

**UP4FUN**



# UP4FUN

## A school-based and family-involved intervention to reduce and break up sitting time among European 10-12 year olds – systematic development and formative evaluation

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## Abstract

**Background** Systematically developed interventions that address sitting time in school-aged children are not well researched. This paper describes the systematic development of a school-based and family-involved intervention aimed at reducing and breaking up sitting time at home and in school among 10-12 year olds across Europe.

**Methods** The UP4FUN intervention was developed based on a five step model. The process included defining the potential determinants of sedentary behaviour, conducting stakeholder interviews on family-involvement and potential intervention activities, choosing behaviour change techniques and pretesting core components across the five intervention countries.

**Results** The most important determinants for screen-based activities appeared to be the children's preferences (positive) and parental rules (negative). The stakeholders found the topic relevant, but the concepts of light intensity physical activity and activity breaks were new, and thinking of fun alternatives to screen time was difficult. After pretesting, some of the tasks for the children were simplified and the newsletters for the parents were restructured.

**Conclusion** Interventions aiming to reduce and/or break up sitting time in youth are important contributions to the obesity prevention evidence-base. The systematic development and the comprehensive formative evaluation ensured that the UP4FUN intervention should be feasible and appropriate across Europe.

**Keywords:** Intervention, children, sedentary behaviour, screen time, family

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## BACKGROUND

There is convincing evidence for an increase in overweight and obesity among children and adolescents across Europe over the past decades<sup>1-3</sup>, and hence an urgent need for evidence-based interventions that contribute to early primary prevention of overweight.

The ENERGY (European Energy balance Research to prevent excessive weight Gain among Youth) project aimed to extend, update and learn from earlier evidence on obesity prevention among 10-12 year olds and apply this knowledge to contribute to obesity prevention across Europe<sup>4</sup>. The ENERGY-project consisted of two major parts. The first part of the ENERGY-project consisted of reviews, secondary data-analyses, focus groups and a cross European school-based survey in seven countries conducted to compile and enrich the existing evidence regarding obesity, potential determinants of obesity and interventions to prevent obesity in 10-12 year olds<sup>5-11</sup>. The second part of the ENERGY-project consisted of the systematic development, implementation and evaluation of an intervention in five countries in Europe (Belgium, Germany, Greece, Hungary and Norway) in order to further develop the evidence-base for prevention of childhood overweight and obesity.

The ENERGY-project was funded against the knowledge that school-based obesity prevention interventions up until then had mainly focussed on physical activity and/or diet, and these efforts had not been very successful in reducing the prevalence of overweight<sup>12</sup>. The explanations given for this was that such intervention schemes were not guided by a careful enough systematic evidence-based development process, and therefore had been too general, insufficiently informed by evidence from earlier research and insufficiently rooted in behaviour change theory, had failed to include effective intervention strategies tailored to the most important and modifiable determinants of the key health behaviours, and especially failed to include strategies aiming to change sustainable school and family environmental factors, and failed to conduct careful pre-testing and formative evaluation procedures before larger scale implementation<sup>12,13</sup>. In addition, the evidence-base for developing cross-European obesity prevention interventions was insufficient, due to the lack of good quality,

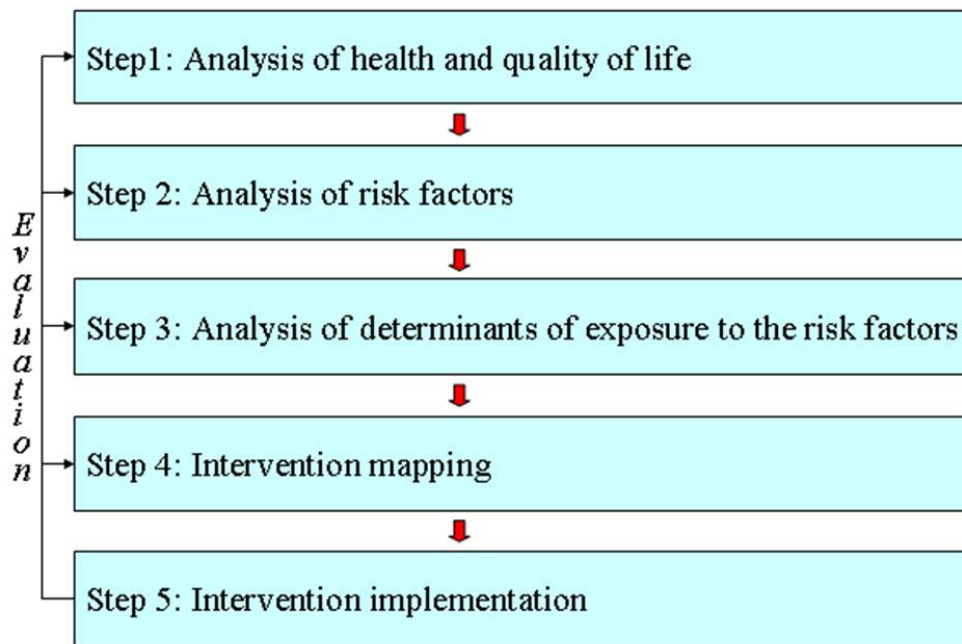
comparable data on the prevalence of overweight<sup>14</sup>, as well as simultaneously collected data on energy-balance related behaviours among adolescents across Europe.

