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# The Relationship Between Physical Activity and Physical Self-Esteem in Adolescents: The Role of Physical Fitness Indices

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The aim of this study was to investigate if physical fitness (strength/power, endurance, flexibility and coordination) mediates the cross-sectional relationship between physical activity and physical self-perception (athletic competence and physical appearance) in a sample of 15-year old adolescents. We wanted to investigate the relative strength of each indirect effect. The present data are taken from two waves of a larger data collection for the project "Youth in Balance", and was collected in the autumn of 2005 ($N = 1207$) and 2008 ($N = 632$). A total of 1839 students (889 girls and 950 boys) from 12 schools in Kristiansand took part. A bias-corrected bootstrapping technique was used to examine indirect effects. Results revealed that cardiovascular endurance, lower-body strength/power, and upper-body strength stood out as unique mediators in the relationship between physical activity and athletic competence in both genders. Furthermore, there was an indirect effect of physical activity on physical appearance through physical strength/power and flexibility in males. No indirect effects of physical activity on physical appearance through actual physical fitness indices were detected in females.

El objetivo de este estudio fue investigar el grado de influencia del nivel de aptitud física (fuerza/potencia, resistencia, flexibilidad y coordinación) sobre la relación transversal establecida entre el nivel de actividad física y la auto percepción del rendimiento físico (capacidad deportiva y apariencia física) en una muestra de adolescentes de 15 años de edad. Se deseaba investigar el grado de influencia relativa de cada efecto indirecto. Los datos presentados en este estudio, formaban parte de dos muestras pertenecientes al proyecto "jóvenes en equilibrio" las cuales fueron recolectadas en otoño de 2005 (N=1207) y 2008 (N=632). Un total de 1839 estudiantes (889 chicas y 950 varones) de 12 escuelas de Kristiansand tomaron parte en el estudio. Se aplico la técnica bootstrapping para corregir el sesgo y analizar los efectos indirectos. Low resultados revelaron que los únicos mediadores con gran influencia sobre la relación entre el nivel de actividad física y la capacidad deportiva en ambos sexos fueron: El nivel de Resistencia cardiorrespiratoria, la fuerza/potencia de las extremidades inferiores y la fuerza de las extremidades superiores.

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Además, se observo un efecto indirecto de la actividad física sobre la apariencia física, el cual estaba mediado por el nivel de fuerza/potencia y flexibilidad en los varones. En las chicas, no se observaron otros efectos indirectos de la actividad física sobre la apariencia física mediado por los índices actuales de aptitud físcia considerados en este estudio.

Adolescence is a time of rapid emotional, physical, and social changes. Such changes can be stressful for young individuals, and they are at risk at experiencing a decrease in self-esteem and general self-worth during adolescence (3,42,49). Establishing positive and realistic self-perceptions are decisive in the development of identity, self-respect, well-being, and a feeling of being valuable.

Self-esteem is considered to be multidimensional, consisting of domain-specific components, such as academic, social, and physical self-esteem (22,45). Physical self-esteem, which may comprise perceived physical appearance and perceived athletic competence (23) is regarded particularly important for young peoples' general self-esteem and psychological well-being (20,44). Furthermore, perceptions of one's physical self may be particularly sensitive to variations in physical activity level (7). Physical activity and exercise may be seen as factors that have the potential to stabilize or enhance physical self-perception during the adolescent years (8,20,21). Exercise and training are proposed to reduce appearance dissatisfaction and enhance physical self-perception (10,11,18). Indeed, Jackson and Marsh (28) suggested that physical activity affected global self-esteem indirectly by enhancing physical competence and body-image. Furthermore, recent research on Norwegian adolescents suggests that there is an indirect effect of physical activity on global self-worth through both athletic competence and physical appearance (25).

One of the hypotheses developed to explain the association between physical activity and physical perception is improvement in actual physical fitness (20,21,45). Indeed, the development of physical fitness may be seen as a logical building block for enhanced perceptions of physical competence. Feeling good about the"outer self" through enhanced physical fitness may foster positive evaluations of one's physical appearance and athletic competence (20,23,45). Improved physical perception is associated with physical fitness, weight loss, and with feelings of a more "toned" body (5).

