Intervención multidisciplinar y no competitiva en salud pública para el tratamiento del sedentarismo y la obesidad infantil: Programa Nereu

Noemí Serra-Paya, Assumpta Ensenyat, Alfonso Blanco-Nespereira

National Institute for Physical Education of Catalonia (INEFC), University of Lleida (Lleida) 25192, Spain.

RESUMEN

El objetivo es evaluar sí el Programa Nereu tiene un impacto favorable en los hábitos de actividad física, el sedentarismo y en la adiposidad en niños con sobrepeso y obesidad, como herramienta de intervención integral en salud pública para el tratamiento de la obesidad infantil. El diseño del estudio fue prospectivo longitudinal con post-test a los 9 meses. El Programa Nereu consistió en actividad física no competitiva para niños con componentes conductuales, sesiones de hábitos saludables para los padres y estrategias del comportamiento para ambos. Ochenta y seis niños (10.65 ± 2 años) sedentarios y con sobrepeso u obesidad, según los criterios IOTF y sus padres participaron. La actividad física, las conductas sedentarias y la adiposidad se midieron a los 9 meses.

Los niños expresaron pasar más tiempo ($p < 0,01$) en actividades de intensidad moderada ($3,1 \pm 1,62 h \cdot set^{-1}$) y alta intensidad ($3,1 \pm 1,62 h \cdot set^{-1}$) y menos tiempo ($p < 0,001$) en actividades sedentarias ($5,4 \pm 6,3 h \cdot week^{-1}$). El IMC z-score se redujo en 0,2 ± 0,29 unidades ($p < 0,001$).

Estos resultados indican un cambio positivo en los hábitos de actividad física, las conductas sedentarias y la puntuación z del IMC en niños sedentarios con sobrepeso y obesidad. Esta intervención podría ser una interesante herramienta de intervención de

salud pública para el tratamiento de la obesidad infantil. Sin embargo, los estudios futuros deben aclarar estas asociaciones.

Palabras clave: comportamiento; niños; motivación; obesidad; salud pública; sedentarismo.

Multidisciplinary friendly and uncompetitive behavioural intervention in public health for the management of sedentary and overweight or obese children: Nereu Programme

ABSTRACT

The aim was to evaluate if the NEREU Programme would favourably impact on PA, sedentary behaviour and adiposity in sedentary overweight and obese children as a public health intervention tool for the management of children's obesity.

The design was a longitudinal prospective study with post-test at 9 months, consisted of PA for children with behavioural components, family behavioural sessions for parents and behaviour strategies for both. Eighty-six (10.65±2years) sedentary and overweight or obese children according the IOTF Criteria and their parents participated. PA, sedentary behaviours and adiposity were collected at baseline and 9 months after. *Results:* The children reported more time ($p<.01$) on moderate (2.4±5.4h·week^{-1}) and high (3.1±1.62h·week^{-1}) intensity PA and less time ($p<.001$) on sedentary activities (5.4±6.3h·week^{-1}). BMI z-score was reduced by 0.2±0.29 units ($p<.001$).

These results may induce a positive change in physical activity, sedentary behaviours and BMI z score in sedentary overweight and obese children. This intervention could be an interesting public health intervention tool for the management of children's obesity. However, future studies should clarify these associations.

Keywords: behaviour; children; motivation; obesity; public health; sedentary.

Introduction

Childhood obesity has become one of the most prevalent health disorders in developed countries. According Spanish health inquiry in 2010, in Spain, 28.6% of children and adolescents aged 2-17 years are overweight or obese (National Health System of Spain,

2010). Apart from the immediate repercussion of excess fat mass on body image and its consequences on psychological well-being, the major concerns of childhood obesity are the relationship with the presence of comorbidities during childhood, such as metabolic syndrome (Weiss, et al., 2004) or inflammatory markers, (Burke, 2006) and a greater risk of suffering cardiovascular events in adult life (Baker et al., 2007; Bibbins-Domingo et al., 2007).

In developed societies, obesity is attributed mainly to an energy imbalance (Davison & Birch, 2002), it indicate that due to changes in physical activity behaviour, the caloric intake of fat rich diets may not be counterbalanced with a greater energy expenditure. In the last years in developed countries, time spent on physical activity tasks has decreased, whereas that devoted to sedentary behaviours, like watching TV or playing computer games has increased (Agarwal, 2008).