The purpose of this paper is to describe and discuss the systematic development of a theory- and evidence-based intervention aimed at contributing to obesity prevention among 10-12 years olds across Europe. In many effect papers of interventions only a short paragraph deals with a description of the rationale of the intervention and why specific methods and practical strategies were chosen for the intervention. The lack of information on the development process of interventions also hinders the practical use of the results of systematic reviews as it is in most cases impossible to have a clear overview of the salient characteristics of interventions leading to the desired effects and those not leading to effect<sup>15</sup>. In the context of the ENERG-project several studies were conducted to inform the decisions on the focus of the intervention and the development of an intervention contributing to obesity prevention in children. How the results of these studies were used in the development process and informed the choices that had to be made are described in this paper.

## **METHOD**

Within the ENERGY-project special attention was given to reaching and involving the family, using economic incentives and the possibility to disseminate the intervention across Europe. The intervention development followed the five steps of the model of planned promotion of population health (Figure 1)<sup>16</sup> and was guided by the Intervention Mapping protocol<sup>17</sup>.





**Figure 1:** The model of planned promotion of population health<sup>16</sup>

Step 1, *Analysis of health and quality of life*, was conducted as part of the grant writing activity. Steps 2 and 3, *Analysis of risk factors* and *of determinants of the exposure to risk factors*, consisted of literature reviews, secondary data analyses, focus group interviews with parents and a cross-sectional survey conducted in the first phase of the ENERGY-project and served to decide on the aim of the intervention. In step 4, *Intervention development*, the results of steps 1-3 were used to brainstorm intervention ideas and develop guides for stakeholder interviews with principals, teachers, parents and children. Findings from these stakeholder interviews were used to select the behaviour change techniques<sup>18</sup> and structure the components into an intervention program. In addition, core intervention components were pretested for acceptability and barriers to implementation, including potential cultural differences between the five countries across Europe (Belgium, Germany, Greece, Hungary and Norway). Ethical approval was obtained in each country. Step 5, *Intervention implementation*, was informed by the stakeholder interviews, the pretesting, and the partners' previous experiences with implementing school-based interventions. *The evaluation phase* consisted of an effect evaluation based on a group-randomized controlled trial design as well as a thorough process evaluation of implementation and reach<sup>19,20</sup>. Due to the time-constraint of the project, the intervention was implemented and evaluated within a four month period. The evaluation phase will not be further described here.

## RESULTS

### **Step 1: Analysis of health and quality of life and Step 2: Analysis of risk factors**

The ENERGY cross-sectional study confirmed a need for prevention of overweight and obesity across Europe as indicated by high prevalence of overweight including obesity as well as risk behaviours for unnecessary weight gain<sup>9</sup>. Most of the risk-behaviours assessed (high consumption of soft drink and/or fruit juice, breakfast skipping, lack of active transportation and/or sport participation) varied by country, whereas screen time (TV, computer and game console combined) was high in all the seven countries with an average of about 3 hours of screen time/day<sup>9</sup>. Accelerometer data from a subsample indicated that total sedentary time during waken hours was on average 7.9 and 8.3 hours/day for boys and girls, respectively<sup>10</sup>. Given that there has already been quite many interventions focused on dietary behaviours and/or physical activity of children<sup>21,22</sup>, it was decided to focus on sedentary behaviour only and develop an intervention component that could be added to existing interventions on diet and/or physical activity.

It has been argued that “sedentary physiology” should be a separate and distinct field from exercise physiology<sup>23</sup>. In this field, sedentary behaviour refers to activities that do not increase energy expenditure above resting level<sup>24</sup>. This includes all activities done while sitting, such as watching TV and other screen-based entertainment, reading, working at a desk, socializing while sitting (in person or by phone) and motorized transportation<sup>24</sup>. However, the most studied sedentary activity among youth so far has been TV-watching<sup>23,25-26</sup>. Among children and adolescents, TV-watching has been associated with unfavourable body composition primarily in cross-sectional studies<sup>25</sup>, while a recent systematic review<sup>26</sup> concluded that there is insufficient evidence for a positive longitudinal relationship between TV-time and BMI or other indicators of fat mass. Future studies should thus focus on other modes of sedentariness. In addition, research among adults indicates that breaking up prolonged sitting may be beneficial for biological markers of metabolic risk<sup>27</sup>.

