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Review Article

Can Nutrition Education in Primary Schools be an Efficient Way to Prevent Obesity in Adult Life? A Review of the Literature

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Abstract

The global prevalence of childhood obesity is expected to reach 60 million by 2020. Childhood obesity is now an accepted as a public health problem because of the serious impact on children's health and health care costs. It is shown that obese children are more likely to stay obese into adulthood and to develop cardiovascular diseases at a younger age. In addition to complications related to physical state, obese children can experiment psychosocial consequences such as discrimination, low self-esteem and loneliness. Given the difficulties involved in weight loss and the costly treatment of obesity, initiating obesity prevention at an early age has reached general consensus.

Excess weight is influenced by complex interactions among genetic, biological, and environmental factors. Although genetic and biological factors are indeed important, they cannot fully explain this current global trends, given that factors are also underlying causes of such phenomenon. Therefore, inadequate food intake (quality and quantity of food) and sedentary (low o none physical activity) should be the primary focus to work to prevent or mitigate childhood obesity.

Given the significance of this early on an individual's life course, schools are a primary setting for health promotion as they represent a micro-environments in which children spend a substantial part of their time and have a key role in influencing their daily choices. For this purpose, important targets are increaseing nutrition knowledge, improveing dietary habits and physical education. Moreover, schools can provide an ideal setting for nutrition interventions as they serve as a focal point to engage families, educators, administrators and community members to implement effective and sustainable aid for children and adolescents. On the other side, a school-based nutrition approach should also provide a comprehensive nutrition programs and a multi-level approaches spanning from a child's home to very school environment.

This review therefore provides a general evaluation of effectiveness of a school-based approach and summarizes fundamental features of programs that have achieved results.

Keywords: Education Program; Primary School Children; Overweight; Physical Activity; Nutrition

Abbreviations

EF: Extra Fit; FV: Fruit and Vegetables; HPSF: Health Promoting Schools Framework; MDL: Motor and Dietary Literacy; PA: Physical Activity; SHCP: Shaping Healthy Choices Program; ST: Sedentary Time; WHO: World Health Organization; AS:Sk: Active Schools: Skelmersdale.

Introduction

- According to the World Health Organization (WHO), in Europe in 2009–2010, on average, one in every three children aged six to nine years was overweight or obese, while among children aged 11 and 15 years the prevalence of overweight and obesity was 11–33% and 10–23%, respectively [1]. It

is estimated that around 55% of obese children and 70% of obese adolescents will experience adult obesity [2].

- Obesity has a multi-factorial and multi-level etiology, although genetic and biological factors are important, environmental and societal factors associated with food intake and physical activity should be the primary focus for understanding the macro-level impact on obesity [3].
- Current epidemiological data shows, with increasing force, that the obesity and overweight epidemic and its early onset in childhood make it necessary to consider excess weight as a cardiovascular risk factor also in pediatric age [4]; moreover, childhood obesity can continue into adulthood, and is therefore associated with an increasing risk later in life [5].
- Behaviors most often linked to overweightness are low fruit and vegetable consumption, skipping breakfast, high fat and energy content of the diet, low fiber daily intake and high soft drink consumption [6]. Moreover, it has been demonstrated that children with insufficient physical activity (PA) are at a higher risk to be overweight/obese and this risk increases with age [7]. Given the difficulties involved in weight loss [8], and the costly treatment of obesity [9], initiating obesity prevention at an early age has reached global consensus.
- The projections for future incidence of obesity-related morbidity and mortality are very high and so are the anticipated costs for health care and economic losses [10]. Numerous studies provides evidence-based support for preventive health care to promote normal growth and development of young population and reduce the risk of diet-related diseases in adulthood, by early shaping of adequate dietary and lifestyle behaviors [11].
- School systems should consider earlier interventions because school-based structural interventions may be particularly promising to improve children's health. Indeed, there is a robust body of empirical literature documenting that healthier school environments benefit students [12]. The intervention should focus on the main behavioral changes: increasing physical activities inside and outside school hours, decreasing consumption of high-energy or high-fat foods and sugar-sweetened drinks, promoting a healthy breakfast and increasing consumption of fruits and vegetables.
- School-based education programs held by health professionals may offer the best opportunities for implementing effective and sustainable interventions that are effective in both children and adolescents.
- In this review, we summarize the main school intervention programs to evaluate their effectiveness in improving the lifestyle of children and adolescents. We will highlight the strengths and weaknesses of the studies in order to define the characteristics that an education program should have to improve the lifestyle of children in order to prevent diseases in adulthood due to excess weight in childhood.
- Schools is as a primary context for the development of healthy dietary behaviours and nutrition related knowledge, and although evidence is mixed, previous research has found that these domains can be improved through school-based interventions [13]. Thus, exposing children to healthy foods and providing an appropriate nutritional education may help prevent the onset of overweight and obesity, laying the foundation for lifelong health and well-being [Schmitt 2018].
- Schools are unique in some aspects. Students spend a significant part of their lives in schools and there they are exposed to dietary and physical activity factors, an intervention has the possibility to reach almost all the children in a short time [14].
- Different school-based nutrition programs have been conducted worldwide. In most cases, these successful school-based interventions have been multi-layered, carried out through classroom lessons and workshops, home-based activities and potentially involving environmental changes [15,16].
- This article provides an overview on school-based interventions aimed at preventing overweight and/or obesity during childhood and adolescence. The ideal approach has not yet been proposed but numerous studies agree on what must be the fundamental features for it to have an effect. In the below sections of this review will be explored the major characteristics (Table 1).