Physical fitness is considered a multidimensional construct, including different components such as cardiovascular endurance, muscular strength/power, flexibility, and motor coordination (50). Furthermore, fitness is generally defined with a focus on two goals; performance and health. Performance-related fitness refers to the components of fitness that are central for optimal work or sport performance (e.g., agility, balance, coordination, power, reaction time, and speed), whereas health-related fitness refers to the components that more directly relates to health status (6) such as cardiorespiratory fitness, muscular strength and endurance, flexibility, and body composition. With increased focus on physical inactivity, cardiovascular fitness, and overweight in youth, the term physical fitness has tended to become more narrowly defined in practice, with focus on endurance testing and body composition, and less on other dimensions of fitness that are part of motor development and daily function, such as strength, motor coordination, and flexibility.

A great deal of attention has been given to the role of physical activity and physical fitness in the enhancement of psychological health (for a review, see 52). Despite extensive research in the area of physical perception during adolescence,

less is known about the relative contribution of different physical fitness domains. Lubans and Cliff (33) reported that physical self-worth was associated with absolute total strength in males and relative total strength in females. Furthermore, Craft, Pfeiffer, and Pivarnik (17) found that cardiovascular endurance was positively correlated to athletic competence but not to physical appearance in a small sample of early adolescent girls. Similarly, Raudsepp, Libik, and Hannus (41) reported that physical appearance and athletic competence were moderately related to cardiovascular fitness in both boys and girls. Furthermore, Poulsen, Ziviani, and Cuskelly (40) reported in a sample of boys (age 10–13) that individuals with poor motor coordination reported significantly lower on athletic competence and physical appearance compared with individuals with moderate or high motor coordination. Similar results were reported in Piek, Baynam, and Barrett (37); individuals with high athletic competence had better gross motor skills.

Generally, strength training and aerobic training have been proposed as two of the most important types of physical activities to have beneficial effect on self-esteem (21,29). Fox (21) suggests that weight and resistance training may be superior to endurance training in improving body image and self-esteem. Resistance training may have a great potential for clear and rapid changes in body composition and strength. For example, Velez and coworkers (51) reported that a 12-week resistance training program improved physical self-concept in a sample of Hispanic adolescents. Moreover, Lubans and colleagues (32) found that resistance training programs improved physical self-perception in adolescent girls. Various forms of cardiovascular exercise programs have also indicated that they can be effective in improving self-perception, although only approximately 50% of the studies report significant changes (21). Studies with other activities (flexibility, motor skill programs) generally fail to indicate significant changes, although they are too few in number to make firm conclusions (21). Enhanced physical fitness usually leads to an increase in lean body mass and physical abilities and a decrease in body fat mass, which in turn may affect the way adolescents perceive their physical self. However, Whitelaw and coworkers (52) pointed that the assertions put forward in this area are inconsistent. Little is known about how different domains of physical fitness affect different aspects of physical perception. Furthermore, these relationships may not be equal for male and female adolescents. For example, the sociocultural pressure for males to be lean and muscular, and girls to be thin and slender (48), may affect the way different physical fitness dimensions affect males' and females' physical self-esteem.

## The Aim of the Study

Given the importance of physical self-esteem for general well-being in adolescents, it would be useful to know which dimensions of physical fitness that feed into individual's perceived physical self-esteem. Such knowledge would help professionals and academics when conducting interventions to improve young peoples' self-perceptions. To the best of our knowledge, no study has previously investigated the role of objective measures of multiple physical fitness domains in the cross-sectional relationship between physical activity and physical perception in adolescent boys and girls.

Based on previous research, the aim of this study was to investigate if physical fitness (upper-body strength, lower-body strength/power, cardiovascular endurance,

flexibility, and coordination) mediates the cross-sectional relationship between physical activity and physical self-perception (athletic competence and physical appearance) in a sample of 15-year oldmale and female adolescents. We also wanted to investigate the relative strength of each indirect effect. The major advantage of exploring one multiple mediation model instead of several simple mediation models stems from the fact that in the former model, each specific mediator's effect on the X → Y relationship is conditional on the presence of the other mediators (38). Furthermore, the possibility to determine the relative magnitudes of the specific indirect effects is then highly feasible. Indeed, Cerin (14) calls for this perspective when investigating the association between physical activity and mental health outcomes. The hypothesized model is presented in Figure 1.