This led to the aims of the UP4FUN intervention - to reduce and break up sitting time at home (with special emphasis on TV and PC/electronic games) and to break up sitting time in school among 10-12 year olds in Europe.

### **Step 3: Analysis of determinants of the exposure to risk factors**

An ENERGY-review showed that parental rules/restrictions of screen-based behaviours, the number of TVs in the home and parental role modelling of sedentary behaviour were the three most important correlates of screen time<sup>5</sup>. Preliminary, single predictor analyses were conducted for the four of the UP4FUN intervention countries that also had participated in the ENERGY cross-sectional study. The data collection methods and specific questions are described elsewhere<sup>8</sup>, and the statistical analysis is described as a footnote of Table 1. The results showed that all of the potential determinants were associated with screen time in all of the four countries (Table 1). However, based on standardized beta-coefficients, preference for TV-viewing was important across the four countries as was various aspects of the home environment related to parent-child interactions. Preferences and the home environment were thus the main determinants.

### **Step 4: Intervention development**

#### ***Parental involvement***

An ENERGY-review suggested that addressing multiple home-related determinants and parenting practices were most likely to be effective and that the parental components should encompass different strategies<sup>6</sup>. However, focus group research among parents in four countries (Belgium, Hungary, Norway and Spain) within the ENERGY-project indicated that parents did not want the intervention to address their own behaviour<sup>7</sup>, but preferred focus on the behaviour of their child. Furthermore, they preferred interactive and practical activities for them to do with their child. These activities could be either school- or home-based, should be inexpensive, be planned on a convenient moment and concern practical issues. Furthermore, limiting sedentary time was considered the parents' sole responsibility, whereas physical activity and diet was considered a shared responsibility between home and school<sup>7</sup>, which indicated that conducting a school-based intervention on sedentary behaviours would be a challenge.

#### ***Stakeholder interviews***

Semi-structured interviews were performed with the main stakeholders; headmasters (n=3), teachers (n=19), children (n=48) and parents (n=19 mothers) in the five intervention countries. Most teachers, parents and children would like to learn more about negative effects of prolonged sitting-time and alternatives to screen time

activities. In general, promotion of moderate to vigorous physical activity came quickly to mind in all groups when asked for ideas of fun alternatives to sitting time, indicating that the concept of light intensity physical activity as an alternative was new. Children were not allowed to bring game consoles to school in most countries and screens were used for a limited amount of time in school/for homework, thus intervening on screen time at or related to school was not deemed feasible. All groups said that homework assignments focusing on reducing children's sitting time would be acceptable. Most parents and teachers agreed on using self-monitoring activities to promote awareness, and on setting individual goals and discussing family rules as strategies to reduce sitting-time. Most parents and children were negative to using an electronic TV time manager. The children thought breaking-up lessons (i.e. playing games, having dance breaks) would be fun, but many teachers voiced concerns about noise and too much time needed to get the children back to classwork after such breaks and therefore suggested to have the break-ups between lessons.

Economic incentives at the teacher or school level were not considered necessary, and incentives for the pupils should not be dependent on family involvement to ensure equal opportunity for all pupils. Preferably, incentives should be given to the whole class (i.e. sports equipment or a trip) or to every pupil. Thus, the economic incentives were renamed motivational factors and focused on things that would make it fun for the pupils to participate.

Other relevant factors that came up in the stakeholder interviews: projects focussing on physical activity and active transport had already been carried out (Belgium, Norway, Hungary, Greece - according to the Greek headmasters, but not the parents/children), parents perceived their children to be sufficiently physically active already (Greece), reducing sitting time was perceived to be a family issue (headmasters in Greece, but parents thought it was a school issue) and teachers asked the distribution of intervention material to be done before the summer vacation in order to implement the intervention in autumn (Germany).

