          |   |

#### Nedre luftveier:

137. Bronchiolitt (R S og andre)  1. Ja  2. Nei Hvis ja, antall ganger   Alder første gang   mnd  
a b c
138. Innlagt sykehus  1. Ja  2. Nei Hvis ja, hvilket sykehus: \_\_\_\_\_ Alder: \_\_\_\_\_
139. Påvist R-S virus  1. Ja  2. Nei  3. Vet ikke
140. Influensa  1. Ja  2. Nei Hvis ja, antall ganger   Alder første gang    
a b c
141. Innlagt sykehus  1. Ja  2. Nei

|                      |   |  |   |  |                           |
|----------------------|---|--|---|--|---------------------------|
| 142. Bronkitt        | <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei         | Hvis ja, antall ganger<br>a <input type="text"/> | Alder første gang<br>b <input type="text"/> | Innlagt sykehus<br>c <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei | Kode <input type="text"/> |
| 143. Kikhoste        | <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei         | Hvis ja, antall ganger<br>a <input type="text"/> | Alder første gang<br>b <input type="text"/> | Innlagt sykehus<br>c <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei |                           |
| 144. Lungebetennelse | <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei         | Hvis ja, antall ganger<br>a <input type="text"/> | Alder første gang<br>b <input type="text"/> | Innlagt sykehus<br>c <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei |                           |
| Etiologi:            | d <input type="checkbox"/> 1. Ukjent<br><input type="checkbox"/> 2. Kjent | Hvilken: _____                                   |   | Hvilket: _____   |                           |

**Bakterielle:**

|  |   |                                   |   |
|--|---|-----------------------------------|---|
| 145. Urinveisinfeksjoner (øvre og nedre) | <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei | 150. Tuberculose (kun lunger)     | <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei |
| 146. Skarlagensfeber                     | <input type="checkbox"/>  | 151. Tuberculose (ikke lunger)    | <input type="checkbox"/>  |
| 147. Brennkopper (impetigo)              | <input type="checkbox"/>  | 152. Hjernehinne bet. (meningitt) | <input type="checkbox"/>  |
| 148. Benbetennelse (ostemyelitt)         | <input type="checkbox"/>  | Etiologi:                         |   |
| 149. Sepsis (blodforgitning)             | <input type="checkbox"/>  | 153. Abscesser                    | <input type="checkbox"/>  |
|  |   | Etiologi:                         |   |

171. Hvor mange ganger har barnet vært innlagt på sykehus (eksklusiv astma):

Hvis ja, alder:  Årsak: \_\_\_\_\_

Er barnet operert for

172. Mellomørebetennelser:  1. Ja  
 2. Nei

Hvis ja, antall ganger

Alder 1. gang  Alder siste gang

**Soppinfeksjoner:**

|                   |                          |                          |                          |
|-------------------|--------------------------|--------------------------|--------------------------|
| 154. Trøske       | <input type="checkbox"/> | 156. Andre (Fotsopp etc) | <input type="checkbox"/> |
| 155. Bleieutslett | <input type="checkbox"/> |                          |                          |

173. Tonsillehypertrofi:  1. Ja  
 2. Nei

Hvis ja, Alder 1. gang  Alder siste gang

**Mage/tarm infeksjoner:**

|  |                            |                                      |   |
|--|----------------------------|--------------------------------------|---|
| 157. Omgangssyke (gastroenteritt)      | a <input type="checkbox"/> | Antall totalt b <input type="text"/> | Antall første leveår c <input type="text"/> |
| 158. Salmonella og andre bakt. infek.  | <input type="checkbox"/>   |                                      |   |
| 159. Orme/parasitt sykdommer           | <input type="checkbox"/>   |                                      |   |
| 160. Utredet for feber av ukjent årsak | <input type="checkbox"/>   |                                      |   |
| 161. Andre infeksjoner                 | <input type="checkbox"/>   | Hvilke: _____                        |   |

174. Falske mandler (adenoide vegetasjoner)  1. Ja  
 2. Nei

Hvis ja, Alder 1. gang  Alder siste gang

175. Utredet for snorking (adenoider og otitt) (ikke operert)  1. Ja  
 2. Nei

Hvis ja, Alder 1. gang  Alder siste gang

**Tidligere ikke infeksjøs sykdommer:**

|                      |   |                                 |   |
|----------------------|---|---------------------------------|---|
| 162. Magetarmkanalen | <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei | 167. Blod lymfeorganer          | <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei |
| 163. Hjerne/kar      | <input type="checkbox"/>  | 168. Urinveier                  | <input type="checkbox"/>  |
| 164. Endokrinologi   | <input type="checkbox"/>  | 169. Luftveier (ekskl. OAD)     | <input type="checkbox"/>  |
| 165. Nevrologi       | <input type="checkbox"/>  | 170. Reumatisk bindevevs sykdom | <input type="checkbox"/>  |
| 166. Muskel/skjelett | <input type="checkbox"/>  | Hvilke: _____                   |   |

176. Har barnet fått antibiotika?  1. Ja  
 2. Nei

177. Hvor mange antibiotikakurer har barnet fått totalt?

Første to leveår  Fra 2 års alder

178. For hva:

Otitter  a  < 2 år  e

Andre luftveisinfeksjoner  b  > 2 år  f

Urinveisinfeksjoner  c  g

Annet  d  h



179. Hvor mange perioder har barnet fått febernedsettende pr år?

Første to leveår      Fra 2 års alder  
a  1. Aldri 3. 3-5      b   
2. <2 4. >5

For hva: \_\_\_\_\_ For hva: \_\_\_\_\_

180. Type febernedsettende:  1. Paracetamol  
 2. Acetylsalicylsyre

181. Bruker/har barnet brukt andre typer medikamenter? (ikke astma/allergimedisiner)  1. Ja  
 2. Nei

Hvis ja, for hva: \_\_\_\_\_

hvilket medikament: \_\_\_\_\_

i hvilken periode: \_\_\_\_\_

### Atopisk sykehistorie

182. Har barnet fått påvist en eller flere allergier, ikke matvareallergier? a  1. Ja  
 2. Nei

Hvis ja, alder:   b

183. Har barnet noen gang fått diagnosen høysnue, allergisk rhinitt? a  1. Ja  
 2. Nei

Hvis ja, alder:   b

184. Har barnet noen gang hatt følgende symptomer uavhengig av forkjølelse? a  1. Ja  
 2. Nei

Hvis ja, hva var debut alder: b

c  Rennende nese      e  Nesetetthet  
d  Kløende/rennende øyne      f  Nysing

185. Har barnet noen gang i.l.a. de siste 12 mnd hatt følgende symptomer uavhengig av forkjølelse?

Hvis ja, hvilke: a  1. Ja  
 2. Nei

b  Rennende nese      d  Nesetetthet  
c  Kløende/rennende øyne      e  Nysing

Hvis ja, når har barnet symptomer?

f  1. Hele året    2. Vår/sommerhalvåret  
3. Høst/vinterhalvåret

186. Hva er det som utløser disse øye/nese sympt?

a  Vet ikke      f  Trepollen  
b  Hund      g  Andre pollen  
c  Katt      h  Temperaturforandring/  
d  Andre pelsdyr      fysisk aktivitet  
e  Annet