Time of educational intervention

Time of intervention vary among different studies. Finding suggest that from short (12 weeks or less) [13, 17- 20] to intermediate (4-12 months) [11,21-24] and long (more than one year) [25,26] interventions have the ability to significantly enhance children's knowledge.

To enhance children's dietary behaviors, in particular to increase the preferences for fruits and vegetables (FV) at post-test, even a short (6-week) intervention has the ability to enhance significantly children's outcomes [13].

School garden programs show potential for school-based interventions to act as mediators of FV intake. School gardens interventions ranged from 14-week to those implemented across 2

Author	Children Age (years) /grade	Sample (N)	Follow-up	Intervention Strategies	Subjects involved	Tools strategy	Statistical methods	Outcomes	Results
Schmitt S., *et al*. (2019) [13]	2nd grade	131	6 weeks	school lessons and tasting	researchers and teachers (after training)	questionnaire	RCT	knowledge FV preferences	+ +
Huys N., *et al*. (2019) [17]	10-12	350	3 months	school lessons and garden	teachers	questionnaire	education-based study	FV consumption	-
Uzsen H., *et al*. (2019) [18]	8/2nd grade	59	4 months	school lessons and games	researchers	questionnaire	education-based study	knowledge	+
Davis JN., *et al*. (2016) [19]	4th grade	304	12 weeks	garden and cooking	researchers	questionnaire	RCT	FV knowledge	+
Rosi A., *et al*. (2016) [20]	8-11	8165	3 months	game	researchers	questionnaire	education-based study	knowledge	+
Scherr RE., *et al*. (2017) [21]	9-10/4th grade	409	1 school year	garden	researchers	knowledge: questionnaire; body composition: anthropometric measurements	RCT	knowledge FV intake body composition	+ + +
Rosi A., *et al*. (2016) [22]	8-10	112	1 hour	game (robot)	researchers	questionnaire	RCT	knowledge	+
Asakura K [23]	1st-2nd grade	1210	4 months	school lessons	researchers	questionnaire	cross-sectional study	knowledge	+
Viggiano A., *et al*. (2015) [24]	9-19	3110	6 months	game	teachers (after training)	knowledge: questionnaire; body composition: anthropometric measurements	RCT	knowledge body composition	+ +
Kocken PL., *et al*. (2016) [25]	9-11	1112	2 years	school lessons	teachers	knowledge: questionnaire; PA : accelerometer; body composition: anthropometric measurements	RCT	knowledge PA body composition	+ + -
de Villers A., *et al*. (2016) [26]	4th grade	998	3 years	school lessons	teachers (after training)	questionnaire	RCT	knowledge body composition	+ -