### ***Theoretical framework and behaviour change techniques***

The intervention was framed in a social ecological perspective<sup>28</sup> due to the clear influence of the home physical and social environment. Changing personal determinants of sedentary time (i.e. awareness, attitudes, preferences, self-efficacy) was also considered of importance to promote self-regulation because 10-12 year olds are likely to spend much non-supervised time at home. The taxonomy of behaviour change techniques<sup>18</sup> was applied to characterise the link between the determinants and intervention components (Table 2). At the individual level the following behaviour change techniques were applied to the pupils: information about the behaviour-health link, self-monitoring with normative feedback on behaviour and goal setting with self-rewarding, use of prompts/prompt practice and identification as role models. The main targets at the interpersonal level were the parents, but the children could define who in their home should help them. They were also encouraged to ask for and offer help to their peers. Planning for social support and social change was thus the most used change technique at this level, but the following additional techniques were used (mainly targeting the parents): information about the behaviour-health link, agreement on behavioural contract, opportunities for social comparison and identification as role models. Finally, at the organisational level the teacher was targeted with information about the behaviour-health link and trained to model breaking-up sitting time and to use prompts and cues to remember this.

### ***Description of the UP4FUN intervention program***

The name UP4FUN was chosen to remind the pupils to get UP and engage in FUN alternatives to sitting. A company designed the material to appeal to children of both gender and across Europe through a general youth culture image, and inspire to activity and fun without promoting organized sports. The cultural fit of the design was verified by the national ENERGY-partners.

The intervention included 6 phases with 1-2 lessons each (Table 3). These lessons introduced the topic of the phase, and were followed by tasks in school, as well as messages to the family and tasks at home in the 6 newsletters (NEWS) to parents/family. Each NEWS was 2-3 pages and designed to bring the children's personalized messages from school to home (e.g. about the results of their sitting time registration and their personal goal for change) and to work on that specific topic through tasks at home. During the intervention, motivating factors were used to support the fun part of the intervention (a sheet of stickers to each pupil and a class-set

of step counter per school) and the social commitment to the message (bracelet with UP4FUN embossed). In week 5, the focus was on conducting Activity breaks (2-4 minutes) in class at school and during screen time at home either alone or with the family. The program ended with a Family Fun Event in phase 6 that was announced in NEWS 1 and 5. The aim of this event was to summarise the project, share experiences and raise continued support for the main message. Alternatively, this concluding event could be done in class. NEWS 6, none the less, aimed to convey the main results from this event from each class.

### ***Pretesting***

The ideas for an intervention should be pretested for their feasibility, acceptability and fit within the local situation before including them in the program<sup>29</sup>. Thus, researchers conducted a teacher training and teachers were requested to test lessons 1-3 and provide parents with the text of NEWS 1 and 4 in at least one class in each of the five countries. Testing these lessons provided feedback on the logistics of step counters in the classes, how pupils should register and calculate sitting time and how they perceived the task of setting personal goals to reduce sitting time. NEWS 1 introduced the project to the parents. NEWS 4 focused on the influence of the social and physical home environment on sitting time. For the latter, feedback from the parents on the specific content as well as the general format of the NEWS was requested. NEWS 4 was thus provided in two formats – a two-page NEWS with homework on a separate sheet (two pages) and a four-page NEWS with homework integrated in the text.

A total of 15 teachers, 138 pupils and 64 parents answered questionnaires in the pre-testing and additionally 37 pupils participated in focus groups. The pretesting confirmed the cultural appropriateness and interest in the topic and that the children liked the step counters, but also revealed the complexity of registering sitting time and lack of understanding of the purpose of the goal setting task. The sitting time card was therefore simplified to assess overall time of four activities (TV/Film, electronic games, computer and reading) for one afternoon and one weekend day. The goal setting task was explained in more detail in the teacher manual. The teachers found the components more time consuming than expected and required that the intervention should take no more than one class hour per week. Parents' responses were mixed with regards to the importance of the topic for their child, the length and structure of the NEWS and homework. Where appropriate it was acknowledged in the NEWS that some families might already have strict rules about screen time. The NEWS with

homework integrated was chosen to ensure child-parent interactions (length 2-3 pages). The text of the NEWS was split into boxes with clear headings allowing for selective reading, i.e. “Homework for children”, “Suggestions for parents” and “Suggestions for children” or the fact boxes headed by questions like “Do children really sit that much?”. Personal messages from the child to their family about the part of the project carried out in school were incorporated in every NEWS to motivate the child to deliver the NEWS to their family.

### **Step 5: Intervention implementation**

Based on the stakeholder interviews and the pre-test it was decided to preferably have a one hour training of all teachers conducted in each school implementing the intervention. However, a common teacher training for all intervention schools in one area was also an option. The school management was invited to facilitate awareness as well as a supportive implementation environment. The training focused equally on the scientific rationale and on explaining the intervention components. Each teacher received a teacher manual with both brief and detailed outlines of each lesson and supporting material. All materials for the pupils were provided in the right amounts per class to reduce the burden on the teacher and the school. The material was printed in full-colour, but can also be printed in black and white and electronic copies were provided. The researchers were available for questions by phone and e-mail, but no active support was planned during the implementation phase.