The relevance of the problem raised is also reflected in the large number of reviews and recommendations issued by different institutions and researchers (SEEDO, 2000; Nishida et al., 2003; Biddle et al., 2011). Most of these guidelines are based on intensive multidisciplinary interventions that combine strategies for improving diet composition with strategies for reducing sedentary behaviour and offering opportunities for increasing activity levels. However, results are contradictory (Campbell et al., 2001; Doak et al., 2006) and in some cases intervention programs are ineffective in modifying adiposity and/or physical activity behaviour. Van Sluijs et al., (2007) reviewed evidence on the effectiveness of interventions designed to increase physical activity in children. The results concerning family interventions to increase physical activity in children were inconclusive. According to Connelly, Duaso & Butler (2007) neither nutrition education, nor nutrition skills, nor physical education differentiate between effective or ineffective childhood obesity prevention programs. Connelly et al., (2007) found that

effective programs were those that provided compulsory physical activity from moderate to high intensity. Compared to the research, on the role of physical exercise programs for childhood obesity prevention, there are relatively few studies focused on the effectiveness of supervised physical exercise programs for obesity treatment among children (Epstein et al., 2005; Golan et al., 2006), and few interventions address the specific needs and interests of obese children (Daley et al., 2005), especially their physical activity needs. The purpose of this study was to determine whether a physical activity intervention for children based on friendly uncompetitive physical activity, associated with parental theoretical sessions of multidisciplinary behaviour intervention would favourably impact on physical activity, sedentary behaviour and indices of adiposity (BMI *z* score and fat distribution) in sedentary overweight and obese children.

Methods

Design

The intervention design is a longitudinal prospective study of 9 months duration. Measures were collected at the beginning (baseline) and at the end of the intervention (9 months later). We collected BMI, BMI z score, physical and sedentary behaviours by a questionnaire and total body mass and regional fat mass distribution was estimated by multichannel bioelectrical impedance analysis (BIA). Before proceeding with the program, informed parental consent and children's assent were obtained. Ethical approval was granted by the Arnau Vilanova hospital Ethics Committee and all procedures were conducted in accordance with the Declaration of Helsinki.

Participants

Eighty-six children (10.65±2 years) recruited from their paediatric healthcare centre who were sedentary and overweight or obese, and their parents participated in the intervention. The inclusion criteria of the intervention program were participants

between 8 to 12 years old, overweight or obese according to the International Obesity Task Force criteria defined by Cole, et al., (2000) (Table I) and sedentary (less than 3 hours per week of physical activity outside school hours) according to the questionnaire of Serra-Majem and Aranceta (2001), specific for Spanish children between 4 and 14 years old, addressed from their pediatric healthcare centre and suffered no comorbidities or diseases that contraindicated exertion. All participants were recruited from their paediatric healthcare centre by their paediatrician and participated voluntarily in the program. From their post code and the paediatric healthcare centre that the participants have assigned, the majority of the families came from a low socio-economic neighbourhood.

Table 1. Baseline characteristics of the study children

Baseline Characteristics	Total (n = 86)	Boys (n = 56)	Girls (n = 30)
Age (years)	10.65±2	10.65±2.1	10.67±1.7
Height (cm.)	147.3±11.9	147±12.9	147.5±10
Weight (kg.)	57.39±15	58±16.3	56±12.6
BMI z-score (units)	2.44±0.56	2.53±0.57*	2.27±0.50
BMI ($kg \cdot m^{-2}$)	25.97±3.6	26.23±3.7	25.48±3.3

BMI: body mass index (weight (kg) / height (m^2)

Values are expressed as mean±sd

Mean value significant different than girls, *$p < .05$

Procedure

The program is a 9 month duration (from October to June, that is, an academic year) multidisciplinary behavioural intervention consisting of (a) physical activity training for children, (b) family behavioural counselling sessions for parents, and (c) behaviour strategies, that involves parental and child participation (Table II). All intervention groups had a maximum of 12 children or parents. The children's physical activity intervention took place in a school sports centre and the theoretical sessions in the

paediatric healthcare centre, next to the school. Both sessions were performed simultaneously.