Hva: \_\_\_\_\_

Kode

187. I hvor stor grad har disse øye/nese symptomene innvirket på de daglige aktivitetene?

1. Ikke i det hele tatt    2. Litt  
 3. Moderat                    4. Mye

188. Har barnet vært utredet pga øye/nese symptomene? a  1. Ja  
 2. Nei

Alder første gang: b

Hvis ja, hvordan?

c  Prikktest      e  Sykehistorie alene  
d  Provokasjon    f  Blodprøver (Spesifikk IgE)

189. Hva slags behandling har barnet fått for sine øye/nese symptomer?

a  Ingen behandling  
b  Vet ikke  
c  Lokale antihistaminer  
d  Systemiske antihistaminer  
e  Lokale steroider  
f  Systemiske steroider  
g  Natriumkromoglikat  
h  Leukotrienantagonist  
i  Hyposensibilisering  
j  Homeopati  
k  Annen alternativ behandling

Hva: \_\_\_\_\_

190. Har barnet hatt/har barnet i dag atopisk eksem (barneeksem)? a  1. Ja  
 2. Nei

Alder ved symptomstart b

Hvis ja, har barnet fortsatt atopisk eksem? c  1. Ja  
 2. Nei

Hvis nei, alder ved symptomslutt: d

191. Hva forverrer/forverret eksemet?

a  Fødemidler med melk  
b  Fødemidler med egg  
c  Andre fødemidler  
d  Andre allergier  
e  Annet - Hva: \_\_\_\_\_

|  |   |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
|--|---|----------------------------|---|------------------|----------------------------|--|--------|----------------------------|----------------------------|-------------|---------------|----------------------------|-----|----------------------------|----------------------------|-------------------------|---------------|----------------------------|------|----------------------------|----------------------------|----------------------------|------|----------------------------|--------|----------------------------|----------------------------|------------------------------|------------------|----------------------------|-------------|----------------------------|----------------------------|---|-------|----------------------------|--|--|-----------|----|--|----------------------------|----------------------------|--|----------------------------|----------------------------|--|----------------------------|--|
| 192. Når er eksemet til stede? <input type="checkbox"/> 1. Kun i vinterhalvåret<br><input type="checkbox"/> 2. Hele året<br><input type="checkbox"/> 3. Annet  | Kode <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>  |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| 193. Hva slags behandling har barnet fått?<br>a <input type="checkbox"/> Kun fuktighetskrem<br>b <input type="checkbox"/> Steroidsalve gr. 1-2<br>c <input type="checkbox"/> Steroidsalve gr. 3-4<br>d <input type="checkbox"/> Lysbehandling<br>e <input type="checkbox"/> KPbad/krySTALLfiolett pensling/alsolomslag<br>f <input type="checkbox"/> Annet<br>Hva: _____   | 196. Har barnet hatt en kjent matvareallergi? <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei<br>197. Mistenkt matvareallergi? <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei<br>198. Hvis ja, har barnet fortsatt matvareallergi? <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei<br>199. Alder ved symptomstart: <input type="text"/> <input type="text"/>   |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| 194. Har barnet vært innlagt sykehus pga eksemet?<br>Hvis ja, hvilket type sykehus?<br>a <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei<br>b <input type="checkbox"/> 1. Lokal sykehus<br><input type="checkbox"/> 2. Region sykehus  | 200. Hvilke symptomer ga matvareallergien?<br>a <input type="checkbox"/> Utslett<br>b <input type="checkbox"/> Magesmerter<br>c <input type="checkbox"/> Eksem<br>d <input type="checkbox"/> Allergisjokk<br>e <input type="checkbox"/> Urticaria<br>f <input type="checkbox"/> Uro<br>g <input type="checkbox"/> Pusteproblemer<br>h <input type="checkbox"/> Diarrhea/kvalme<br>i <input type="checkbox"/> Liten vekt oppgang<br>j <input type="checkbox"/> Kløe i munn/svelg<br>k <input type="checkbox"/> Hudkløe<br>l <input type="checkbox"/> Annet<br>Hva: _____ |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| 195. Har barnet pga eksemet vært på:<br>1. Ja<br>2. Nei<br>a <input type="checkbox"/> Behandlingsreiser<br>b <input type="checkbox"/> Voksentoppen<br>c <input type="checkbox"/> Geilomo   |   |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| 201. Hvilke matvarer var/er barnet allergisk mot?  |   |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| <table border="0"> <tr> <td></td> <td>Tidligere</td> <td>Nå</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Kumelk</td> <td>a <input type="checkbox"/></td> <td>k <input type="checkbox"/></td> <td>1. Mistenkt</td> <td>Sitrusfrukter</td> <td>f <input type="checkbox"/></td> </tr> <tr> <td>Egg</td> <td>b <input type="checkbox"/></td> <td>l <input type="checkbox"/></td> <td>2. Påvist v/S-IgE alene</td> <td>Tomat/jordbær</td> <td>g <input type="checkbox"/></td> </tr> <tr> <td>Fisk</td> <td>c <input type="checkbox"/></td> <td>m <input type="checkbox"/></td> <td>3. Påvist v/prikkest alene</td> <td>Kiwi</td> <td>h <input type="checkbox"/></td> </tr> <tr> <td>Nøtter</td> <td>d <input type="checkbox"/></td> <td>n <input type="checkbox"/></td> <td>4. Påvist v/S-IgE + prikkest</td> <td>Mel, alle sorter</td> <td>i <input type="checkbox"/></td> </tr> <tr> <td>Stenfrukter</td> <td>e <input type="checkbox"/></td> <td>o <input type="checkbox"/></td> <td>5. Påvist v/provokasjon (inkl. alle parametre).</td> <td>Annet</td> <td>j <input type="checkbox"/></td> </tr> </table> |   | Tidligere                  | Nå  |                  |                            |  | Kumelk | a <input type="checkbox"/> | k <input type="checkbox"/> | 1. Mistenkt | Sitrusfrukter | f <input type="checkbox"/> | Egg | b <input type="checkbox"/> | l <input type="checkbox"/> | 2. Påvist v/S-IgE alene | Tomat/jordbær | g <input type="checkbox"/> | Fisk | c <input type="checkbox"/> | m <input type="checkbox"/> | 3. Påvist v/prikkest alene | Kiwi | h <input type="checkbox"/> | Nøtter | d <input type="checkbox"/> | n <input type="checkbox"/> | 4. Påvist v/S-IgE + prikkest | Mel, alle sorter | i <input type="checkbox"/> | Stenfrukter | e <input type="checkbox"/> | o <input type="checkbox"/> | 5. Påvist v/provokasjon (inkl. alle parametre). | Annet | j <input type="checkbox"/> | <table border="0"> <tr> <td></td> <td>Tidligere</td> <td>Nå</td> </tr> <tr> <td></td> <td>p <input type="checkbox"/></td> <td>q <input type="checkbox"/></td> </tr> <tr> <td></td> <td>r <input type="checkbox"/></td> <td>s <input type="checkbox"/></td> </tr> <tr> <td></td> <td>t <input type="checkbox"/></td> <td></td> </tr> </table> |  | Tidligere | Nå |  | p <input type="checkbox"/> | q <input type="checkbox"/> |  | r <input type="checkbox"/> | s <input type="checkbox"/> |  | t <input type="checkbox"/> |  |
|  | Tidligere   | Nå                         |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| Kumelk   | a <input type="checkbox"/>  | k <input type="checkbox"/> | 1. Mistenkt                                     | Sitrusfrukter    | f <input type="checkbox"/> |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| Egg  | b <input type="checkbox"/>  | l <input type="checkbox"/> | 2. Påvist v/S-IgE alene                         | Tomat/jordbær    | g <input type="checkbox"/> |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| Fisk   | c <input type="checkbox"/>  | m <input type="checkbox"/> | 3. Påvist v/prikkest alene                      | Kiwi             | h <input type="checkbox"/> |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| Nøtter   | d <input type="checkbox"/>  | n <input type="checkbox"/> | 4. Påvist v/S-IgE + prikkest                    | Mel, alle sorter | i <input type="checkbox"/> |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| Stenfrukter  | e <input type="checkbox"/>  | o <input type="checkbox"/> | 5. Påvist v/provokasjon (inkl. alle parametre). | Annet            | j <input type="checkbox"/> |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
|  | Tidligere   | Nå                         |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
|  | p <input type="checkbox"/>  | q <input type="checkbox"/> |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
|  | r <input type="checkbox"/>  | s <input type="checkbox"/> |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
|  | t <input type="checkbox"/>  |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| 202. Har barnet hatt elveblest? Hvis ja, hvor ofte?<br>a <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei<br>b <input type="checkbox"/> 1. En gang 2. 2-5 ganger 3. >5 ganger   | 205. Har barnet noen gang hatt pustevansker i forbindelse med elveblesten? <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei  |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| 203. Hva utløser elveblesten?<br>a <input type="checkbox"/> Vet ikke<br>b <input type="checkbox"/> Pollen<br>c <input type="checkbox"/> Matvarer<br>d <input type="checkbox"/> Pelsdyr<br>e <input type="checkbox"/> Kulde/berøring<br>f <input type="checkbox"/> Infeksjoner<br>Hvilke matvarer: _____  | 206. Har barnet noen gang hatt et allergisk sjokk (anafylaktisk sjokk)?<br>a <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei<br>Hvis ja, antall ganger: b <input type="text"/> <input type="text"/> Alder første gang: c <input type="text"/> <input type="text"/><br>Hvis ja, hva var det barnet reagerte på? _____  |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |
| 204. Hva slags behandling har barnet fått for elveblesten?<br>a <input type="checkbox"/> Ingen<br>b <input type="checkbox"/> Antihistaminer<br>c <input type="checkbox"/> Adrenalin<br>d <input type="checkbox"/> Steroider  | 207. Har barnet vært innlagt sykehus pga. allergisk sjokk? <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei<br>Hvis ja, hvilken allergi? _____<br>208. Har barnet adrenalin penn (Epi-penn, Anaguard)? <input type="checkbox"/> 1. Ja<br><input type="checkbox"/> 2. Nei   |                            |   |                  |                            |  |        |                            |                            |             |               |                            |     |                            |                            |                         |               |                            |      |                            |                            |                            |      |                            |        |                            |                            |                              |                  |                            |             |                            |                            |   |       |                            |  |  |           |    |  |                            |                            |  |                            |                            |  |                            |  |