# Method

## Participants

The present data taken from two waves ofa larger data collection for the project "Youth in Balance" includes 9th graders (secondary school; 15 years of age), and was collected in the autumn of 2005 ($N$ = 1207) and 2008 ($N$ = 632). A total of 1839 students (889 girls and 950 boys) from 12 schools in Kristiansand municipality took part in the study during the two waves. The participation rate was approximately 80%. The purpose of the Youth in Balance project is to investigate young people's physical activity, health related physical fitness, and self-esteem. Participation in the survey was voluntary and the participants could withdraw from the study at any time. The study was assessed and approved by the National Committees for Research Ethics in Norway and the Norwegian Social Science Data Services.

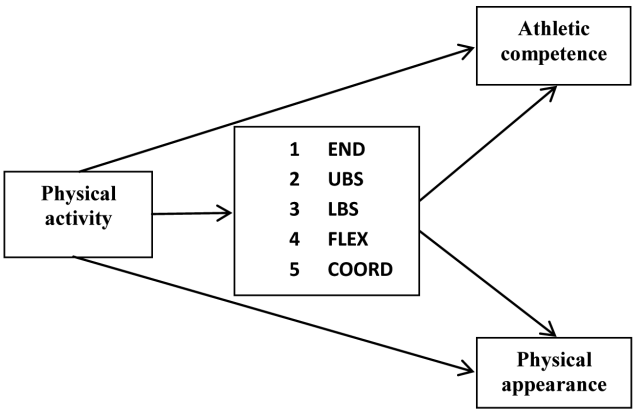


**Figure 1** — The hypothesized multiple mediator model. Note. END = Cardiovascular endurance (multistage fitness test); UBS = Upper-body strength (push-ups test); LBS = Lower-body strength / power (standing broad-jump); FLEX = Flexibility (sit-and-reach); COORD = Motor coordination (side-to-side).

## Instruments

***Height and Weight.*** Height was measured without shoes to the nearest 0.5 cm. Weight was measured without shoes in lightweight clothes to the nearest 0.1 kg using standard equipment that is found in the school nurse office. The equipment was calibrated by the researchers in the project. Body mass index (BMI: kg/m$^2$) was calculated as weight in kilograms divided by square of height in meters.

***Perceived Competence.*** Perceived competence in the physical domain was assessed by two subscales from the revised Norwegian version (53) of Harter's Self-Perception Profile for Adolescents (SPPA; 24); perceived athletic competence (ATH) and physical appearance (APP). The ATH was used to indicate individuals' perceptions of their athletic ability and competence in sports. APP relates to whether the individual is satisfied with his/her own body and appearance, or whether he/she wishes that his/her body was different. The scales consist of five descriptions on athletic competence and physical appearance respectively (e.g., ATH: *"I do well in all kinds of sports"*, APP: *"I am very happy with my appearance."*), and the participants indicate their degree of agreement on a four-point scale (1:describes me very poorly; 2:describes me fairly poorly;3:describes me fairly well; 4:describes me very well). The mean score was derived from the item scores, thereby indicating the overall perceived athletic competence and physical appearance, respectively. Psychometric support for the measure is derived from Wichstrøm's (53) analyses. Cronbach's alpha in the current study was .82 for ATH and .88 for APP. This was considered acceptable (16).

***Physical Activity.*** The instrument used for assessing level of physical activity (PA) wasdeveloped for the current study. The participants were asked threequestions regarding their own physical activity behavior, indicating moderate-to-vigorous physical activity, moderate physical activity, and strength training. The questions included were1 (moderate-to-vigorous physical activity) *"how many days the last week did you exercise/participate in physical activity for at least 20 minutes to the extent that it made you sweat and/or breathe hard, such as basketball, football, handball, running, swimming, or fast bicycling?"* (0–7); 2 (moderate physical activity) *"how many days the last week did you exercise/participate in physical activity for at least 30 minutes that did not make you sweat and/or breathe hard, such as fast walking, slow bicycling, skating, or slow swimming?" (0–7);* 3(strength training) *"how many days the last week did you perform strength training such as push-ups, sit-ups, or weight lifting?"*(0–7). Question 1 and 2 were taken from the Youth Risk Behavior Study (54). The numbers in parentheses are summed into a total physical activity index (0–21). The index was considered continuous, and was normally distributed in the current sample.

