Original Article

Methodology of the Comprehensive Program on Prevention and Control of Overweight and Obesity in Iranian Children and Adolescents: The IRAN-Ending Childhood Obesity (IRAN-ECHO) Program

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Abstract

Background: The World Health Organization program on Ending Childhood Obesity (WHO-ECHO) has developed a comprehensive and integrated package of recommendations to address childhood obesity. The present study, entitled IRAN-ECHO, was designed and implemented in the framework of the WHO-ECHO program. **Methods:** The IRAN-ECHO program is implementing multicomponent interventions by considering life course dimensions. The program has two parts: a population approach and an individual approach. The population approach considers different periods in life, including prenatal, infancy, childhood, and adolescence, as well as family and society. The individual approach targets those children or adolescents with overweight or obesity; this part is conducted as a referral system that is now integrated in the current national health system. As part of the population approach, a quasi-experimental study was conducted in six provinces to compare the status before and after implementing parts of the interventions. By intersectoral collaboration with different organizations, multicomponent interventions are conducted for different age groups. **Results:** The IRAN-ECHO program is being conducted in six provinces, and will be considered in all provinces in the near future. Its main effects could be assessed in future years. Part of this program that was conducted as a quasi-experimental survey comprised 7149 students and showed that a high percentage of students had acceptable knowledge about adverse health effects of overweight and obesity. However, the knowledge about the low nutritional value of unhealthy snacks such as potato chips, puffs, industrial juices, and carbonated drinks was not appropriate. Many participants had the undesirable attitude of skipping one of the main meals when attempting to lose weight. **Conclusions:** The IRAN-ECHO program is presenting the feasibility of conducting the WHO-ECHO recommendations in Iran. The scope of potential policy recommendations to decrease childhood obesity is extensive and includes various elements. This program considers multisectoral interventions through population and individual approaches. The multicomponent interventions of this program address the obesogenic environment by considering the life course dimensions. It is expected that, by its life course interventions, it could help in primordial and primary prevention of noncommunicable diseases.

Keywords: *Individual approach, obesity, population approach, prevention, risky behaviors*

Introduction

In the recent decades, rapid lifestyle changes have occurred because of industrialization of societies. Obesity is a multifactorial disorder derived by interaction of genetic, environment, and lifestyle habits.[1] Childhood obesity has become a major health problem because of its clinical and public health consequences. Several primary comorbid conditions are associated with obesity, including diabetes, cardiovascular diseases, and some cancers.[2] It is well documented that childhood obesity increases the risk of chronic diseases in adulthood. Sedentary lifestyle, genetics, socioeconomic situation, and undesirable food habits are some contributing factors related to obesity. It is well documented that behaviors such as dietary habits and physical activity begin from childhood and track into adulthood.[3,4]

In the recent years, obesity has become highly prevalent in children and adolescents of low- and middle-income countries.[5] The prevalence of childhood overweight and obesity is 12%–30% in developed countries and 2%–12% in developing countries.[6] Iran is one of the countries facing an escalating trend of childhood obesity. According to

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an Iranian national study performed in thirty provinces, prevalence of overweight, obesity, and abdominal obesity was reported to be 9.7%, 11.9%, and 19.1%, respectively, in children and adolescents aged 6–18 years,[7] when using the cutoffs from the WHO for overweight and obesity and a waist-to-height ratio of >0.5 as cutoff for abdominal obesity. As highlighted by a recent systematic review, the ascending trend of weight gain among Iranian children warrants the provision of precautionary interventions at the national level.[8]

Health promotion strategies should be focused on improving dietary habits and increasing physical activity that are the most essential elements in the prevention and treatment of obesity.[9] It is documented that raising the individual's education and awareness for lifestyle modification is one of the most important strategies for prevention and control of obesity and overweight.[10] A systematic review showed that school-based interventions, involving student families and multidimensional interventions, could increase physical activity among adolescents.[11] Findings of an interventional study in a middle school on overweight adolescents showed that the health promotion program was effective on modification of dietary patterns and physical activity.[12]

It is believed that most of the studies were descriptive and assessed the prevalence and risk factors of obesity. Thus, in comparison with large descriptive studies, interventional studies in children and adolescents were still comparably scarce. Therefore, implementing interventional programs to prevent weight disorders in children and adolescents is essential.