Kode

Har barnet brukt: (som hjemme behandling)

0-3 år

Etter fylte 4 år

224. 1.Ja 2.Nei

|   |   |                          |
|---|---|--------------------------|
| $\beta$ -2 agonist på forstøver         | a | <input type="checkbox"/> |
| $\beta$ -2 agonist som spray            | b | <input type="checkbox"/> |
| $\beta$ -2 agonist som spray m/kammer   | c | <input type="checkbox"/> |
| $\beta$ -2 agonist som pulver           | d | <input type="checkbox"/> |
| $\beta$ -2 agonist som mikstur          | e | <input type="checkbox"/> |
| Langtidsvirkende $\beta$ -2 agonist     | f | <input type="checkbox"/> |
| Lomudal som spray                       | g | <input type="checkbox"/> |
| Lomudal som pulver                      | h | <input type="checkbox"/> |
| Lomudal på forstøver                    | i | <input type="checkbox"/> |
| Inhalasjonssteroider som spray          | j | <input type="checkbox"/> |
| Inhalasjonssteroider som spray m/kammer | k | <input type="checkbox"/> |
| Inhalasjonssteroider som pulver         | l | <input type="checkbox"/> |
| Inhalasjonssteroider på forstøver       | m | <input type="checkbox"/> |
| Leukotrienantagonist                    | n | <input type="checkbox"/> |
| Ipratropiumbromid (Atrovent)            | o | <input type="checkbox"/> |
| Adrenalin på forstøver                  | p | <input type="checkbox"/> |
| Aminophyllin klyster                    | q | <input type="checkbox"/> |
| Aminophyllin p.o.                       | r | <input type="checkbox"/> |
| Hyposensibilisering                     | s | <input type="checkbox"/> |
| Systemiske steroider                    | t | <input type="checkbox"/> |

225.

|   |   |                          |
|---|---|--------------------------|
| $\beta$ -2 agonist på forstøver         | a | <input type="checkbox"/> |
| $\beta$ -2 agonist som spray            | b | <input type="checkbox"/> |
| $\beta$ -2 agonist som spray m/kammer   | c | <input type="checkbox"/> |
| $\beta$ -2 agonist som pulver           | d | <input type="checkbox"/> |
| $\beta$ -2 agonist som mikstur          | e | <input type="checkbox"/> |
| Langtidsvirkende $\beta$ -2 agonist     | f | <input type="checkbox"/> |
| Lomudal som spray                       | g | <input type="checkbox"/> |
| Lomudal som pulver                      | h | <input type="checkbox"/> |
| Lomudal på forstøver                    | i | <input type="checkbox"/> |
| Inhalasjonssteroider som spray          | j | <input type="checkbox"/> |
| Inhalasjonssteroider som spray m/kammer | k | <input type="checkbox"/> |
| Inhalasjonssteroider som pulver         | l | <input type="checkbox"/> |
| Inhalasjonssteroider på forstøver       | m | <input type="checkbox"/> |
| Leukotrienantagonist                    | n | <input type="checkbox"/> |
| Ipratropiumbromid (Atrovent)            | o | <input type="checkbox"/> |
| Adrenalin på forstøver                  | p | <input type="checkbox"/> |
| Aminophyllin klyster                    | q | <input type="checkbox"/> |
| Aminophyllin p.o.                       | r | <input type="checkbox"/> |
| Hyposensibilisering                     | s | <input type="checkbox"/> |
| Systemiske steroider                    | t | <input type="checkbox"/> |

1. Ikke etter fylte 4 år
2. Etter fylte 4 år
3. Siste 12 mndr.
4. Siste 14 dager





Kode

226.Hvis barnet har brukt  $\beta$ -2 agonist siste 12 mnd/14 dager, hvor stort har forbruket i gjennomsnitt vært pr. brukeruke?