Taylor SL., *et al*. (2018) [28]	9-10	100	8 weeks	game	researchers	PA : accelerometer; body composition: anthropometric measurements	RCT	PA body composition	- -
Varriale L., *et al*. (2019) [29]	5-11	85	3 months	school lessons	teachers	questionnaire	education-based study	knowledge PA FV intake	- + -
Haapala., *et al*. (2017) [30]	6-15	10000	2 years	School lessons	researcher	PA: accelerometer; body composition: anthropometric measurements	education-based study	PA body composition	+ -
O'Leary., *et al*. (2019) [31]	6 and 10 years	473	2 years	game and school lessons	researcher	knowledge: questionnaire; PA : accelerometer; body composition: anthropometric measurements	education-based study	knowledge body composition	- -
Van Kann DHH., *et al*. (2016 [32]	8-11	520	12 months	nr	researcher	accelerometer and questionnaire	education-based study	PA	-
Waters E., *et al*. (2017) [33]	5-12	2965	3.5 years	school lessons	teachers	questionnaire	RCT	FV intake PA body composition	+ - -
Sharma S., *et al*. (2015) [40]	3rd grade	57	16 weeks	tasting, cooking	teachers (after training)	questionnaire	education-based study	FV intake	+
Hermans RCJ., *et al*. (2018) [41]	10-13	108	2 weeks	videogame	nr	questionnaire	education-based study	Knowledge	-
La Torre., *et al*. (2017) [42]	8-10	44	2 years	game	researchers	questionnaire	RCT	knowledge PA	+ +
Rosi A., *et al*. (2015) [43]	8-10	76	3 months	school lessons, videogame	teachers	food diaries	education-based study	FV intake	+
Viggiano A., *et al*. (2018) [45]	7-11	1313	8 and 18 months	game	teachers	knowledge, PA: questionnaire; FV: food diaries; intake, body composition: anthropometric measurements	education-based study	PA FV intake body composition	+ + -

Spears-Lanoix EC., *et al*. (2015) [50]	3rd grade	122	5 years	garden, school lessons	researchers	questionnaire	RCT	knowledge FV intake PA body composition	+ + + +
Christian MS., *et al*. (2014) [51]	8	641	18 months	garden	researchers and teachers	questionnaire	RCT	FV intake	+
Leuven JRFW., *et al* (2018) [52]	10-12	150	7 -12 months	garden, cooking, school lessons	researchers	questionnaire	education-based study	knowledges	+
Abbreviations: FV: Fruit & Vegetables, PA: Phisical Activity, RCT: Randomized Control trial; nr: not reported; +: positive intervention effect; -: negative intervention effect									

Table 1: Summary and findings of some nutrition education interventions

academic years and showed an increase of children self-reported FV intake [27].

At the same time, we should consider that the intervention duration varied in relation to the type of program and to the period of the evaluation. For example, Huys et colleagues underlined that the period October–December was not ideal, as this is the fall season in Belgium and it is therefore very difficult to grow many vegetables in the school garden [17].

PA and ST strongly affect lifestyle. It is showed that the duration of the interventions on them has highly influenced the effects. Short-term interventions, in which intervention last maximum 8 weeks [for example Active Schools:Skelmersdale (AS:Sk) and Motor and Dietary Literacy (MDL)], showed a preventive action on physical inactivity. [28,29]. The effect of previous research, in which programmes were longer, were consistent with the AS:Sk intervention. For example the "Finnish school on the move" study showed a decrease in ST at 1,5 year follow-up [30]. According to this, also Project Energize and Project Spraoi had reported a positive improvement in PA among children involved in the programme [31]. These interventions could be considered as medium-term intervention, because of their duration (maximum 2 years). In contrast, Van Kann and colleagues observed a general increase in ST at 12-month follow-up of their Active Living multicomponent school-based intervention [32]. Nevertheless in the longest intervention analyzed there were no intervention effect on self-reported level of PA and ST [33]. Moreover, it is to be considered that in a long-term intervention several factors come into play, such as seasonality, so the possibility of moving also varies according to the climatic conditions. Furthermore, in some studies only the activity spent outdoors was considered as PA. Thus the PA changes across the school year and also between weekend and weekend and certain sociodemographic subgroups [34].

The majority of studies which focusing on anthropometric changes (a decrease in the percentage of overweight students) has often with interventions of less than one-year duration with no effect on BMI. Time is needed for changes to embed within a complex system [35]. In fact, a review that examined 106 papers demonstrated that duration of studies did not result in BMI change, and there was no a statistically significant difference between studies lasting up to 1-year and those lasting longer [14]. For example, The Fun'n healthy in Moreland!, underpinned by the WHO Health Promoting Schools Framework (HPSF), is one of the longest intervention program involving 24 primary schools of South Eastern Australia and a mixed method approach to evaluation. The primary outcome was change in adiposity. After 3.5 years of intervention there was no statistically significant difference between BMI z score post-intervention [33].