The physical activity training offered to children consisted of 105 sessions (3 sessions per week, each lasting 60 minutes). Sessions aimed to increased active behaviour and promote enjoyment during physical activity. All training sessions had a similar structure but differed in the contents of the main part. Sessions had a four part structure, and consisted of assembly, warm-up, main part and cool-down periods. During the assembly, the coach explained the day's training task, introduced some content and games related to healthy behaviour of physical activity and diet, and attempted to motivate the children. During the warm-up part, dynamic activities, such as walking or jogging, were performed at low intensity. The main part of the session focused primarily on being physically active but as participants were children not especially fit, exercises were of short duration (4-5 minutes), moderate-high intensity, and intersected by periods of low intensity. This structure was used because obese children tend both to be sedentary and to have had poor experiences with exercise (ACSM, 2000). Furthermore, short bouts of intermittent exercise are considered most appropriate for this population (Daley et al., 2005). Training tasks were mainly aerobic, but strength, joint mobility, and balance were also included (table II). These were planned according to 3 essential pillars: playing, enjoying oneself and moving. All activities were performed in a friendly uncompetitive atmosphere and were adapted to children's needs, because motivating obese children to be physical active cannot be achieved in the same approach as for children of normal weight (McWhorter, et al., 2003). Obese children are physiologically different from those who are normal weight, and have significant emotional differences (Sothern, et al., 1999). The cool-down period comprised recovery exercises and static stretching allowing children to recover. All the

physical activity training for children was programmed by specialists with at least 3 years of experience of physical activity with obese children and following the physical activity guidelines for children (ACSM, 2010; Aznar, and Webster, 2006; WHO, 2010).

The family behavioural counselling sessions for parents consisted of 21 theoretical counselling lessons, each lasting 60 minutes, during which trained nurses from the paediatric healthcare centre and physical activity professionals from sport science centre dealt with multidisciplinary behaviour including physical activity, diet and healthy habits (table II).

The three behaviour strategies sessions for parents and children were planned to reinforce the acquisition of physical activity and eating habits within the family behaviour (table II). The assembly of physical activity training for children, the sessions of the family theoretical counselling lessons for parents and the behaviour strategies sessions for parents and children were planned according the recommendation of the guidelines of different organisations (AESAN, 2011; CECC, 2010; COM, 2005; WHO, 2010). Additionally, four extra family physical activities (e.g. skiing, water party) were organized to foster this more active behaviour in an experiential way.

Table 2. Contents of physical activity training for children, family theoretical counselling sessions and behaviour change strategies for both.

Term	Children physical activity sessions	Family counselling sessions
1st TERM (October-December) GETTING INFORMED	Physical activity and diet games[♯] Personal knowledge games Interaction group activities Collaboration games Traditional games Balance	Risk of sedentary behaviour and obesity Physical exercise benefits Myths related to nutrition Different physical activities and sports Emotions and Social skills Healthy lifestyles benefits Behaviour strategies*

2nd TERM (January-March) BECOMING AWARE	Physical activity and diet contents[♯] Different kind of adapted sports without competition Games with alternative equipment Aerobic games Joint mobility Strength games	Awareness of healthy behaviour Food categories Breakfast is important! Barriers to exertion (social, physical, psychological) Physical activity and eating strategies *
3rd TERM (April-May) COMMITTING AND KEEPING UP	Physical activity and diet behaviour strategies[♯] Motor and physical abilities Aerobic tasks Strength exercise Different kind of sports and activities Outdoor sports and games	Planning and checking physical exercise and nutrition schedule Relapse prevention Psychological strategies to increase healthy and active behaviour Behaviour family strategies *

* Behaviour strategies, that involves parental and child participation.

♯ Theoretical contents deal during the assembly part of the children physical activity sessions

Instruments

Before and after the program, daily sedentary and physical activity behaviour of children was assessed by a modified version of a 7-day recall physical activity questionnaire (43). The questionnaire obtained a correlation coefficient of r = .81 in the test-retest reliabilities for the Godin-Shephard to the self-administered survey and a correlation of r = .53 ($p < .001$) for the total group that supported the validity of the questionnaire for children (Sallis, Buono, & Roby, 1993). Questionnaires were completed through the use of experienced interviewers. Physical activities were classified according to their metabolic cost as sedentary activities (< 1.4 METs), light intensity activities (1.5 to 2.9 METs), moderate intensity (3 to 4.9 METs) or high intensity (>5 METs), following the recommendations of Ainslie et al., (2000).