***Physical Fitness Dimensions.*** The following five tests were chosen because they were possible to carry out in field testing, and were presumed to give an indication of the adolescents' physical fitness in the domains of cardiovascular endurance, upper-body muscular strength, lower body muscular strength/power, flexibility, and motor coordination. Fitness testing data for each subject was converted to z-scores based on the sample mean and standard deviation for each gender.

Upper-body strength (UBS) was estimated using a push-up test (PU) to failure (4). Subjects were required to keep their body straight. All push-ups had to be performed with a minimum angle of 90° at the elbow before returning to the arms fully extended position. The number of push-ups to failure was recorded. Males

executed the push-ups on the hands and toes while female executed the push-ups on the hands and knees.

The standing broad-jump (SBJ) from the EUROFIT-test battery (1) was assessed to measure lower-body muscle-strength/power. The standing broad-jump was measured using a tape measure attached to foam mats. Participants were asked to jump forward as far as possible, swinging their arms and flexing their knees before jumping. Subjects completed 3 trials with the best result registered to the nearest cm. Distance was measured from the take-off point to the landing point of the back of the heel in accordance with the EUROFIT testing instructions (1).

Cardiovascular endurance (END) was estimated using the endurance shuttle run test (MST; 31), which requires participants to run back and forth between two lines set 20 m apart. Running pace is determined by an audio signal. The velocity increased by 0.5 kph every minute. The test was terminated when the participant failed to reach the end lines in time with two consecutive audio signals. The result was recorded as the number of completed 20-m levels and shuttles.

Flexibility (FLEX) was measured with the sit and reach test (SR) using the procedures of the EUROFIT directive (1). Subjects sat on the floor with knees extended and feet placed at 90 degrees against a box. Testing was performed without shoes. The edge of the box was 15cm behind the zero point for measurement such that if the fingertips were in line with the box edge, a flexibility score of 15cm was assigned. The participants were asked to reach forward slowly and extend forward as far as possible, in a smooth stretching movement. Scores were measured to the nearest 0.5cm. The best of 3 trials was recorded.

One KTK-subtest (Körperkoordinationstest für Kinder; 43), the Side-to-Side jump (SS) was included to estimate motor coordination (COORD). The KTK-test battery is a standardized normative instrument which measures gross motor coordination (COORD). During two consecutive trials, the participant is required to make 15 sideways jumps as fast as possible, time taken in seconds is recorded as result.

The SBJ and the SR tests taken from the EUROFIT-battery have been validated previously (47). The PU-test (4) and the MST (30,31) are proven to be highly reliable in adolescents.Test—retest reliability for the SS-test was 0.84 in a group of 45 college students (unpublished data).

## Procedures

The anthropometric measurements of height and weight were performed in a private room inside the school area by a trained research assistant or the schools own health-personnel when available. The physical fitness tests were carried out during a physical education session, administered by trained research assistants or qualified Physical Education instructors who had been specifically trained to administer the fitness tests. The questionnaire was carried out during the students' regular school class lessons within the same month as and before the physical fitness tests, and the participants were given the necessary instructions by the class teacher. The completed questionnaires were put into sealed envelopes and collected by the teacher.