People involved in the educational intervention

People involved in the programs are many, teachers, nutrition educators, physical educators, school staff could personally involve in developing the interventions.

Regarding the effect on knowledge, only one of the studies analyzed proposed a teacher-led program and showed a very small effect size on students' knowledge [17]. The effect was significantly higher if the teachers of intervention classes participated in training sessions conducted by project staff [13]. It is important to emphasize that the majority of educational programs were conducted

by a researcher who has a background in food science to ensure a high level of teaching [11,18-22,24,26,36].

The educational interventions on PA were developed by different figure depending on the type of program. Often teachers or school staff were the key driver of physical and health behaviors. Hills., et al. reported that physical educators should encourage the entire school staff to be more physically active in order to educate children to emulate them [11,18,19,21,37]. Teachers were also supported by external expert tutors, who helped planning the activities and driving students through the program. This format has a positive impact on preventing physical inactivity and inadequate diet [29,31].

Although the analyzed educational interventions show no effect on BMI [14,25,38], the Shaping Healthy Choices Program (SHCP) conducted by experts in different fields (e.g. nutrition, medicine, food safety, agriculture and child development) have has delivered a coordinated program with the goal of improving dietary and lifestyle habits among Fourth-graders children in California. The program led to a greater improvement in BMI percentile, BMI Z-score, and waist-to-height ratio in the intervention group compared with the control schools [21]. On the contrary, the "Extra Fit!" (EF!) education program evaluate the effect of the intervention on the promoting a healthy eating, BMI and waist and hip circumference. After two years follow-up, no positive effects of EF! were found with regard to anthropometric measures when follow-up measurements were compared to the baseline. A strong limitation appeared from the process-evaluation of the intervention. Teachers rated the lessons of EF! not entirely positive [25].

Strategy applied in the educational intervention

The strategies used in the education program are decisively for the success. Studies have found that programs focused on school- gardens may be effective in promoting dietary behaviors and knowledge, yet many schools do not have the space, resources or expertise to implement such programs [13]. One key ingredient that might facilitat positive effects on health behaviors and knowledge could be the inclusion of tastings. Fruits and vegetables tastings has been shown to promote preferences for these foods [13,21], and to improve vegetables identification [19] and knowledge [17,19,21]. As the authors already suggested, the importance of an external support could increase the school gardens presence. For example, local organizations or community could play a role in donateing extra materials (e.g. soil, seeds, maintenance of the school garden during holiday periods [17] and community could help in the expansion of school gardens by providing space for gardening nearby schools [39]. In fact, having a big harvest would make it easier to work with vegetables in the classroom and it would mean having tasting material or being able to use it for preparing meals in the canteen or at home.

School garden programs could affect also on students' dietary outcomes [13]. There are different typologies of these programs, for example, the national farm to school movement to bring more local fruits and vegetables into school cafeterias or classroom [27]. Gardens are used to increase exposure to FV with aim to improve children's dietary choices through improved knowledge of and attitudes toward FV [27]. As already underlined, for young children education the tasting of fruits and vegetables has been shown to promote preferences for these foods [13,40]. Unfortunately, the use of school gardens strategy is not always possible because many schools do not have the space, resources or expertise to implement such programs.

Another strategy used is the game-based nutrition education instead of narration methods, to increase children's understanding [20], helping them to acquire healthy nutrition behaviors [18].

Different authors agree that an education involving interactive elements such as games, songs and videos make the acquired information stick to the mind and increase significantly the nutritional knowledge scores [13,20,22,36,41,42].

The use of board educational games was shown to improve students' nutritional knowledge in different studies in Italy [24,42], moreover the earlier the intervention occurs and the better the results are in terms of improvement of knowledge [42].

Providing children with nutrition and health knowledge in a fun and engaging manner facilitate a sense of self-efficacy for making healthy choices [13].