All anthropometric measurements were taken at the beginning of the program and 9 months later, at the end. Body weight was measured with a weighing scale (SECA model 755, SECA Corp., Hamburg, Germany, 2006) and height with a stadiometer

(Añó Sayol, Barcelona, Spain). Children were lightly dressed and without shoes. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). To overcome limitations of BMI due to changes associated with growing and maturity, BMI *z* score was used. To determine BMI *z* score, the LMS method (Cole, & Green, 1992) was used as a reference. Regional fat mass distribution was estimated by multichannel bioelectrical impedance analysis (BIA). Total body resistance and reactance were measured with a multisegmental and multifrequency bioelectrical impedance analyzer (Promis Body Composition, Promis Corp., Puerto de Santa Maria, Spain, 2006) in supine position.

BIA validated and reliability has been for the assessment of body composition in children (Jensky-Squires, Dieli-Conwright, & Rossuello, 2008). Subjects' age, gender, weight and height were entered into the machine. Skin was cleaned and adhesive electrodes positioned on the back of hands and feet. During measurements children were asked to remain as quiet as possible.

On both occasions, all anthropometric measures were taken by the same trained professional. Children were referred to the Functional Assessment Laboratory of the National Institute for Physical Education of Catalonia (INEFC) between 6:00 pm and 7:00 pm. and had been instructed to come to the appointment, without having eaten for at least four hours, or having performed any physical exertion for two hours. Children's attendance was recorded with the purpose of considering adherence to the intervention.

At the end of the program, both children and parents filled out a satisfaction survey. The questions of the children were: 1- Do you like the games that have been performed in the program? 2- Are you happy with your coach? 3- Would you like to repeat the program? The questions of the parents were: 1- Has your child enjoyed during the program? 2- Are you happy with your child's coach? 3- Would you like your child to

participate in the program again? The format of the scale was between 1(always) and 4 (never) for the first and second questions and for the third question in both questionnaires the answer was yes or not. These questionnaires were administered by specialists, designed specifically for the intervention and had been used satisfactorily in a pilot trial, with the same sample of children.

Data analysis

All statistical analyses were conducted with SPSS version 15.0 (SPSS Inc., Chicago, IL, 2007). Data are reported as mean ± standard deviations.

Accepting an alpha risk of 0.05 and a beta risk of 0.1 in a two-sided test, 83 subjects are necessary to recognize as statistically significant a difference greater than or equal to 0.2 units. The standard deviation is assumed to be 0.5. It has been anticipated a drop-out rate of 20%. Student t-test was used to compare paired-samples or independent samples (girls versus boys). When group samples were too small, or when variables did not show normality, checked by Kolmogorov-Smirnov test, U of Mann–Whitney and W of Wilcoxon, non parametric tests were used. Statistical significance was set at $p < .05$. To analyze the influence of age and sex in the outcome measures a regression analysis of adiposity changes with age, sex and the degree of obesity was conducted.

Results

Thirty-six children successfully completed the 7-day recall physical activity questionnaire before and at the end of the program. Results show that at the beginning of the program, they devoted 87% of their weekly time to sleep or to sedentary activities and only 3% and 1% to physical activities of moderate and high intensity respectively. At the end of the program, sedentary activities decreased to 84% and moderate and high increased to 4.5% and 3%, respectively. In that sense, children stated they spent more time on moderate (2.4 ± 5.3 h·week^{-1}; $p < .01$) and high (3.1 ± 1.62 h·week^{-1}; $p < .01$)

intensity physical activities and less time on sedentary activities (5.4 ± 6.3 h·week^{-1}; p < .001). The reduction is due in part to a decline in time dedicated to sedentary activities, like video-computer games 1.6 ± 4.6 h·week^{-1} (5.9 ± 5.2 h·week^{-1} vs. 4.27 ± 5.08 h·week^{-1}; p < .05) or/and to watching TV 3.2 ± 4.8 h·week^{-1} (12.7 ± 6.83 h·week^{-1} vs. 9.48 ± 5.02 h·week^{-1}; p < .001) between the beginning and the end of the intervention respectively. Results were similar for sex, age or the degree of obesity (overweight or obese).

Changes in BMI *z* score and BMI are shown in table 3. BMI *z* score at the end of the program was significantly reduced 0.2 ± 0.29 units (2.44 ± 0.56 units vs. 2.23 ± 0.59 units; p < .001) for the whole group. Results were similar for sex, age or the degree of obesity.