## Statistical Analysis

The IBM SPSS version 19.0 was used for computing descriptive statistics, correlations and regression analyses. Only participants with complete data were included in the analyses. Because this study includes adolescents from two waves of data

(2005 and 2008 respectively) a dichotomized variable representing the year of testing was included in the analyses as covariate, to control for possible differences from wave one to wave two. In assessing multiple mediation, Preacher and Hayes' (38) macro for SPSS was used to test the hypothesized multiple indirect effects. Separate analyses were performed for males and females. In addition to normal theory linear regression procedures, Preacher and Hayes (38) recommend a bias-corrected (BC) bootstrapping technique to measure indirect effects. Bootstrapping involves repeated extractions with replacement of samples from the data set (in this case 20,000 samples were drawn), and the estimation of the indirect effects in each resample data set. In contrast to other mediation methods, this method has greater power to detect significant effects while allowing for the control of covariates, without imposing any questionable distributional assumptions on the data (26). To reveal the precise nature of the mediation, Preacher and Hayes' (38) technique produces point estimates and bias-corrected confidence intervals for each of the proposed indirect effects, as well as point estimates of the remaining direct effect. For the indirect effect tests, confidence intervals that do not include zero demonstrate significant mediation. In addition, the procedure generates point estimates and BC confidence intervals for pairwise contrasts between specific indirect effects. Contrast refers to comparing two mediators in their unique ability to mediate, above and beyond any other mediators or covariates in the model. Regarding contrasts, confidence intervals that does not include zero suggests that one indirect effect is significantly larger than the other.

Because this study consisted of individuals from 12 different schools the possibility of clustering effect on school-level existed. To examine the possible nonindependence produced by school variation in levels of the variables, analyses were also performed with the school-variable included as 11 dummy variables and treated as covariates. No differences in the results were detected when investigating the analyses with and without the school-covariates. Therefore, all analyses are presented without school as covariate.

## Results

The directions of the bivariate correlations shown in Table 1 were as expected. The five physical fitness dimensions were positively correlated for both genders, in the range of low to moderate ($r = .10–.53$). The strongest association was found between the upper-body strength test and the cardiovascular endurance test (males $r = .48$, females $r = .53$). All variables except BMI were positively correlated with perceived athletic competence in both males and females. Not surprisingly, BMI was either negatively correlated or not correlated (physical activity and flexibility) with the other variables. This pattern was consistent across gender. All variables but physical activity and flexibility (females) were correlated with physical appearance.

In line with the hypothesized model, physical activity positively predicted all physical fitness dimensions except coordination in males and flexibility in females. When investigating the total effect (Table 2 and 3, PA on ATH/APP; i.e., the effect before entering the mediators into the equations) the results indicated that PA predicted athletic competence in both genders, but not physical appearance.

**Table 1 Descriptives and Correlation for Major Study Variables According to Gender**

| | M(*SD*) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| M(*SD*) | - | 9.0(4.33) | 24.0(12.2) | 193(23.9) | 8.8(2.5) | 16.1(8.0) | 85.5(12.7) | 20.3(3.0) | 3.1(0.67) | 2.9(0.62) |
| 1 PA | 8.1(4.07) | - | .25** | .12** | .24** | .09* | .09** | .02 | .25** | .01 |
| 2 UBS | 27.7(14.5) | .40** | - | .43** | .48** | .10* | .37** | -.14** | .39** | .21** |
| 3 LBS | 167(23.8) | .26** | .47** | - | .45** | .01 | .38** | -.17** | .35** | .26** |
| 4 END | 6.7(2.1) | .35** | .53** | .52** | - | .08 | .37** | -.24** | .37** | .16** |
| 5 FLEX | 22.9(8.8) | .07 | .18** | .21** | .13** | - | .10* | .01 | .14** | .12** |
| 6 COORD | 84.5(13.0) | .26** | .40** | .50** | .48** | .23** | - | -.25** | .28** | .12** |
| 7 BMI | 20.5(2.9) | .04 | -.10* | -.32** | -.27** | .01 | -.25** | - | -.10* | -.16** |
| 8 ATH | 2.4(0.65) | .24** | .44** | .44** | .44** | .14** | .34** | -.10** | - | .37** |
| 9 APP | 2.5(0.80) | .07 | .23** | .21** | .24** | .06 | .15** | -.20** | .42** | - |

Note. Female values beneath the diagonal, male values above the diagonal. PA = Physical activity (scale 0–21); UBS= Upper-body strength (push-ups; reps); LBS= Lower body strength/power (standing broad-jump; cm); END= Endurance (multistage fitness test; score based on level and shuttle); FLEX= Flexibility (sit and reach; cm); COORD= Motor coordination (side to side test; sec); BMI = Body mass index; ATH = Athletic competence (scale 1–4); APP = Physical appearance (scale 1–4). ** p <.01; * p < .05.