The use of new technologies to develop educational interventions seems to be more effective than traditional approaches in delivering information [43]. Nevertheless, other studies are needed because of a lack of consensus. For example, a brief game-based intervention like the Alien Health Game has the potential to improve children's nutritional knowledge in the short term, but may not be strong enough to increase nutritional knowledge and eat-

ing behavior in the long term [41]. However, an Italian study has demonstrated that the presence of a humanoid robot to support the teacher did not result in any significant learning improvement [22].

Generally, studies hypothesized that proper education might have a positive impact on diet and physical inactivity [29,33,44]. Viaggiano et colleagues suggested that knowledge does not necessarily translate in good behaviors and behaviorally nutrition education is often focused only on few aspects of nutrition [45].

Referring to physical activity, which is also a cornerstone of healthy life style, firstly should be enjoyable. Hills., *et al*. declared that multi-component comprehensive school PA program is needed to ensure that children get the opportunity to meet the PA guidelines. Moreover, school-based interventions have demonstrated that health oriented programs should involve high levels of PA [37]. Varriale and colleagues suggested that "Motor and Dietary Literacy" (MDL), a short motor and dietary education program, could act to educate population toward the improvement in motor skills and lifestyle by starting from the primary school. MDL integrated education on physical movement with the principles of healthy eating, affecting globally the habits of the children [29].

Furthermore, studies underlined the importance of multi-level interventions. For example, "fun 'n healthy in Moreland" program was focused not only on changes in the PA curriculum but also on school environment in terms of policies, programs, and parents' engagement [33]. The interventions were focused on the importance of expansion of canteen, replacing sugary drinks with milk and water, the importance of eating breakfast and the food groups that contribute to a balanced diet [31,33].

Subjects involved in the educational intervention

The approaches for obesity prevention should be based on the involvement of different levels of society which should act in the same direction.

Most authors agree that parental involvement can increase children's nutritional behavior, more than children's knowledge [17,18,21,25,26] There are different ways to involve parents, such as newsletters for parents, homework to do with children, parental evenings and involving them in the maintenance of the garden during the school year or during holidays [17,39], cooking lessons or shows [19,21].

Generally, the interventions to increase children PA were usually addressed only to students. Different authors [28,33,37] suggests that an increasing effect will be obtained if the PA is supported during, after and before school, and if is staff, family and community involvement is included [37]. In fact, modifications to out-of school sedentary habits would be beneficial to avoid any compensation effects on PA at school [28]. Moreover, it is shown that when the committee holds discussion groups with teachers, school staff, parents and community leaders, findings were positive [44]. For this purpose, schools are urged to institute a great number of health promoting practices targeting students, staff and parents during the program [33].

There is emerging evidence that stronger state-level competitive food policies are associated with a healthier weight trajectory among middle school students [46].

The trial of Ickovics focused on school wellness policy support and implementation and had a greater effect than previous studies, indicating that school-based structural interventions may be particularly promising and that school systems should consider earlier interventions. After the intervention of 3 years, students that had received support for nutrition policies had healthier BMI percentile trajectories. This study was conducted giving substantial importance to the school's nutritional environment at the national level and implementing a new school meal regulations in the third years of this study [47].

Evaluation of educational intervention results

As knowledge is known to influence nutrition behavior, many nutrition interventions seek to modify knowledge, and to measure knowledge change as an indicator of intervention effectiveness. Analysis of the literature reveals a wide variety of tools that have been used to measure nutrition knowledge in schools [48].

According to Contento and colleagues, measurement tools must be tightly linked to the purpose of the intervention to be considered applicable [49]. Furthermore, it is necessary to consider the psychometric properties of the available tools to ensure that the tools are effective and reliable. The tools should be pilot tested, refined and adapted before use to ensure that they are measuring what the researchers really intend to see [48].

In fact, few studies have used tools from literature [21,25] most have used homemade tools based on what they intend to teach

during the program [13,18,20,22,23,26,36,45] or literature model adapted to relate to construct of interest [11,13,17,19].

Referring to school garden intervention, studies showed increases in FV consumption. These studies had measured different parameters, such as nutrition/dietary knowledge willingness to taste FV attitudes toward FV and preference for or choosing FV for meals and snacks [27,50-52].

In some studies, a panel of experts identified outcome measures to analyse the students' self-reported answers about their frequency of consumption [44].

Physical activity is measured by using questionnaires [24,28,31,44] or by accelerometers [28,31] and also by through checklists related to predetermined exercise pathways, resulting in a global performance parameter that is measured at the end of the education program [29].