## **DISCUSSION**

The present paper describes the systematic development of UP4FUN, an intervention aimed at reducing and breaking up sitting time at home (with special emphasis on TV and PC/electronic games) and at breaking up sitting time in school among 10-12 year olds in five European countries. By aiming to break up as well as reduce sitting time both at home and at school, the UP4FUN intervention contributes to fill a gap in the current literature<sup>30</sup>, which so far has been dominated by studies aimed at reducing TV-time<sup>23,25</sup>. Furthermore, the age of the target group (10-12 years) at the transition between childhood and adolescence, and the cross-European design contribute to the uniqueness of this study.

The systematic theory- and evidence-based process of developing the intervention is an important prerequisite and addresses the potential weaknesses of previous obesity prevention interventions<sup>12,13</sup>. However, it should be noted that the lack of research on limiting sitting time and promoting breaks in sitting time resulted in a challenge of choosing the most important and modifiable potential determinants as well as intervention strategies. A recent review of prospective studies on determinants of sedentary behaviour in youth concluded there was insufficient prospective evidence for determinants of sedentary behaviour<sup>31</sup>. The determinants in that review were generally others than those found in reviews including both cross-sectional and longitudinal studies<sup>32-33,5</sup>. This underscores the need for more longitudinal studies on potential determinants, especially determinants of behaviour change, to inform future interventions. The consistency of the associations between potential determinants and screen time across the different countries participating in the ENERGY cross-sectional survey was reassuring with regards to developing one intervention for all countries.

The theoretical framework and behaviour change techniques applied in UP4FUN are in line with recent reviews on sedentary behaviour<sup>33-35</sup> with the addition of skills training and prompting for breaking up of prolonged sitting. Electronic devices for controlling TV-viewing time have been found to produce the largest effects on screen-time<sup>34,35</sup>, but were not used in UP4FUN. The reasons for this were lack of support for this strategy by the stakeholders interviewed and that including such devices in a European wide dissemination of the intervention was not considered feasible. Major changes in the physical environment and pedagogical methods in the classroom<sup>36</sup> were explored in the stakeholder interviews, but not included since this would not be feasible to implement in the six week evaluation study.

The consistent focus on finding and testing feasible strategies for involving parents<sup>5-7</sup> is another strength of UP4FUN. Yet, when choosing behaviour change techniques and the sequencing of the program, the empirical evidence<sup>5</sup> had to be balanced against the parents wish that the intervention should not target their own behaviour<sup>7</sup>. This may have affected the potential effectiveness of the intervention since the focus on the influence of the parents and home environment was only indirect through the child-parent interactions around the child's behaviour. Furthermore, parents had indicated that sedentary behaviour was the responsibility of the home<sup>7</sup> and thus a school-based intervention may not have been seen as appropriate. Yet, no other channels to reach



parents from all socio-economic backgrounds that suited all the countries were found in the formative phase.

The formative evaluation phase involving stakeholder in all the countries and the pre-testing of critical components of the intervention both in school and with parents in all the countries addresses the last of the weaknesses of previous obesity prevention interventions<sup>12,13</sup>. This made it possible to adapt the components to fit the children, the teachers and the parents. Furthermore, all countries reported lack of time for the teacher training and the implementation of the project in the weekly schedules as potential barriers. Therefore a six week duration of the intervention was determined as the maximum possible time given that the intervention should be combined with other interventions on diet and physical activity. This time frame was also most feasible to be included in the evaluation study within the ENERGY-project. However, we acknowledge that this period is too short to expect sustainable changes in school and family environmental factors and thus substantial behaviour change. Therefore, if the program appears feasible to implement its effectiveness should be tested in a study of longer duration and in combination with interventions targeting diet and physical activity.

## **CONCLUSION**

The UP4FUN intervention targeted reducing and breaking up sitting time because this risk behaviour was equally prevalent across Europe based on the ENERGY cross-sectional survey. Furthermore, not many systematically developed interventions focussing on this behaviour and that could be added to interventions on diet and physical activity had been developed so far. The weak scientific evidence for determinants of sedentary behaviour made the process challenging, but the newness of sitting time as a health issue was supported by interviews with teachers and parents. The development process uncovered several common challenges: the lack of time for additional projects in schools, parents not wanting to be directly targeted and children finding it difficult to suggest fun alternatives to sitting which were not sports, but also some variation in the perceived importance of reducing/breaking up sitting time and the best intervention strategies. The systematic development and the comprehensive

formative evaluation phase ensured that the intervention should be feasible and appropriate across Europe.