Siste 12 mnd

Siste 14 dager

a

1. Daglig
2. 4-6 dager/uke
3. 1-3 dager/uke

d

Antall puff/dag

b

e

Hvor mange uker

c

f

227.Har barnet brukt  $\beta$ -2 agonist (hurtigvirkende astmamedisin) i forbindelse med fysisk aktivitet de siste 12 måneder?

1.Ja  
 2.Nei

228.Hvis barnet har brukt inhalasjonssteroider, hva var alder ved behandlingsstart?

a   år

Bruker barnet fortsatt inhalasjonssteroider?

b  1.Ja  
 2.Nei

Hvis nei, alder ved seponering:

c   år

229.Hvis barnet har brukt inhalasjonssteroider siste 12 mnd/14 dager, hvilken type og hvor stor dose?

Siste 12 mnd

Siste 14 dager

a

1. Flutide
2. Pulmicort/Becotide
3. Annen

c

hvilken:

b     Dose (ug/dag) d

230.Hvis barnet bruker inhalasjonssteroider, bruker barnet det hele året?

1.Ja  
 2.Nei

231.Hvis ja, hvor mange måneder, siste år?

232.Hvis nei, hvilken/hvilke deler av året bruker barnet inhalasjonssteroider?

- a  Sommer    c  Vinter  
b  Høst        d  Vår

233.Hvis barnet bruker inhalasjonssteroider, bruker barnet det kun ved forverrelser?

a  1.Ja  
 2.Nei

Hvis ja, hvor mange perioder brukte barnet inhalasjonssteroider siste år?

b

234.Har barnet noen gang brukt systemiske steroidkurer ?

a   1.Ja  
  2.Nei

Hvis ja, hva var alder ved første kur?

b

Antall systemiske steroidkurer siste 12 mnd?

c

235.Har barnet vært til alternativ behandling for sin astma?

a  1.Ja  
 2.Nei

Hvis ja, var/er det: 1.Regelmessig  
2.Sporadisk

b

Alder første gang:

c

236.Hvis ja, hvilken type?

- a  Homeopat  
b  Fysioterapi  
c  Akupunktur  
d  Annet

hva: \_\_\_\_\_

237.Hvordan vil du karakterisere barnets helse i forhold til astma/astmalignende symptomer?

0-3 år

Etter fylte 4 år

a

b

Siste 12 mnd

Siste 14 dager

c

d

- 1.Ikke syk i det hele tatt
- 2.Svært lite syk
- 3.Endel syk, men ikke særlig plagsomt
- 4.Mye syk, men tolerabelt for familien
- 5.Svært mye syk, går utover familien



Kode

238. Hvor mye har barnet vært borte fra skolen pga astma?

Siste 12 mnd

a

1. Intet fravær
2. < 5 dager
3. 5-10 dager
4. > 10 dager

Siste 14 dager

b

239. Føler barnet (spør det) at astmaen hemmer dets fysiske aktivitet?

a  1.Ja  
2.Nei

Føler du at astmaen vanligvis hemmer barnets fysiske aktivitet nå?

b  1.Ja  
2.Nei

240. Hvor mange ganger har barnet vært hos doktor pga astma de siste 12 måneder?

Rutinekontroll  a Pga akutte forverrelser  b

241. Har barnet vært innlagt sykehus pga astma/ obstruktivt pustebesvær?

a  1.Ja  
2.Nei

Hvis ja, antall innleggelser: b

Alder første innleggelse c  Alder siste innleggelse d

Ved hvilket/hvilke sykehus:

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---

242. Hva slags behandling fikk barnet ved innleggelsene? (Antall innleggelser med aktuell behandling).

a

i.v. behandling

b

Inhalasjons  
behandling

c

Systemiske  
steroider

243. Har barnet vært innlagt på Voksentoppen og/eller Geilomo?

a  1.Ja  
2.Nei

Hvis ja, antall ganger: Voksentoppen b  Geilomo c

244. Har barnet vært på behandlingsreiser pga astma?

1.Ja  
2.Nei



## **Appendix 5**

ACQ-questionnaire (paper 4)



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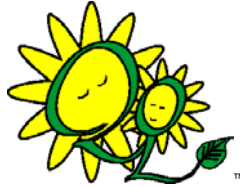
# KONTROLLSKJEMA FOR ASTMA (ACQ)

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## NORWEGIAN VERSION

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Senior Translator: Torbjørn Moum

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NOVEMBER 1999

Vennligst svar på spørsmålene 1-6.

Sett en ring rundt tallet for det svaret som best beskriver hvordan du har hatt det den siste uken.

- |   |   |
|---|---|
| 1. Hvor ofte har du vanligvis <b>våknet</b> om natten <b>på grunn av astmaen</b> i den siste uken?        | 0 Aldri<br>1 Nesten aldri<br>2 Noen få ganger<br>3 Nokså mange ganger<br>4 Mange ganger<br>5 Svært mange ganger<br>6 Umulig å sove på grunn av astmaen                  |
| 2. Hvor <b>sterke var astmasymptomene</b> i den siste uken vanligvis <b>når du våknet</b> om morgenen?    | 0 Ingen symptomer<br>1 Svært milde symptomer<br>2 Milde symptomer<br>3 Moderate symptomer<br>4 Nokså sterke symptomer<br>5 Sterke symptomer<br>6 Meget sterke symptomer |
| 3. Hvor <b>hemmet var du</b> generelt sett av astmaen <b>i dine gjøremål</b> i den siste uken?            | 0 Ikke hemmet i det hele tatt<br>1 Svært lite hemmet<br>2 Litt hemmet<br>3 Moderat hemmet<br>4 Meget hemmet<br>5 Svært hemmet<br>6 Totalt hemmet                        |
| 4. Hvor mye <b>kortpustethet</b> opplevde du generelt sett i løpet av den siste uken på grunn av astmaen? | 0 Ingen<br>1 Svært lite<br>2 Litt<br>3 Moderat<br>4 Nokså mye<br>5 Mye<br>6 Svært mye   |

5. Hvor stor del av tiden hadde du **piping i brystet** generelt sett i løpet av den siste uken?
- 0 Ikke noe av tiden  
1 Nesten ikke noe av tiden  
2 Litt av tiden  
3 En del av tiden  
4 En god del av tiden  
5 Mesteparten av tiden  
6 Hele tiden
6. Hvor mange **sprayer/inhalasjoner med hurtigvirkende astmamedisin** (f.eks. Ventolin/Bricanyl/Berotec) har du vanligvis brukt hver dag den siste uken?
- 0 Ingen  
1 1 - 2 sprayer/inhalasjoner de fleste dagene  
2 3 - 4 sprayer/inhalasjoner de fleste dagene  
3 5 - 8 sprayer/inhalasjoner de fleste dagene  
4 9 - 12 sprayer/inhalasjoner de fleste dagene  
5 13 - 16 sprayer/inhalasjoner de fleste dagene  
6 Mer enn 16 sprayer/inhalasjoner de fleste dagene
- (Vennligst be om hjelp dersom du er usikker på hvorledes du skal svare på dette spørsmålet.)*