Sedentary activity, physical activity and activity intensity were measured by parental and child report through questionnaires [28,24,44]. As Waters suggested, there is a problem in measuring PA in that way, because children have difficulty recalling episodes of physical activities and cannot accurately report frequency, intensity or duration of the activity. In general the activity measure consists in time outside after school, but it does not include inside activities after school like dance/aerobics/swimming, that may be ignored [28,33,37]. On the other hand, wearing accelerometers to measure PA may have altered children's habitual level of PA. A limitation in using accelerometers was that children who fulfilled the wear time criteria might have altered their habitual level of PA because of wearing the instrument [28,31,53].

A strength of intervention must be the standardization (z-scores) of all the variables included in the analysis in order to evaluate the effect taking in account that they are dealing with growing children [5].

Conclusion

In conclusion, the analyzed studies have shown that nutrition education programs have an effect on students' knowledge and improvement of eating habits (FV consumption) in the short term. However, the long-term effect on increasing PA and improving BMI values is not sustainable.

In summary, the features that a program must have to increase the chances of observing an effect even in the long term are

- The interventions that aim to improve BMI percentiles should be direct to obese children but recommendations and educational programs are done for all children. Indeed, it is anticipated that by improving health-related behaviors of children at an early age, the program will influence their future BMI percentile trajectory;
- The involvement of parents is recognized as an important aspect for the success;
- Multicomponent interventions involving children, family, school, school environment and community are needed to have a long-lasting effect on healthy lifestyle;
- To alternate theory lessons with practical lessons focusing on "fun" is appreciated from the children and stimulate learning and encourage health behaviors;
- The program with the focus on targeting multiple behaviors related to a healthy lifestyle should have the duration of two school years because long-term follow-up is necessary to evaluate the sustainability.

Furthermore, during the design of the intervention, it would be useful to identify factors that influence uptake, fidelity, sustainability, cost, and scale up of policies and other innovations that improve health outcomes for children and adolescents.

Bibliography

1. World Health Organization. European Food and Nutrition Action Plan 2015-2020, REGIONAL COMMITTEE FOR EUROPE 64th SESSION. Copenhagen, Denmark (2014).

2. Simmonds M., *et al*. "Predicting adult obesity from childhood obesity: A systematic review and meta-analysis". *Obesity Reviews* 17.2 (2016): 95-107.

3. Popkin BM., *et al*. "The Global Nutrition Transition: The pandemic of obesity in developing countries". *Nutrition Review* 70.1 (2012): 3-21.

4. Orlando A., *et al*. "Hypertension in Children: Role of Obesity, Simple Carbohydrates, and Uric Acid". *Frontiers in Public Health* 6 (2018):129.

5. Genovesi S., *et al*. "Effects of Lifestyle Modifications on Elevated Blood Pressure and Excess Weight in a Population of Italian Children and Adolescents". *American Journal of Hypertension* 31.10 (2018): 1147-1155.

6. Brown T., *et al*. "Systematic review of school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity: An update to the obesity guidance produced by the National Institute for Health and Clinical Excellence". *Obesity Reviews* 10.1 (2009): 110-141.

7. Pate RR., *et al*. "Objectively measured physical activity in sixth-grade girls". *Archives of Pediatrics and Adolescent Medicine* 160.12 (2006):1262-1268.

8. Baranowski T., *et al*. "School-based obesity prevention: a blueprint for taming the epidemic". *American Journal of Health Behavior* 26.6 (2002): 486-493.

9. Solmi F., *et al*. "Association between childhood obesity and use of regular medications in the UK: longitudinal cohort study of children aged 5-11 years". *BMJ Open* 5.6 (2015): e7373.

10. Sassi F. "Obesity and the economics of prevention, FIT NOT FAT". Organisation for Economic Co-operation and Development (OECD) (2010).

11. Hamulka J., *et al*. "Effect of an Education Program on Nutrition Knowledge, Attitudes toward Nutrition, Diet Quality, Lifestyle, and Body Composition in Polish Teenagers. The ABC of Healthy Eating Project: Design, Protocol, and Methodology". *Nutrients* 10.10 (2018): E1439.

12. Taber DR., *et al*. "Weight status among adolescents in states that govern competitive food nutrition content". *Archives of Pediatrics and Adolescent Medicine* 130.3 (2012): 437-444.