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**Trial registration** The study is registered in International Standard Randomized Controlled Trial Number Register (registration number: ISRCTN34562078).

### **Ethical approvals**

In Belgium the study was approved by the Medical Ethics Committee of the University Hospital Ghent; in Germany the study was approved by State Medical Chamber of Baden-Württemberg; in Greece the study was approved by the Bioethics Committee of Harokopio University; in Hungary the study was approved by the Scientific and Ethics Committee of Health Sciences Council; and in Norway the survey was approved by the National Committees for Research Ethics in Norway.

### **Authors' contributions**

Conceived and designed the intervention and evaluation study: NL, SB, EB, FNV, LM, EK, GM, MG, MMvS, CW, JB, IdB, MJMC, YM. Wrote the manuscript: NL, FNV, SB, EB. Conducted the statistical analyses: MMvS. Provided feedback on drafts of the manuscript: LM, EK, GM, MG, MMvS, CW, JB, IdB, MJMC, YM.

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**Table 1:** The associations\* between potential determinants and weekly minutes of screen time in 4 European countries.

N	<b>Belgium</b>		<b>Greece</b>		<b>Hungary</b>		<b>Norway</b>	
	986		1084		1019		996	
	<i>b(SE)</i>	$\beta$	<i>b(SE)</i>	$\beta$	<i>b(SE)</i>	$\beta$	<i>b(SE)</i>	$\beta$
<i>Personal</i>								
Knowledge	<b>188.2</b> <b>(23.5)§</b>	0.27	<b>123.5 (17.6)§</b>	0.22	<b>178.5 (18.3)§</b>	0.32	<b>146.0 (23.1)§</b>	0.22
Attitude	<b>161.6</b> <b>(29.5)§</b>	0.18	<b>162.7 (24.3)§</b>	0.20	<b>260.0 (22.5)§</b>	0.34	<b>209.8 (26.5)§</b>	0.24
Health belief	<b>-42.1 (15.7)‡</b>	-0.09	<b>-54.8 (14.5)§</b>	-0.12	<b>-91.3 (16.3)§</b>	-0.54	<b>-40.6 (16.4)#</b>	-0.08
Self-efficacy to NOT watch TV	<b>-200.0</b> <b>(18.8)§</b>	-0.32	<b>-191.8 (16.5)§</b>	-0.33	<b>-137.2 (18.8)§</b>	-0.22	<b>-162.5 (20.4)§</b>	-0.24
Automaticity	<b>127.6</b> <b>(16.9)§</b>	0.24	<b>146.0 (16.2)§</b>	0.26	<b>137.5 (16.5)§</b>	0.25	<b>132.2 (17.6)§</b>	0.23
Preference	<b>248.5</b> <b>(26.2)§</b>	0.30	<b>295.2 (20.0)§</b>	0.41	<b>298.2 (21.0)§</b>	0.41	<b>274.3 (24.0)§</b>	0.34
<i>Home environmental</i>								
Parental rules	<b>-296.6</b> <b>(43.7)§</b>	-0.21	<b>-295.1 (42.4)§</b>	-0.21	<b>-354.3 (45.7)§</b>	-0.24	<b>-231.2 (41.4)§</b>	-0.17
Parental norm	<b>160.3</b> <b>(34.2)§</b>	0.15	<b>97.8 (24.2)§</b>	0.12	<b>230.7 (31.6)§</b>	0.23	<b>150.4 (35.8)§</b>	0.13
Allowing whenever child wants	<b>137.3</b> <b>(16.1)§</b>	0.27	<b>133.6 (16.8)§</b>	0.24	<b>154.5 (16.3)§</b>	0.29	<b>161.6 (17.1)§</b>	0.29
Allowing when child asks	<b>230.0</b> <b>(26.2)§</b>	0.27	<b>230.7 (20.2)§</b>	0.33	<b>174.8 (22.4)§</b>	0.24	<b>178.8 (26.6)§</b>	0.21
Parental modelling	<b>151.1</b> <b>(27.0)§</b>	0.18	<b>158.6 (21.8)§</b>	0.22	<b>256.6 (27.8)§</b>	0.28	<b>183.6 (30.2)§</b>	0.19
Watching together	<b>55.0 (6.0)§</b>	0.28	<b>45.3 (5.5)§</b>	0.24	<b>63.0 (6.1)§</b>	0.32	<b>55.6 (9.2)§</b>	0.19
TV in bedroom	<b>329.3</b> <b>(49.5)§</b>	0.21	<b>205.8 (40.5)§</b>	0.15	<b>270.6 (49.2)§</b>	0.17	<b>192.6 (42.7)§</b>	0.14
<i>Peer environmental</i>								
Peer norm	<b>147.2</b>	0.14	<b>97.1 (22.7)§</b>	0.13	<b>135.1 (28.5)§</b>	0.15	<b>137.6 (42.0) ‡</b>	0.11