### Fylles ut av en ansatt ved klinikken

7. FEV<sub>1</sub> pre-luftveisdilator: ..... 0 > 95% forventet  
1 95 - 90%  
FEV<sub>1</sub> forventet:..... 2 89 - 80%  
3 79 - 70%  
FEV<sub>1</sub> % forventet:..... 4 69 - 60%  
(Noter reelle verdier på de prikkede linjene 5 59 - 50%  
og før opp FEV<sub>1</sub> % forventet i neste 6 < 50% forventet  
kolonne)





## **Appendix 6**

PAQLQ-questionnaire (paper 4)



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# SPØRRESKJEMA OM ASTMA OG LIVSKVALITET FOR BARN OG UNGDOM MED STANDARDISERTE AKTIVITETER (PAQLQ(S))

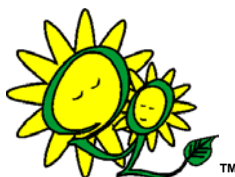
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Web: <http://www.qoltech.co.uk>

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ASTRAZENECA R&D Lund

Translated by MAPI RESEARCH INSTITUTE  
Senior Translators: Torbjørn Moum

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DESEMBER 2000

SPØRRESKJEMA OM ASTMA  
OG LIVSKVALITET FOR BARN OG UNGDOM (S)  
(NORWEGIAN VERSION)  
UTFYLLES AV PASIENTEN

PASIENTIDENTIFIKASJON \_\_\_\_\_

DATO \_\_\_\_\_

side 1/4

Vennligst fyll ut **alle** spørsmålene ved å sette en ring rundt det tallet som passer best med hvordan du har hatt det i løpet av **den siste uka, på grunn av astmaen din.**

HVOR **PLAGET** HAR DU VÆRT I LØPET AV DEN SISTE UKA AV:

|   | Enormt plaget | Veldig plaget | Mye plaget | Ganske plaget | Litt plaget | Nesten ikke plaget | Ikke plaget |
|---|---------------|---------------|------------|---------------|-------------|--------------------|-------------|
| 1. AKTIVITET MED KROPPEN (slik som å løpe, svømme, idrett, gå oppoverbakke/opp trapper og sykling)?                       | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |
| 2. Å VÆRE SAMMEN MED DYR (slik som å leke med kjæledyr og passe dyr)?   | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |
| 3. TING DU GJØR SAMMEN MED VENNER OG FAMILIEN (slik som å leke i friminuttet, og gjøre noe sammen med venner og familie)? | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |
| 4. HOSTING  | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |

ALT I ALT, **HVOR OFTE** DEN SISTE UKA HAR DU:

|   | Hele tiden | Nesten hele tiden | Ganske ofte | En del av tiden | Av og til | Nesten ikke noe av tiden | Ikke noe av tiden |
|---|------------|-------------------|-------------|-----------------|-----------|--------------------------|-------------------|
| 5. Følt deg FRUSTRERT OG LEI på grunn av astmaen?         | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |
| 6. Følt deg SLITEN på grunn av astmaen?                   | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |
| 7. Følt deg BEKYMRET ELLER ENGSTELIG på grunn av astmaen? | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |

SPØRRESKJEMA OM ASTMA  
OG LIVSKVALITET FOR BARN OG UNGDOM (S)  
(NORWEGIAN VERSION)  
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PASIENTIDENTIFIKASJON \_\_\_\_\_

DATO \_\_\_\_\_

side 2/4

HVOR **PLAGET** HAR DU VÆRT DEN SISTE UKA AV:

|                  | Enormt plaget | Veldig plaget | Mye plaget | Ganske plaget | Litt plaget | Nesten ikke plaget | Ikke plaget |
|------------------|---------------|---------------|------------|---------------|-------------|--------------------|-------------|
| 8. ASTMA-ANFALL? | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |

ALT I ALT, **HVOR OFTE** DEN SISTE UKA HAR DU:

|                                   | Hele tiden | Nesten hele tiden | Ganske ofte | En del av tiden | Av og til | Nesten ikke noe av tiden | Ikke noe av tiden |
|-----------------------------------|------------|-------------------|-------------|-----------------|-----------|--------------------------|-------------------|
| 9. Vært SINT på grunn av astmaen? | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |

HVOR **PLAGET** HAR DU VÆRT DEN SISTE UKA AV:

|                       | Enormt plaget | Veldig plaget | Mye plaget | Ganske plaget | Litt plaget | Nesten ikke plaget | Ikke plaget |
|-----------------------|---------------|---------------|------------|---------------|-------------|--------------------|-------------|
| 10. PIPING I BRYSTET? | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |

ALT I ALT, **HVOR OFTE** DEN SISTE UKA HAR DU:

|   | Hele tiden | Nesten hele tiden | Ganske ofte | En del av tiden | Av og til | Nesten ikke noe av tiden | Ikke noe av tiden |
|---|------------|-------------------|-------------|-----------------|-----------|--------------------------|-------------------|
| 11. Vært SUR OG GRETTE PÅ grunn av astmaen? | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |

HVOR **PLAGET** HAR DU VÆRT DEN SISTE UKA AV:

|                        | Enormt plaget | Veldig plaget | Mye plaget | Ganske plaget | Litt plaget | Nesten ikke plaget | Ikke plaget |
|------------------------|---------------|---------------|------------|---------------|-------------|--------------------|-------------|
| 12. TETTHET I BRYSTET? | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |

SPØRRESKJEMA OM ASTMA  
OG LIVSKVALITET FOR BARN OG UNGDOM (S)  
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DATO \_\_\_\_\_

side 3/4

ALT I ALT, **HVOR OFTE** DEN SISTE UKA HAR DU:

|   | Hele tiden | Nesten hele tiden | Ganske ofte | En del av tiden | Av og til | Nesten ikke noe av tiden | Ikke noe av tiden |
|---|------------|-------------------|-------------|-----------------|-----------|--------------------------|-------------------|
| 13. Følt deg FORSKJELLIG FRA ANDRE ELLER UTENFOR på grunn av astmaen? | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |

HVOR **PLAGET** HAR DU VÆRT DEN SISTE UKA AV:

|                    | Enormt plaget | Veldig plaget | Mye plaget | Ganske plaget | Litt plaget | Nesten ikke plaget | Ikke plaget |
|--------------------|---------------|---------------|------------|---------------|-------------|--------------------|-------------|
| 14. TUNGPUSTETHET? | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |

ALT I ALT, **HVOR OFTE** DEN SISTE UKA HAR DU:

|   | Hele tiden | Nesten hele tiden | Ganske ofte | En del av tiden | Av og til | Nesten ikke noe av tiden | Ikke noe av tiden |
|---|------------|-------------------|-------------|-----------------|-----------|--------------------------|-------------------|
| 15. Følt deg FRUSTRERT OG LEI FORDI DU IKKE KLARTE Å HOLDE FØLGE MED ANDRE? | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |
| 16. VÅKNET OM NATTA på grunn av astmaen?                                    | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |
| 17. Hatt det UBEHAGELIG ELLER EKKELT på grunn av astmaen?                   | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |
| 18. Følt deg ANDPUSTEN?   | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |
| 19. Følt at DU IKKE KLARTE Å HOLDE FØLGE MED ANDRE på grunn av astmaen?     | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |

SPØRRESKJEMA OM ASTMA  
OG LIVSKVALITET FOR BARN OG UNGDOM (S)  
(NORWEGIAN VERSION)  
UTFYLLES AV PASIENTEN

PASIENTIDENTIFIKASJON \_\_\_\_\_

DATO \_\_\_\_\_

side 4/4

ALT I ALT, **HVOR OFTE** DEN SISTE UKA HAR DU:

|  | Hele tiden | Nesten hele tiden | Ganske ofte | En del av tiden | Av og til | Nesten ikke noe av tiden | Ikke noe av tiden |
|--|------------|-------------------|-------------|-----------------|-----------|--------------------------|-------------------|
| 20. Hatt vanskelig for å få SOVE OM NATTA på grunn av astmaen? | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |
| 21. Blitt REDD på grunn av et astma-anfall?                    | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |

TENK PÅ ALLE DE TINGENE DU HAR GJORT DEN SISTE UKA:

|   | Enormt plaget | Veldig plaget | Mye plaget | Ganske plaget | Litt plaget | Nesten ikke plaget | Ikke plaget |
|---|---------------|---------------|------------|---------------|-------------|--------------------|-------------|
| 22. Hvor plaget har du vært av astmaen i disse tingene? | 1             | 2             | 3          | 4             | 5           | 6                  | 7           |

ALT I ALT, **HVOR OFTE** DEN SISTE UKA HAR DU:

|  | Hele tiden | Nesten hele tiden | Ganske ofte | En del av tiden | Av og til | Nesten ikke noe av tiden | Ikke noe av tiden |
|--|------------|-------------------|-------------|-----------------|-----------|--------------------------|-------------------|
| 23. Hatt vanskelig for å TREKKE PUSTEN DYPT? | 1          | 2                 | 3           | 4               | 5         | 6                        | 7                 |

**OMRÅDEKODE:**

**Symptomer: 4, 6, 8, 10, 12, 14, 16, 18, 20, 23**

**Begrenset aktivitet: 1, 2, 3, 19, 22**

**Følelsesmessig fungering: 5, 7, 9, 11, 13, 15, 17, 21**





## **Appendix 7**

Questionnaire to assess personal, social and environmental correlates of physical activity (paper 2)



IDnummer

|  |  |  |  |
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## SPØRRESKJEMA OM FYSISK AKTIVITET

### Les dette først!

På de neste sidene følger noen spørsmål om fysisk aktivitet (leke, være i bevegelse, drive idrett), om hva du spiser, TV-titting og hvor mye du sover. Du skal sette kryss ved det svaret som passer best for deg. Det er viktig at du leser spørsmålet og svarene nøye før du setter kryss. Dersom du ønsker å forandre et svar etter at du har satt kryss – sett da strek over krysset, og sett et nytt kryss på det svaret som passer best. Dersom det er noe du lurer på kan du spørre om hjelp.

Husk dette før du setter i gang: Vær ærlig! Det er ingen svar som er mer riktige enn andre, og ingen får vite hva du har svart.

Lykke til med skjemaet!



1. Er du gutt eller jente?

- Gutt  
 Jente

2. Hvordan kommer du deg vanligvis til skolen? (Sett bare ett kryss)

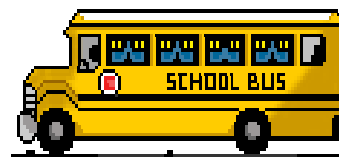
- Med bil eller motorsykkel  
 Med buss, trikk, t-bane eller tog  
 Med sykkel  
 Går

3. Hvordan kommer du deg vanligvis hjem fra skolen? (Sett bare ett kryss)

- Går  
 Med bil eller motorsykkel  
 Med buss, trikk, t-bane eller tog  
 Med sykkel

4. Hvor lang tid bruker du vanligvis til skolen?  
(Sett bare ett kryss)

- Mindre enn 5 minutter  
 6 til 15 minutter  
 16 til 30 minutter  
 31 minutter til 1 time  
 Mer enn 1 time



De neste spørsmålene dreier seg om fysisk aktivitet som du gjør på FRITIDEN (for eksempel i helgene, på ettermiddag/kveld og i ferier), IKKE når du er på skolen. Eksempler på fysisk aktivitet er å løpe, gå fort, stå på rulle skøyter, bruke sparkesykkel, sykle, gå på ski, svømme, spille fotball eller danse

**IDRETT/MOSJON/FYSISK AKTIVITET** – all aktivitet som gjør deg andpusten eller litt svett.

5. Utenom skoletid: Hvor mange ganger i uka driver du idrett/mosjon slik at du blir andpusten eller svett?

- ganger per uke

6. Omtrent hvor mange timer per uke bruker du på dette? (Sett bare ett kryss)

- 0 timer  
 1-2 timer  
 3-4 timer  
 5-7 timer  
 8-10 timer  
 11 timer eller mer

7. Hvor slitsom er denne idretts-/mosjonsaktiviteten? (Sett bare ett kryss)

- Driver ikke idrett/mosjon  
 Litt anstrengende  
 Ganske anstrengende  
 Meget anstrengende  
 Svært anstrengende

8. **Hvor ofte har du drevet med følgende treningsaktiviteter i løpet av de siste 12 måneder i snitt? (Sett ett kryss for hver aktivitetsgruppe)**

|   | Aldri                    | Under<br>1 gang<br>pr uke | 1<br>gang<br>pr uke      | Flere<br>ganger<br>pr uke |
|---|--------------------------|---------------------------|--------------------------|---------------------------|
| Utholdenhetsidrett (feks løp, sykling, langrenn, svømming).....   | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>  |
| Lag-/ballidretter (feks squash, håndball, fotball, ishockey).....                                       | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>  |
| Styrkeidrett (feks bryting, vekttrening).....   | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>  |
| Kampsport (feks judo, karate, taekwondo).....   | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>  |
| Tekniske idretter (feks ridning, alpint, telemark, friidrett, snowboard, golf, rullebrett/skøyter)..... | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>  |
| Risikoidrett (feks elvepadling, fjellklatring, paragliding).....  | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>  |
| Annet.....  | <input type="checkbox"/> | <input type="checkbox"/>  | <input type="checkbox"/> | <input type="checkbox"/>  |

9. **Hvor ofte trener, leker eller driver du med idrett med vennene dine? (Sett bare ett kryss)**

- Nesten aldri eller aldri
- En eller to ganger i uken
- Nesten hver dag
- Hver dag

10. **Hvor ofte SPØR DU vennene dine om å trene, leke eller drive idrett/fysisk aktivitet med deg? (Sett bare ett kryss)**

- Nesten aldri eller aldri
- En eller to ganger i uken
- Nesten hver dag
- Hver dag

11. **Hvor ofte SPØR vennene dine DEG om du vil trene, leke eller drive idrett/fysisk aktivitet? (Sett bare ett kryss)**

- Nesten aldri eller aldri
- En eller to ganger i uken
- Nesten hver dag
- Hver dag

12. **Hvor ofte OPPMUNTRER din mor eller far DEG å trene, leke eller drive med idrett/fysisk aktivitet? (Sett bare ett kryss)**

- Nesten aldri eller aldri
- En eller to ganger i uken
- Nesten hver dag
- Hver dag