Table 3. Body mass index at the beginning and at the end of the intervention program.

	All children (n = 86)		Boys (n = 56)		Girls (n= 30)	
	Before	End	Before	End	Before	End
BMI z score (units)	2.44±0.56	2.23±0.59*	2.53±0.57	2.33±0.61*	2.27±0.5	2.05±0.51*
BMI (kg·m^{-2})	25.97±3.6	25.85±3.9	26.23±3.7	26.1±3.8	25.48±3.3	25.39±3.9

Values are expressed as mean±sd

Difference between before and end of the intervention *P <0.001

Results from bioelectrical impedance analysis showed that body composition and fat distribution were different for boys and girls (Figure 1). For any measures taken, boys presented, in relative terms, a smaller amount of fat than girls (p < .05), except to trunk fat that was similar for girls and boys (p = .512). Fat percentages were higher in trunk fat mass than in extremities among boys, whereas among girls fat showed a homogenous distribution between trunk and extremities.

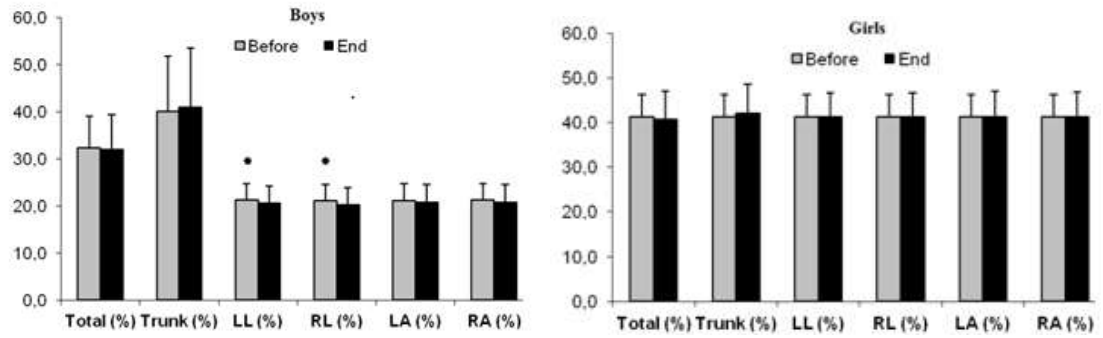

Figure 1. Body fat distribution before and after the intervention, for boys and girls

Values are expressed as mean±sd. Significant differences between before and after the intervention *p < .001

Total= whole body fat; trunk= fat located at abdominal level; LL= left leg fat; RL=right leg fat; LA= left arm fat; RA= right arm fat.

At baseline fat distribution for boys and girls were different, the regression analysis indicated that neither sex, nor age or the degree of obesity (overweight or obese) had a significant effect on changes in whole body adiposity parameters (BMI-z score, BMI and % Total Fat) during the program. Nevertheless, as shown in figure 1, boys presented a significant reduction of percentage of fat mass in lower extremities. The reduction for the left lower extremity was 0.69 ± 1.7% of fat (21.21 ± 3.46 vs. 20.52 ± 3.71; $p < .01$) and for the right lower extremity was 0.75 ± 1.67 % of fat (21.05 ± 3.56 vs. 20.30 ± 3.57; $p < .01$) between the beginning and the end of the intervention respectively.

Adherence to the program was high and 85% of children attended more than 80% of the sessions, 13% attended between 56% and 80% of the sessions and only one participant (2%) was present in less than 56% of the sessions.

At the end of the program, in the satisfaction survey for children, 85% (n=73) of children started that they always enjoyed the games and activities they performed during the program and that they liked they coach, and 95% (n=82) of the children would like to repeat the program. In relation to the satisfaction survey from their parents (n=70),

79% (n=55) of the parents declared that their child always enjoyed the program and liked the coach, and 90% (n=63) of the parents wanted to repeat the program.

Discussion

The focus of this study was to determine whether a physical activity intervention for children based on friendly uncompetitive physical activity, associated with parental theoretical sessions of multidisciplinary behaviour intervention would favourably impact on physical activity, sedentary behaviour and indices of adiposity (BMI *z* score and fat distribution) in sedentary overweight and obese children.