13. Schmitt S., *et al*. "The effects of a nutrition education curriculum on improving young children's fruit and vegetable preferences and nutrition and health knowledge". *Public Health Nutrition* 22.1 (2019): 28-34.

14. Amini M., *et al*. "Effect of School-based Interventions to Control Childhood Obesity: A Review of Reviews". *International Journal of Preventive Medicine* 6 (2015): 68.

15. Delgado-Noguera M., *et al*. "Primary school interventions to promote fruit and vegetable consump-tion: a systematic review and meta-analysis". *Journal of Preventive Medicine* 53.1-2 (2011): 3-9.

16. French SA., *et al*. "Environmental interventions to promote vegetable and fruit consumption among youth in school settings". *Journal of Preventive Medicine* 37.6 Pt 1 (2003): 593-610.

17. Huys N., *et al*. "Effect and process evaluation of a real-world school garden program on vegetable consumption and its determinants in primary schoolchildren". *PLoSONE* 14.3 (2019): e0214320.

18. Uzşen H., *et al*. "A Game-based Nutrition Education: Teaching Healthy Eating to Primary School Students". *Journal of Pediatrics Research* 6.1 (2019): 18-23.

19. Davis J.N., *et al*. "LA Sprouts: A 12-Week Gardening, Nutrition, and Cooking Randomized Control Trial Improves Determinants of Dietary Behavior". *Journal of Nutrition Education and Behavior* 48.1 (2016):2-11.e1.

20. Rosi A, *et al*. "Giocampus school: a "learning through playing" approach to deliver nutritional education to children". *International Journal of Food Sciences and Nutrition* 67.2 (2016): 207-215.

21. Scherr RE., *et al*. "A Multicomponent, School-Based Intervention,theShaping Healthy Choices Program, Improves Nutrition-Related Outcomes". *Journal of Nutrition Education and Behavior* 49.5 (2017): 368-379.e1.

22. Rosi A., *et al*. "The use of new technologies for nutritional education in primary schools: a pilot study". *Public Health* 140 (2016): 50-55.

23. Asakura K., *et al*. "Relationship between nutrition knowledge and dietary intake among primary school children in Japan: Combined effect of children's and their guardians' knowledge". *Journal of Epidemiology* 27.10 (2017): 483-491.

24. Viggiano A., *et al*. "Kaledo, a board game for nutrition education of children and adolescents at school: cluster randomized controlled trial of healthy lifestyle promotion". *European Journal of Pediatrics* 174.2 (2015): 217-28.

25. Kocken P.L., *et al*. "Effects of a Theory-Based Education Program to Prevent Overweightness in Primary School Children". *Nutrients* 8.1 (2016): E12.

26. de Villers A., *et al*. "Primary School Children's Nutrition Knowledge, Self-Efficacy, and Behavior, after a Three-Year Healthy Lifestyle Intervention (HealthKick)". *Ethnicity and Diesease* 26.2 (2016): 171-180.

27. Berezowitz CK., *et al*. "School Gardens Enhance Academic Performance and Dietary Outcomes in Children". *Journal of School Health* 85.8 (2015): 508-518.

28. Taylor S.L., *et al*. "Evaluation of a Pilot School-Based Physical Activity Clustered Randomised Controlled Trial—Active Schools: Skelmersdale". *International Journal of Environmental Research and Public Health* 15.5 (2018): E1011.

29. Varriale L., *et al*. "Motor and dietary education against obesity forstudents: Evidence from Italy". *Journal of Human Sport and Exercise* (2019).

30. Haapala H.L., *et al*. "Changes in physical activity and sedentary time in the Finnish Schools on the Move program: a quasi-experimental study". *The Scandinavian Journal of Medicine and Science in Sports* 27.11 (2017): 1442-1453.

31. O'Leary M., *et al*. "Project Spraoi: two year outcomes of a whole school physical activity and nutritionintervention using the RE-AIM framework". *Irish Educational Studies* 38:2 (2019): 219-243.

32. Van Kann DHH., *et al*. "The effect of a school-centered multicomponent intervention on daily physical activity and sedentary behavior in primary school children: The Active Living study". *Journal of Preventive Medicine* 89 (2016): 64-69.