13. **Hvor ofte BRINGER din mor eller far DEG til trening, lek eller idrett/fysisk aktivitet? (Sett bare ett kryss)**
- Nesten aldri eller aldri
  - En eller to ganger i uken
  - Nesten hver dag
  - Hver dag
14. **Hvor ofte SER din mor eller far på at DU trener, leker eller driver idrett/fysisk aktivitet? (Sett bare ett kryss)**
- Nesten aldri eller aldri
  - En eller to ganger i uken
  - Nesten hver dag
  - Hver dag
15. **Hvor ofte trener, leker eller driver din mor eller far idrett/fysisk aktivitet sammen med deg? (Sett bare ett kryss)**
- Nesten aldri eller aldri
  - En eller to ganga i uken
  - Nesten hver dag
  - Hver dag
16. **Hvor ofte sier din mor eller far at idrett/fysisk aktivitet er bra for helsen din? (Sett bare ett kryss)**
- Nesten aldri eller aldri
  - En eller to ganger i uken
  - Nesten hver dag
  - Hver dag
17. **Hvor ofte snakker læreren din om idrett/fysisk aktivitet? (Sett bare ett kryss)**
- Nesten aldri eller aldri
  - En eller to ganger i uken
  - Nesten hver dag
  - Hver dag
18. **Hvor ofte organiserer læreren din trening, lek eller idrett/ fysisk aktivitet utenom gymtimene? (Sett bare ett kryss)**
- Nesten aldri eller aldri
  - En eller to ganger i uken
  - Nesten hver dag
  - Hver dag
19. **Hvor ofte oppmuntrer læreren din deg til å drive idrett/ fysisk aktivitet? (Sett bare ett kryss)**
- Nesten aldri eller aldri
  - En eller to ganger i uken
  - Nesten hver dag
  - Hver dag



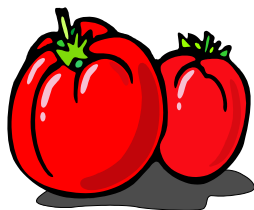
**20. Hvordan passer disse utsagnene for deg?**  
*(Sett ett kryss for hvert utsagn)*

|  | Passer for meg           |                          |                          | Passer ikke for meg      |                          |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|  | 1                        | 2                        | 3                        | 4                        | 5                        |
| - Det er morsommere å drive med trening, lek eller idrett/fysisk aktivitet enn å gjøre andre ting.....                                 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Å drive med trening, lek eller idrett/fysisk aktivitet er det beste jeg vet.....   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Jeg skulle ønske jeg kunne drive mer med trening, lek eller idrett/fysisk aktivitet enn det jeg har anledning til å gjøre.....       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Jeg føler at jeg er bedre enn de fleste barn på samme alder i idrett/fysisk aktivitet .....  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Jeg føler jeg lett kan holde følge med de andre barna på min alder når vi driver med trening, lek eller idrett/fysisk aktivitet..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

**21. Tenk på området der du bor.**  
*(Sett ett kryss for hvert utsagn)*

|  | Passer for meg           |                          |                          | Passer ikke for meg      |                          |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|  | 1                        | 2                        | 3                        | 4                        | 5                        |
| - Det finnes steder nært der jeg bor hvor jeg kan trene, leke eller drive med idrett/fysisk aktivitet, for eksempel lekeplasser, idrettsplasser, parker, haller..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Det føles trygt å gå eller leke alene i mitt nabolag om dagen.   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Det er vanskelig å gå eller leke nær huset mitt på grunn av trafikk.....   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Det er vanskelig å gå eller leke nær huset mitt på grunn av gjenger.....   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Jeg får ikke lov å leke eller drive med idrett/fysisk aktivitet ute fordi foreldrene mine mener det er farlig.....   | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - Det er andre barn i nabolaget som jeg kan gå ut å leke eller drive idrett/fysisk aktivitet med.....  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| - På skolen er det lekeplasser eller områder hvor jeg kan løpe rundt og leke eller drive med idrett/fysisk aktivitet.  | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

I de neste to spørsmålene spør vi om hva du synes om spisevanene dine slik de vanligvis er. Ha det siste året i tankene når du svarer.



22. Tror du kostholdet spiller noen rolle for helsa di? (Sett bare ett kryss)

- Nei
- Ja, men ikke nå, bare når jeg blir eldre
- Ja, både nå og senere i livet
- Vet ikke

23. Hvordan vurderer du ditt eget kosthold? (Sett bare ett kryss)

- Det er veldig sunt
- Det er ganske sunt
- Det er usunt
- Vet ikke

Dette spørsmålet dreier seg om røyking og snusing. Det er viktig at du er ærlig når du svarer på spørsmålet. Husk: Ingen vil se besvarelsen din, verken på skolen eller hjemme.

24. Hvilke av disse passer best for deg? (Sett bare ett kryss)

- Jeg røyker eller snuser ikke, og kommer heller ikke til å begynne.
- Jeg røyker eller snuser ikke, men kommer kanskje til å begynne
- Jeg røyker eller snuser hver dag, men har akkurat startet
- Jeg røyker eller snuser hver dag, og har gjort det i over 6 måneder

I de neste to spørsmålene spør vi om hvor ofte du har gym/kroppsøving på skolen.

25. Hvor mange kroppsøvings-/gymtimer har du på timeplanen hver uke?

(Sett bare ett kryss)

- Mindre enn en time per uke
- En til to timer per uke
- Tre til fire timer per uke
- Fem eller flere timer per uke

26. Hvor ofte deltar du i kroppsøvings-/gymtimene på skolen?

(Sett bare ett kryss)

- Nesten aldri eller aldri
- En til to timer i måneden
- Ukentlig
- Nesten hver gang
- Hver gang



27. Når står du vanligvis opp en skoledag? (Sett bare ett kryss)

- Før 6.30
- Mellom 6.30 og 7.00
- Mellom 7.00 og 7.30
- Etter 7.30



28. Når legger du deg vanligvis en skoledag?

(Sett bare ett kryss)

- Før 20.00
- Mellom 20.00 og 21.00
- Mellom 21.00 og 22.00
- Etter 22.00

29. Hvor mange timer ser du vanligvis på TV før du går på skolen?

(Sett bare ett kryss)

- Ingen
- Mindre enn 1 time
- Mellom 1 til 2 timer
- Mer enn 2 timer

30. Hvor mange timer ser du vanligvis på TV etter skolen? (Sett bare ett kryss)

- Ingen
- Mindre enn 1 time
- Mellom 1 til 2 timer
- Mellom 2 til 3 timer
- Mer enn 3 timer

31. Hvor mange timer bruker du vanligvis på foran PC (spill eller internett) eller med TV spill (playstation, X-box eller lignende) på en ukedag (mandag til fredag)? (Sett bare ett kryss)

- Ingen
- Mindre enn 1 time
- Mellom 1 til 2 timer
- Mellom 2 til 3 timer
- Mer enn 3 timer



Tusen takk for hjelpen ☺



## **Appendix 8**

Semi-structured interview guide of focus group interviews (paper 4)



# **INTERVJUGUIDE InterPLAY**

***Varighet 45-60 minutter pr intervju***

## **Briefing**

Kort muntlig informasjon om studien. Demonstrasjon/informasjon om lydopptak. Informasjon om samtykke og mulighet for å trekke seg gjentas. Alle deltakere forpliktes til gjensidig taushetsplikt og at de kan velge å unnlate å fortelle om/svare på informasjon de anser for fortrolig. Presisere at informasjon ikke skal deles på sosiale medier.