	<b>(34.9)§</b>								
Peer modelling	65.3 (34.8)	0.06	<b>140.0 (25.0)§</b>	0.17	<b>185.2 (34.8)§</b>	0.17	<b>214.6 (33.4)§</b>	0.20	

\*Multilevel single predictor models were conducted for each country separately using multilevel linear regression analysis (MLwin 2.18) and adjusting for age, gender, ethnicity, BMI and school clustering. Assumptions for linear regression analyses were checked, and the data were screened for multicollinearity. For details about the variables see van Stralen et al<sup>8</sup>

\*\*Significant associations are shown in bold, and # p<0.05; ‡ p<0.01; §p<0.001



**Table 2** The UP4FUN intervention by social ecological level, determinant, behaviour change techniques\* and program components.

<b>Social ecological model level</b>	<b>Determinant</b>	<b>Behaviour Change Techniques</b>	<b>Examples of program components</b>
<b>Individual</b>	Knowledge	Provide information about behaviour – health link (IMB)**	The website: up4fun.eu, Week 1: (sedentary/screen time), Week 5: (breaking up sitting time), Week 6: Family Fun Event
	Attitude	Prompt intention formation (SCogT)**	Week 1: Pupils start wearing the UP4FUN bracelet
	Awareness of own behaviour	Prompt self-monitoring of behaviour (CT)**  Provide feedback on performance (CT) Prompt specific goal setting (CT) Provide contingent rewards (OC)**	Week 2: <ul style="list-style-type: none"> <li>• Pupils draw timeline with activities for a normal weekday</li> <li>• Pupils register steps for 3 every day activities at home</li> <li>• Pupils register sitting time by activity (TV, PC, games and reading) for one afternoon of a weekday and one weekend day</li> </ul> Week 3: <ul style="list-style-type: none"> <li>• Pupils sum up sitting time and write personal goal (NEWS 3) and are provided with information on recommendations about duration of screen time</li> <li>• Pupils try out the goal for a week, evaluate with stickers (Smileys and Frownys) and write down 3 difficulties and solutions</li> </ul>
	Automaticity	Teach to use prompts or cues (OC) Prompt practice (OC)	Week 5: Activity breaks in class, make poster(s) of things to do during breaks NEWS 5: Ideas for how to remember to do breaks at home during PC/TV time Week 5: Teacher reminds pupils to get out quickly for recess.
	Preference/liking		Week 2: Pupils make a list of 3 indoor and 3 outdoor fun activities to do at home Week 5: <ul style="list-style-type: none"> <li>• Class brainstorms ideas for recess activities and makes a poster of them</li> <li>• Pupils register steps for walking to school</li> <li>• Pupils try out activity breaks in school</li> </ul>
	Self-efficacy	Prompt barrier identification (SCogT)	Week 3: <ul style="list-style-type: none"> <li>• Pupils try out the goal for a week and write down 3 difficulties and solutions</li> </ul>

			<ul style="list-style-type: none"> <li>Class discusses difficulties and solutions</li> </ul> <p>Week 4: Optional: Family has screen free day + write 3 positive and negative experiences</p>
	Role modelling	Prompt identification as role models (SCogT)	WEEK 5 : Pupils encouraged to model activity breaks during TV-time for family
<b>Interpersonal (family)</b>	Knowledge	Provide information about behaviour – health link (IMB)	The website: up4fun.eu, NEWS 1: (sedentary/screen time), NEWS 5: (breaking up sitting time), Week 6: Family Fun Event
	Awareness of child behaviour	Prompt monitoring of child behaviour (CT)	NEWS 2: Pupil share drawing of when they sit/what they do during a regular weekday. Parents are encouraged to take notice when their child is sitting, NEWS 3: Pupils share results of sitting registration time and personal goal with parents
	Social support	Plan social support and social change (social support theories) Agree on behavioural contract (OC)	NEWS 2: Pupils share list of 3 indoor and 3 outdoor fun activities to do at home NEWS 3: Pupils share results of sitting registration time and personal goal, and are encouraged to ask for help from family members. Suggestion for parents on the different types of support they can offer and how to communicate with the child. NEWS 5: Suggestions: Plan for active transport Week 6/NEWS 6: <ul style="list-style-type: none"> <li>Family participates in Family Fun Event (results from the project through a quiz, sharing of positive and negative experiences, practicing Activity breaks, take on the Family challenge=to continue to work on reducing sitting time)</li> <li>Teacher hands out bracelets to families that take the challenge</li> </ul>
	Role modelling	Prompt identification as role models (SCogT)	NEWS 4: Suggestions: Positive parental modelling and doing fun alternatives together or change the physical availability of screens
	Parenting rules and restrictions	Provide opportunities for social comparison (SCompT)**	NEWS 4: Pupils share with parents the number of pupils in class with rules about screen time and some examples of the rules, and discuss family screen rules Suggestions: Choose one rule and try it out for a week.
	Physical availability	Prompt barrier identification (SCogT)	NEWS 4: Pupils and parents guess number of screens at home by category (TV, PC, games) before pupils count them. Suggestions: Change the