Obesity prevention and treatment requires a whole multisectoral approach in which policies across all sectors would systematically take health into account, avoid harmful health impacts, and thus improve population health and health equity. The WHO program on Ending Childhood Obesity (WHO-ECHO) has developed a comprehensive and integrated package of recommendations to address childhood obesity. The goals of the commission on ECHO are to provide policy recommendations to governments to prevent infants, children, and adolescents from developing obesity and to identify and treat preexisting obesity in children and adolescents. In addition, this program attempts to reduce the risk of morbidity and mortality due to noncommunicable diseases (NCDs), lessen the negative psychosocial effects of obesity both in childhood and adulthood, and reduce the risk of the next generation developing obesity.[13]

The present study was designed and implemented in the framework of the WHO-ECHO program. We assessed the effect of life course interventions for encouraging children to increase their intake of healthy foods and increase their physical activity level. In addition, our main recommendations focus on preconception and pregnancy care, early childhood diet and physical activity, health, nutrition and physical activity for school-age children, and weight management.

The aim of this study is to present the methodology of the IRAN-ECHO program and to present the preliminary findings of part of this study.

Methods

The current study had two parts, one with a population approach and one with an individual approach.

Population approach

This part of the study considered life course interventions for the prenatal period. This approach was highlighting the guidance for prevention of NCDs with a focus on healthy

lifestyle from the preconception period. It continued into antenatal care and aimed at preventing healthy weight gain during pregnancy to reduce the risk of childhood obesity by preventing low or high birth weight, prematurity, and other complications in pregnancy. Encouragement and promoting breastfeeding and providing healthy complementary foods were the interventions considered for infancy. Other interventions focused on providing guidance on, and support for, healthy diet, sleep, and physical activity in early childhood, and promoting healthy habits and ensuring an appropriate growth rate and developing healthy habits by limiting consumption of foods high in fat, sugar, and salt; ensuring availability of healthy foods and physical activity in families and in the early child care settings.

One of the interventions for older children and adolescents was implementing various programs for promoting healthy school environments, health and nutrition literacy, and physical activity among students by establishing standards for school snacks and meals; banning the sale of unhealthy foods and drinks; and providing educational materials on health and nutrition and quality physical education. Increasing public knowledge and family-centered interventions was considered in the implementation of multicomponent programs for promoting the intake of healthy foods and reducing the intake of unhealthy foods and sugar-sweetened beverages (SSBs) by children and adolescents, as well as while implementing programs for promoting physical activity and reducing sedentary behaviors in families and their children.

Quasi-experimental survey

This survey was conducted as part of the population approach, to study the effects of 1-year school-based interventions. This quasi-experimental national survey with before and after study design was performed among 7149 students aged 7–18 years, from urban areas in six provinces of Iran (2015–2016). Inclusion criteria consisted of overweight or obese students according to the WHO growth curves as defined by categories of body mass index (BMI). Those with physical disability, learning disorder, history of chronic disease, history of chronic medication use, and/or being on special diet were not included. Participants with low compliance and incomplete forms were excluded from the study.

Students were selected by a multistage random sampling. In this way, the country was categorized geographically into five stratums including north, south, east, west, and center. From each geographical stratum, one provincial city was selected as the sample area. The selected cities were Ahvaz, Ardebil, Gorgan, Isfahan Mashhad, and Tehran (in alphabetical order). In each city, two areas were selected and then four schools were selected randomly from each area (two elementary and high schools for girls and two elementary and high schools for boys). Finally, these forty schools were randomized to intervention versus controls (twenty schools in the intervention group and twenty in the control group).

In this survey, the sample size for random sampling was calculated by considering the probability of the first type error and the power as 0.05 and 80%, respectively. The final sample size was calculated as 1264 for each province with a probability of a reduction of 20% in excess weight by the intervention process.

Procedure and measurements

The participants filled out a validated questionnaire under the supervision of expert health-care professionals. A team of trained health-care professionals recorded information in a checklist that included questions about personal and family information, socioeconomic status, and lifestyle habits including physical activity, sedentary behaviors, time and sleep duration, and dietary habits. Moreover, it included questions about awareness of causes and consequences of childhood obesity and awareness about healthy lifestyle habits. Regarding the students' nutritional habits, the consumption frequency of the following nine food items was assessed: sweets (cookies, biscuits, and chocolates), salty snacks (puffs, potato chips, and salty snacks), carbonated beverages, fresh fruits, dried fruits, vegetables (fresh or cooked vegetables), packed beans, and fast foods. Duration of television (TV) watching, use of computer, and other sedentary activities were also asked for. To assess the changes, the same questionnaire was completed after the intervention.

Anthropometric measurements

Weight was measured to the nearest 200 g in barefoot and lightly dressed condition. BMI was calculated as weight in kilograms divided by height in meters squared. Waist circumference was measured by a nonelastic tape to the nearest 0.2 cm at the end of expiration at the midpoint between the top of iliac crest and the lowest rib in standing position.