**Table 2 Assessing Indirect Effects of Physical Activity on Athletic Competence Through Physical Fitness Indices in Males and Females**

| | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | PE(*SE*) | BC 95% CI | | PE(*SE*) | BC 95% CI | |
| PAon Mediators | | | | | | |
| END | .060(.010)** | | | .090(.012)** | | |
| LBS | .037(.011)** | | | .056(.011)** | | |
| UBS | .069(.011)** | | | .102(.012)** | | |
| FLEX | .033(.008)** | | | .015(.009) | | |
| COORD | .012(.009) | | | .035(.010)** | | |
| PAon ATH | | | | | | |
| Total | .035(.007)** | | | .039(.009)** | | |
| Direct | .073(.006)** | | | .007(.009) | | |
| Mediators on ATH | | | | | | |
| END | .086(.032)** | | | .094(.040)* | | |
| LBS | .057(.030)* | | | .178(.040)** | | |
| UBS | .145(.031)** | | | .127(.040)** | | |
| FLEX | .001(.034) | | | .070(.051) | | |
| COORD | .045(.038) | | | -.019(.043) | | |
| Indirect via | | | | | | |
| END | .005(.001) | **.001** | **.011** | .008(.004) | **.001** | **.044** |
| LBS | .002(.001) | **.001** | **.005** | .009(.004) | **.004** | **.016** |
| UBS | .010(.003) | **.005** | **.016** | .013(.003) | **.014** | **.022** |
| FLEX | .000(.001) | -.002 | 002 | .000(.002) | -.003 | .007 |
| COORD | .001(.001) | -.001 | .002 | .002(.001) | -.001 | .007 |
| Covariates on ATH | | | | | | |
| BMI | -.009(.010) | | | .010(.012) | | |
| Year | .042(.053) | | | .126(.06) | | |
| Model summary ($R^2$ [p]) | .23 [<.01] | | | .28 [<.01] | | |

Note. ATH = Athletic competence; PA = Physical activity level; Mediators: END = Cardiovascular endurance (multistage fitness test); UBS = Upper-body strength (push-ups test); LBS = Lower-body strength / power (standing broad-jump); FLEX = Flexibility (sit-and-reach); COORD = Motor coordination (side-to-side). PE(*SE*) = Bootstrap-generated point estimate and standard error. BC confidence intervals not including zero in bold. Statistical significance of PE: ** p <.01; * p < .05.

## Athletic Competence as Outcome

When investigating the role of the proposed mediators, cardiovascular endurance and upper-body strength and lower-body strength/power predicted athletic competence in both genders (Table 2, Mediators on ATH). Furthermore, there was an indirect effect of physical activity on athletic competence through muscle strength/power and cardiovascular endurance in both males and females (Table 2, Indirect

**Table 3 Assessing Indirect Effects of Physical Activity on Physical Appearance Through Physical Fitness Indices in Males and Females**

| | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | PE(*SE*) | BC 95% CI | | PE(*SE*) | BC 95% CI | |
| PAonMediators | | | | | | |
| END | .060(.010)** | | | .090(.012)** | | |
| LBS | .037(.011)** | | | .056(.011)** | | |
| UBS | .069(.011)** | | | .102(.012)** | | |
| FLEX | .033(.008)** | | | .015(.009) | | |
| COORD | .012(.009) | | | .035(.010)** | | |
| PAonAPP | | | | | | |
| Total | -.005(.007) | | | .012(.001) | | |
| Direct | -.015(.007)* | | | -.002(.011) | | |
| MediatorsonAPP | | | | | | |
| END | -.022(.037) | | | .076(.052) | | |
| LBS | .094(.036)** | | | .039(.053) | | |
| UBS | .083(.037)* | | | .063(.054) | | |
| FLEX | .083(.040)* | | | .038(.054) | | |
| COORD | .038(.044) | | | -.038(.066) | | |
| Indirect via | | | | | | |
| END | -.001(.001) | -.006 | .002 | .007(.004) | -.002 | .016 |
| LBS | .003(.002) | **.001** | **.007** | .002(.005) | -.003 | .008 |
| UBS | .006(.003) | **.001** | **.012** | .006(.005) | -.003 | .018 |
| FLEX | .002(002) | **.001** | **.006** | .001(.001) | -.001 | .004 |
| COORD | .000(.001) | -.001 | .003 | -.002(.002) | -.006 | .003 |
| CovariatesonAPP | | | | | | |
| BMI | -.029(.011)** | | | -.047(.015)** | | |
| Year | .035(.062) | | | -.035(.081) | | |
| Model summary ($R^2$ [p]) | .10 [<.01] | | | .08 [<.01] | | |