The results from the 7-day recall physical activity questionnaire reflected a behaviour change in the sense of increasing the number of hours dedicated to physical activities and decreasing those devoted to sedentary ones. These data are promising, taking into account that behaviour in society and school is highly sedentary (Kain, et al., 1998), and physical activity participation rates decline sharply with age (Biddle, et al., 2012). However, children did not reach the recommended of 7 weekly hours of moderated-high intensity exercise (Strong, et al., 2005). To achieve this physical activity level, children together with their families, have to acquire autonomy and, apart from attending to the three weekly supervised physical exercise sessions, it is necessary that they change their lifestyle to a more active one (Gortmaker et al., 1999).

Increasing moderate to vigorous physical activity to 5 hours per week was associated with a significant decrease in BMI z score for the whole group, although, fat mass was not significantly modified during the intervention, except in boys' lower extremities. Nonetheless, one of the main limitations of the study has been the absence of a control group, making it difficult to separate effects of puberty and growing from those of the intervention itself. Another limitation was using a non-objective measure of physical

activity making it difficult to confirm the benefits of the intervention. Nevertheless, as already indicated, age, sex or the degree of obesity did not have significant effect on the reduction in the whole body adiposity parameters. Additionally, multichannel bioimpedance analysis confirmed that, even among young children, differences in fat mass distribution due to gender already exist (Rowland, 1996).

According to Connelly et al. (2007) provision of compulsory moderate to high intensity physical activity is the main factor in distinguishing between effective or ineffective programs for childhood obesity prevention. On the contrary, in childhood obesity treatments, participation in supervised physical exercise programs (proposing 3 sessions per week) is not enough to reduce indices of adiposity (Gutin et al., 2002; Carrel. et al., 2005; Daley, et al., 2005). According to Atlantis et al. (2006), McGovern et al. (2008) and Spruijt-metz (2011) between 12% and 14% of the programs for childhood obesity treatment that include physical exercise have a positive effect on the degree of adiposity. From the point of view of Weintraub et al., (2008) the programs in which more hours per week are spent on physical exercise are the ones that have a higher likelihood to be successful. However, the effects of isolated physical exercise on body fat reduction are moderate. Bearing in mind that negative energy balance generated by physical exercise can be easily overcome by means of an increase of food consumption and, as Oude Luttikhuis et al. (2009) and guide of Ministry of Health and Social Policy of Spain (2007) recommend, interventions based on physical exercise and aiming at weight control have to be supplemented with a familiar intervention (Waters et al., 2011; Kitzmann et al., 2010). In a revision in depth, Oude Luttikhuis et al. (2009) remarks that the most effective programs are those that integrate different treatment strategies, and highlights the importance of family interventions that combine diet, physical activity and behavioural components. Regarding the study depicted here, the

intervention is comprised of both physical activity practice and theoretical counselling sessions, where diet, physical activity and behaviour components were addressed.

Other very positive aspects of the intervention have been a good attendance and satisfaction with the program, because one of the most common limitations in medical intervention programs is the relatively low medium-term adherence (Barja, 2005). Furthermore, considering the fact that children were sedentary overweight and obese children, who were not especially willing to participate in physical exercise, this high level of attendance may reflect that a favourable change has been produced regarding children's perception and attitude concerning physical activity. This excellent participation response and satisfaction can be explained by aspects related to recruitment and family information, and/or to the development of the program. Firstly, inclusion into the program was prescribed by the paediatrician and it has been proved that doctor's or paediatrician's counselling may have a great repercussion on their patients (Albright, 2000; Ortega, et al., 2004). Secondly, the content and running of the intervention program may have also had important repercussions on the attendance and satisfaction. Activities were planned according to 3 essential pillars: playing, enjoying oneself and moving. Thus, aspects of friendship, motivation, collaboration and participation were also boosted. Others factors which could have had a positive effect were involvement of professionals specially trained for the program, availability of sports facilities and sports material, children's and parent's sessions were performed simultaneously, and the suggestions for additional physical activities at the weekend.

Conclusions

In view of the results, this intervention based on a friendly uncompetitive physical activity induce a positive change towards more moderate-intense physical activities and

a reduction of the sedentary behaviours and BMI *z* score in sedentary overweight and obese children. The results are encouraging and it could be an excellent tool to the paediatricians, however, future studies should clarify these associations.

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