## **Generelle hjelpespørsmålsstillinger**

- "Når du sier at...., mener du da....?"
- "Er det slik at....?"
- "Kan man med andre ord si at.....?"
- "Hvordan tenker du da?"
- "På hvilken måte mener du at....?"
- "Er det noen som ser annerledes på det?"
- "Tenker dere også på den måten?"
- "Hva tror du gjør at....?"
- "Hva ville skje hvis....?"

## **Debriefing**

Kort oppsummering av samtale. Minne om gjensidig taushetsplikt mellom informantene, og at samtykkeerklæringen når som helst kan trekkes.

## Hovedspørsmål intervju 1 (*hjelpespørsmål i kursiv*)

- Fortell om deg selv (innledende runde)
  - *Hva heter du, hvilken skole går du på, hvem bor du sammen med (foreldre/søsken), hva gjorde at du ble med på InterPLAY?*
  - *Hvor gammel var du når du fikk astma?*
  - *Hva tenker du om å ha sykdommen?*
- Fortell om hva du liker å gjøre på fritiden?
  - *Dine fritidsaktiviteter*
  - *Hva du gjør sammen med vennene dine*
  - *Hva familien pleier å gjøre i helgene*
  - *Er du og dine foreldre uenige om dine aktiviteter? Hvordan?*
- Fortell om hvordan du har det på skolen
  - *Hvordan er det å ha gymnastikk?*
  - *Hva gjør du i friminuttene?*
  - *Hva liker du på skolen?*
  - *Får du hjelp eller tilrettelegging på skolen pga din astma?*
  - *Er du uenig med læreren din ift din astma? Hvordan?*
- Fortell mer om hvordan det er å ha astma
  - *Bryr dine venner seg om at du har astma? Hvordan?*
  - *Er det noe du ikke kan være med på pga din astma?*
  - *Hva forteller du om din sykdom til dine venner?*
  - *Hva forteller du om din sykdom til dine foreldre?*
  - *Hva forteller du om din sykdom til lærere og andre voksne?*
  - *Er du uenig med dine foreldre ift din astma? Hvordan?*
- Fortell om dine medisiner
  - *Når og hvor tar du medisiner?*
  - *Hvilke medisiner bruker du?*
  - *Hvem passer på at du tar dine medisiner?*
  - *Er du og dine foreldre uenige om dine medisiner? Hvordan?*
  - *Hva skjer i kroppen din når du tar medisiner?*
  - *Hvilke reaksjoner får du fra andre på din medisinbruk?*
- Fortell om hvordan det er å være hos legen/sykepleieren
  - *Hvem følger deg dit?*

## Intervjuguide InterPLAY

- *Hva prater dere om hos legen/sykepleieren?*
- *Hvordan liker du å være hos legen? Hva er bra, hva er ikke?*
- *Er du og den som følger deg enige om hvordan du har det?*

## Hovedspørsmål intervju 2 (*hjelpespørsmål i kursiv*)

- **Fortell om hvordan er det å være med på trening med PLAY**
- Fortell om hvordan det er før dere går på trening (*OBS medisiner*)
  - *Spiser dere middag? Sammen med hvem?*
  - *Hvordan kommer du deg til trening?*
  - *Hva tenker du om å gå på trening før du kommer deg avgårde?*
  - *Tar du noen medisiner før trening? Hvilke?*
  - *Har du medisiner med deg?*
  - *Hva tenker du om dine medisiner?*
  - *Er du uenig med dine foreldre før dere går?*
  - *Hva liker du best ved treningen?*
  - *Synes du noe er vanskelig?*
  - *Er du blitt kjent med noen nye venner?*
  - *Hvordan er trenerne?*
  - *Hva lærer du av å være med?*
  - *Hvordan kjennes det i kroppen når...? (eks på ulike observerte aktiviteter)*
  - *Hva blir du sliten av?*
  - *Hva gjør du når du blir sliten?*
  - *Hva gjør at du presser deg mere?*
  - *Hva gjør at du prøver å ta det roligere?*
  - *Hva snakker du med de andre om på/etter treningen?*
- Fortell om hvordan det var på kondisjonstesten (*runde - fortell til de andre*)
  - *Hva opplevde du?*
  - *Hva tenkte du?*
  - *Hvordan kjentes det i kroppen?*
  - *Hvordan var det å bli heiet på?*
  - *Hva synes du om testen?*
- Fortell om hva som skjer etter treningen?
  - *Hvordan kommer du deg hjem?*
  - *Hva finner du på når du kommer hjem?*
  - *Spiser du noe etter trening? Hva? Sammen med hvem?*
  - *Hva snakker du med familien din om?*



- *Hvordan kjennes det i kroppen om kvelden?*
- Fortell om hva du gjør de dagene det ikke er trening
  - *Hvem er du sammen med?*
  - *Hva finner dere på?*
  - *Når går du å legger deg?*
  - *Hva gjør du før du legger deg?*
  - *Hvordan kjennes det i kroppen om kvelden?*

### Hovedspørsmål intervju 3 (*hjelpespørsmål i kursiv*)

- Fortell om aktivitetene/treningene du har vært med på
  - *Hva har vært gøy?*
  - *Hva likte du best?*
  - *Hva likte du ikke?*
  - *Har du lært noe nytt? Hva?*
  - *Har du fortalt vennene dine hva du er med på?*
  - *Hva sier vennene dine om det du er med på?*
  - *Hva synes din familie om det du er med på?*
- Fortell om hvordan det er å ha astma nå
  - *Byr dine venner seg om at du har astma? Hvordan?*
  - *Hvilke medisiner bruker du, når tar du de og hvor?*
  - *Hva synes du om dine medisiner?*
    - *Hvilke reaksjoner får du fra andre på din medisinbruk? (foreldre, venner, lærer, lege/sykepleier)*
    - *Hva skjer i kroppen din når du tar dine medisiner?*
    - *Hva skjer når du ikke tar dine medisiner?*
  - *Hva kan du ikke være med på pga din astma?*
  - *Hva kan du gjøre for å ha det best mulig?*
  - *Er du sprekere enn før?*
  - *Er du mer aktiv enn før?*
  - *Hvilke fritidsaktiviteter er du med på nå?*
  - *Hva gjør du i helgene?*
  - *Hvordan er det med gym på skolen nå?*
  - *Hvordan påvirker astma og trening ditt skolearbeid?*
  - *Hvordan er det med venner nå? Samme? Nye? Gjør dere andre ting?*
  - *Hvem prater du om din sykdom med? Hva prater dere om?*
- Fortell hva som er viktig for deg
  - *Hva drømmer du om?*
  - *Hva er dine mål?*
  - *Hva ønsker du deg fra dine foreldre?*
  - *Hva ønsker du deg fra din lærer?*

## Intervjuguide InterPLAY

- *Hva ønsker du deg fra dine venner?*
- *Hva ønsker du deg fra din lege/sykepleier?*
- *Hvem er du når du er 25 år?*
- *Hva skal til for å nå dine mål?*