Note. APP = Physical appearance; PA = Physical activity level; Mediators: END = Cardiovascular endurance (multistage fitness test); UBS = Upper-body strength (push-ups test); LBS = Lower-body strength / power (standing broad-jump); FLEX = Flexibility (sit-and-reach); COORD = Motor coordination (side-to-side). PE(*SE*) = Bootstrap-generated point estimate and standard error.BC confidence intervals not including zero in bold. Statistical significance of PE: ** p <.01; * p < .05.

via). In other words, cardiovascular endurance, lower-body strength/power, and upper-body strength stood out as unique mediators in the relationship between physical activity and athletic competence, above and beyond the effect of the other mediators. When investigating the contrast between the specific indirect effects, the indirect effect of upper-body strength stood out as stronger than the indirect effect of lower-body strength/power (BC 95% CI for LBS minus UBS: [-.044, -.007]) in males. In other words, the effect of physical activity on boys' athletic competence

through upper-body strength was stronger than through lower-body strength/power. No other differences in contrasts were observed (in either gender).

### Physical Appearance as Outcome

In males, upper-body strength, lower-body strength/power, and flexibility predicted physical appearance (Table 3, Mediators on APP). In females, none of the physical fitness dimensions predicted physical appearance. In both genders, BMI was a unique predictor of lower level of perceived physical appearance (Table 3, Covariates on APP). With regards to the investigated indirect effects, there was an indirect effect of physical activity on physical appearance through the two dimensions of physical strength/power and the flexibility-dimension in males (Table 3, Indirect via). In contrast, no indirect effects of physical activity on physical appearance through actual physical fitness indices were detected in females.

When investigating the contrast between the significant indirect effects in males (e.g., UBS vs LBS), none of the mediators stood out as stronger than the others. In other words, physical activity is indirectly associated with physical appearance in male adolescents equally strongly through actual upper-body strength, lower-body strength/power and flexibility, respectively.

## Discussion

The purpose of this study was to examine the indirect effect of physical activity on physical self-esteem in the format of athletic competence and physical appearance through multiple physical fitness indices in a cross-sectional sample of male and female 15-year old adolescents.

The five physical fitness dimensions yielded only low to moderate intercorrelations, thus supporting the need to investigate several physical fitness indices. A high physical activity level predicted higher level of all physical fitness dimensions for both genders, except motor coordination for males and flexibility for females. The evidence of health related benefits from physical activity in the format of cardiovascular endurance and muscular strength is strong (36). It may be that other dimensions of physical fitness such as coordination and flexibility are not as easily affected by variations in physical activity level. In addition, the questions used to indicate physical activity level may consist of a variety of different activities—some of which may be more or less challenging in terms of motor abilities required.

When considering athletic competence as outcome, both physical activity and the proposed mediators cardiovascular endurance, upper-body strength, and lower body strength positively predicted perceptions of athletic abilities, but motor coordination and flexibility did not. These findings are in line with previous research suggesting that physical activity can develop physical competencies and skills, which in turn are associated with increase in self-esteem and confidence (2,21,45). For example, similar results are reported in a small sample of Italian adolescents (13), where self-esteem was related to objective measures of strength and endurance. Moreover, according to Fox (21), flexibility training has generally failed to indicate significant changes in general well-being in adolescents. One may argue that physical fitness dimensions such as strength and endurance have relative immediate and visible effects on the individuals' body, and therefore have

greater potential to promote self-perceptions such as athletic competence. When considering the motor coordination, previous research has reported significantly lower perception of athletic competence in young people with poor motor ability (e.g., 12). However, it may be that only the most severely affected young individuals have problems related to these issues (19).