	of screens		physical availability of screens.
<b>Organizational (teacher)</b>	Knowledge	Provide information about behaviour – health link (IMB)	The website: up4fun.eu, teacher training, teacher manual,
	Role modelling	Model or demonstrate the behaviour, Teach to use prompts or cues (OC)	Week 5: Teacher modelling of activity breaks once in every sitting lesson, suggested to use alarms as reminders

\* for definitions of behaviour change techniques see Abraham and Mitchie [18]

\*\* IMB=information-motivation-behavioural skills model CT= control theory OC=operant conditioning SCogT=social-cognitive theory SCompT=Social comparison theories

**Table 3** The UP4FUN intervention - the phases, the NEWS and the tasks.

Phases and titles		NEWS titles	Tasks
1	Introduction to UP4FUN	NEWS 1: <i>Welcome!</i>	<ul style="list-style-type: none"> <li>- Families talk about the project at home</li> <li>- Families note down time for Family Fun Event</li> <li>- Pupils start wearing the UP4FUN bracelet</li> </ul>
2	Awareness of sitting time and light physical activity alternatives.	NEWS 2: <i>Awareness of time spent sitting.</i>	<ul style="list-style-type: none"> <li>- Pupils draw timeline with activities for a normal weekday and share it with family</li> <li>- Pupils make a list of 3 indoor and 3 outdoor fun activities to do at home and share the list with family</li> <li>- Pupils register steps for 3 every day activities at home</li> <li>- Pupils register sitting time by activity (TV, PC, games and reading) for one afternoon of a weekday and one weekend day</li> </ul>
3	A challenge – reducing sitting time	NEWS 3: <i>Helping and supporting your child to aim for less sitting time.</i>	<ul style="list-style-type: none"> <li>- Pupils sum up sitting time</li> <li>- Pupils write personal goal</li> <li>- Pupils share results of sitting time and personal goal with family</li> <li>- Pupils try out the goal for a week, evaluate with stickers (Smileys and Frownys) and write down 3 difficulties and solutions</li> <li>- Class discusses difficulties and solutions</li> </ul>
4	Home environment and sitting time	NEWS 4: <i>Do screens control your family life?</i>	<ul style="list-style-type: none"> <li>- Pupils note down number of pupils in class with rules about screen time and some examples of the rules, share this with parents and discuss family screen rules</li> <li>- Pupils and then parents guess number of screens at home by category (TV, PC, games) before pupils count them</li> <li>- Suggestions: Reduce parental modelling and family screen time or change the physical availability of screens</li> <li>- Optional: Family has screen free day + write 3 positive and negative experiences</li> </ul>
5	Breaking up prolonged sitting time and practicing active transport	NEWS 5: <i>Short activity breaks are better than no breaks at all.</i>	<ul style="list-style-type: none"> <li>- Class brainstorms ideas for recess activities and makes a poster of them</li> <li>- Teacher leads one Activity break per sitting lesson throughout the week. Pupils practice Activity breaks during sitting time at home.</li> <li>- Pupils practice active transport to school and register the number of</li> </ul>

			<p>steps</p> <ul style="list-style-type: none"> <li>- Pupils remind parents about Family Fun Event</li> </ul>
6	Summarizing the class results and spreading the Challenge.	NEWS 6: <i>Thank you for taking part in the UP4FUN project.</i>	<ul style="list-style-type: none"> <li>- Class prepares the Family Fun Event</li> <li>- Family participates in Family Fun Event (results from the project through a quiz, sharing of positive and negative experiences, practicing Activity breaks, take on the Family challenge of continuing to work on reducing sitting time)</li> <li>- Teacher hands out bracelets to families (parents and siblings) that take the challenge either at the Family Fun Event or after a response to NEWS 6</li> </ul>