33. Waters E., *et al*. "Cluster randomised trial of a school-community child health promotion and obesity prevention intervention: findings from the evaluation of fun'n healthy in Moreland!". *BMC Public Health* 18.1 (2017): 92.

34. Atkin AJ., *et al*. "Seasonal Variation in Children's Physical Activity and Sedentary Time". *Medicine and science in sports and exercise* 48.3 (2016): 449-456.

35. Hawe P. "Lessons from complex interventions to improve health". *Public Health* 36.1 (2015): 307-323.

36. Meseri R., *et al*. "Evaluation of obesity prevalence and nutritional knowledge in adolescents in a semi urban area of Turkey". *Progress in Nutrition* 17.1 (2015): 58.

37. Hills AP., *et al*. "Supporting public health priorities: recommendations for physical education and physical activity promotion in schools". *Progress in Cardiovascular Diseases* 57.4 (2015): 368-374.

38. Hung L.S., *et al*. "A meta-analysis of school-based obesity prevention programs demonstrates limited efficacy of decreasing childhood obesity." *Nutrition Research* 35.3 (2015):229-240.

39. Huys N., *et al*. "School Gardens: A Qualitative Study on Implementation Practices". *International Journal of Environmental Research and Public Health* 14.12 (2017): E1454.

40. Sharma S., *et al*. "Feasibility and Acceptability of Brighter Bites: A Food Co-Op in Schools to Increase Access, Continuity and Education of Fruits and Vegetables Among Low-Income Populations". *Journal of Primary Prevention* 36.4 (2015): 281-286.

41. Hermans R.C.J., *et al*. "Feed the Alien! The Effects of a Nutrition Instruction Game on Children's Nutritional Knowledge and Food Intake". *Games for Health Journal* 7.3 (2018): 164-174.

42. La Torre G., *et al*. "Improving knowledge and behaviors on diet and physical activity in children: results of a pilot randomized field trial". *Annali di Igiene, Medicina Preventiva e di Comunità* 29.6 (2017): 584-594.

43. Rosi A., *et al*. "The "5 a day" game: a nutritional intervention utilising innovative methodologies with primary school children". *International Journal of Food Sciences and Nutrition* 66.6 (2015): 713-717.

44. Qian L., *et al*. "Effects of a comprehensive nutrition education programme to change grade 4 primary-school students' eating behaviours in China". *Public Health Nutrition* 22.5 (2018): 903-911.

45. Viggiano A., *et al*. "Healthy lifestyle promotion in primary schools through the board game Kaledo: a pilot cluster randomized trial". *European Journal of Pediatrics* 77.9 (2018): 1371-1375.

46. Taber DR., *et al*. "Differences in nutrient intake associated with state laws regarding fat, sugar, and caloric content of competitive foods". *Archives of Pediatrics and Adolescent Medicine* 166.5 (2012): 452-458.

47. Ickovics J.R., *et al*. "Implementing School-Based Policies to Prevent Obesity: Cluster Randomized Trial". *American Journal of Preventive Medicine* 56.1 (2019): e1-e11.

48. Newton G., *et al*. "A Systematic Review of Tools Measuring Nutrition Knowledge of Pre-Adolescents and Adolescents in a School-Based Setting". *Journal of School Health* 89.5 (2019): 402-416.

49. Contento I.R, *et al*. "Review and analysis ofevaluation measures used in nutrition education intervention research". *Journal of Nutrition Education and Behavior* 34(2002): 2-25.

50. Spears-Lanoix EC., *et al*. "Using Family-Focused Garden, Nutrition, and Physical Activity Programs To Reduce Childhood Obesity: The Texas! Go! Eat! Grow! Pilot Study". *Journal of Childhood Obesity* 11.6 (2015): 707-714.

51. Christian MS., *et al*. "Evaluation of the impact of a school gardening intervention on children's fruit and vegetable intake: a randomised controlled trial". *International Journal of Behavioral Nutrition and Physical Activity* 11:99 (2014).

52. Leuven JRFW., *et al*. "School gardening increases knowledge of primary school children on edible plants and preference for vegetables". *Food Science and Nutrition* 6.7 (2018): 1960-1967.

53. Dossegger A., *et al*. "Reactivity to Accelerometer Measurement of Children and Adolescents". *Medicine and Science in Sports and Exercise* 46.6 (2014): 1140-1146.

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