With respect to athletic competence, similar findings were observed for both genders. That is, both males' and females' perceptions of athletic competence seem to benefit from physical activity through higher level of strength and endurance. In males, the upper-body strength stood out as a more important mediator than lower-body strength/power in the relationship between physical activity and athletic competence. The "Adonis complex"—the pursuit of the V-shaped ideal muscular body may contribute to explain the importance put on upper body-strength in male adolescents (35,39).

When investigating physical self-esteem in the format of physical appearance, results revealed no total effect of physical activity in either gender. Furthermore, none of the physical fitness dimensions predicted physical appearance in female adolescents. Indeed, BMI was the only variable included in the model that did predict physical appearance in females. Tiggemann and Williamson (46) found in a cross-sectional study of females (age 16–60 years) a positive correlation between physical activity level and body-image, except for female adolescents between age 16 and 21. In this subsample actually there was an inverse relationship between physical activity and body-image. As a possible explanation the authors (46) pointed to the self-objectification and stringent messages from the media that the western culture put on females, resulting in normative body dissatisfaction. Despite the promotion of physical activity and exercise as an effective way to achieve thinness and beauty, the ideal female body may be impossible to obtain for most young girls. The findings in this study may suggest that it is more difficult for females to benefit from physical activity and increased physical fitness when considering perceived physical appearance. Indeed, Hunter Smart and coworkers (27) argue that maturity-associated changes in physical appearance such as body size and composition may be more important to adolescent females than changes in physical capacity.

In males, there was an indirect effect of physical activity on physical appearance through upper-body strength, lower-body strength/power, and flexibility. Compared with the female body ideal, these fitness dimensions may be more directly related to the male ideal body type, and thus affect males' physical appearance. The male body ideal mainly consist of a strong, lean, and muscular body (15,48). Improved muscular strength and a visually "athletic" body through physical activity may benefit male adolescent's physical appearance. The fact that also flexibility appeared as a mediator in the relationship between physical activity and physical appearance in males, may suggest that this fitness-dimension also play a role related to the mesomorphic-athletic stereotype. A balanced, strong, and flexible male body may demonstrate posture and body awareness, which in turn may affect perceptions of attractiveness.

## Strength and Limitations

One of the major strength of this study is the sample size and the inclusion of objectively measured physical fitness dimensions as mediators. However, this study must be seen in light of its limitations. The sample consisted only of adolescents 15

years of age. Previous research suggests that biophysical changes during puberty may affect self-perceptions and emotional and psychological well-being in young people (9). Thus, it would seem important to examine the relationships investigated in this study in a wider sample of adolescents, both before, during, and after the onset (and span) of the pubertal period. Due to the cross-sectional design of this study, no firm conclusions regarding causality can be drawn. Clearly, the need for longitudinal research and experimental studies is warranted.

Furthermore, other physical self-esteem indices may be associated with physical activity and physical fitness dimensions in different ways compared with athletic competence and physical appearance. In addition, future studies may also consider other physical fitness dimensions such as balance, speed or anaerobic capacity. Furthermore, the physical activity measures in the current study were based on self-reports. Hence, participants may have over-reported their physical activity levels, as a result of an exaggerated perception of time and effort. It should also be noted that the side-to-side jump test as an indicator of motor control may be considered a limitation in the current study. Other, more comprehensive batteries of motor skills may be relevant in future studies (34).

Taken together, this study contributes to the understanding of how and for which young people physical activity may benefit physical self-esteem. Physical fitness is a multidimensional construct, and different activities may provide different opportunities for enhancement of physical fitness dimensions. Indeed, current study findings point to the value of including also resistance training to improve physical self-perception in both boys and girls. Hence our findings may be informative when implementing strategies aimed to improve physical self-esteem within physical activity interventions.

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