We used the WHO growth curves to define BMI categories, i.e., underweight as age- and sex-specific BMI < −2 z-score, overweight as sex-specific BMI for age of > +1 z-score, and obesity as sex-specific BMI for > +2 z-score.[14]

Study design

In each province, interventions were conducted by intersectoral collaboration of different organizations including the health sector, the municipality, and provincial office of education and training. Interventions were applied for overweight and obese individuals after assessing anthropometric indices and evaluating nutritional patterns.

All overweight and obese children and adolescents (BMI for age of > +1 z-score) were evaluated by health-care providers and referred to nutritionist and physician in health centers to get the necessary care.

Education of parents, school staff, and students

Interventions in the school-based part of the whole program included providing written educational materials, group learning, family lifestyle modification, and increasing the public awareness about childhood obesity.

Student group sessions were conducted during one academic year; they consisted of 8 1-h training sessions. These sessions included lecturing, group discussion, presentation, educational films, pamphlets, and use of training booklets.

Training sessions for parents and teachers included four sessions for parents and two sessions for teachers.

Changes in school environment

A healthy and safe environment was provided to ensure sufficient physical activity and a healthy diet. Individuals in the intervention group participated in preventive and control programs. General information was provided to the control group for ethical issues. The duration of the intervention is 6 months, where participants will be followed every 2 months.

Individual approach

This part of the program was implemented for overweight and obese children and adolescents. A referral system was integrated in the current national health system. Health-care providers in public health centers or schools examined children and adolescents, and those who were recognized to have excess weight were referred to the team of trained physicians and dieticians in public health centers. Anthropometric indices, food intake pattern, physical activity pattern, medical history, and some laboratory reports were assessed. The physician conducted the physical examination, ordered laboratory tests, and provided recommendations on healthy lifestyle. The dietitian provided dietary counseling for improving the dietary habits of family and the obese children and adolescents. The main recommendations for lifestyle change consisted of a healthy diet, reducing screen time, increasing physical activity, and enough sleep time, as well as behavioral therapy when necessary. All overweight/obese children and adolescents underwent regular follow-up.

Ethical concerns

The study was reviewed and approved by relevant national agencies. The Research Ethics Committee of Isfahan University of Medical Sciences approved it (Project number: 194356). Written informed consent and verbal assent were obtained from parents and students, respectively. Participation in the study was voluntary, and all the potential participants had the right to withdraw from the study at any time.

Statistical analysis

Comparison of mean of continuous variables across genders was investigated by Student's *t*-test. Chi-square test was used to analyze categorical data. Categorical variables were expressed as percentages. For all analyses, SPSS version 20 (IBM Corp., Chicago, IL, USA) was used. $P < 0.05$ was considered statistically significant.

Results

The whole study was performed at population and individual levels. Several national and provincial meetings were organized, and the project teams in each province were trained. By intersectoral collaboration with different organizations, multicomponent interventions are being conducted as described above.

Findings of the quasi-experimental survey

This part of the national survey was performed on 7149 students (3561 boys and 3588 girls). Approximately, there were equal sex ratios (1:1) in all cities in which the study was conducted. Overall, 1241 students were from single-child families (14/8%), 4003 from two-child families (56%), and the rest from families with more than two children. In total, 4175 (58.4%) of participants were the first child of the family. Most students' parents had diploma degree (32.4% of fathers and 37.8% of mothers). Overall, 265 students were underweight (3.7%), 6339 were normal (88.7%), and 545 were overweight or obese (7.6%). The characteristics of participants are presented in Appendix 1.

Knowledge/attitude/practice toward overweight/obesity

In 7–12-year-old students (87.9% of boys and 88.8% of girls) and in 13–18-year-old students, (81.4% of boys and 84.2% of girls), a majority was aware of adverse effects of overweight and obesity. A substantial number (16.1% of boys and 21.7% of girls aged 7–12 years and 16% of boys and 24.2% of girls aged 13–18 years) were unaware of the most important causes of overweight and obesity. Regarding knowledge of childhood obesity as a risk factor for metabolic disorders in adulthood, in 7–12-year-old students, 4.6% of boys and 6.6% of girls; and in 13–18-year-old students, 6% of boys and 6% of girls did not have desirable attitude [Appendix 2].

Knowledge/attitude/practice toward nutrition

In 7–12-year-old students, 11.1% of boys and 17.6% of girls; and in 13–18-year-old students, 17.5% of boys and 17% of girls were unaware of the main food groups. Regarding the low nutritional values of potato chips, snacks, industrial juices, and carbonated beverages, most of the students were unaware, i.e., in the best report, only 20.8% of 7–12-year-old Ardebil girls were aware of the unhealthy snacks. Regarding nonreplacement of industrial juices with fruits, most of the students believed that

industrial juices were a good alternative to fruits. Regarding the effects of high-caloric foods (chocolates, fast-foods, French fries, high-fat foods, etc.) on overweight/obesity, in 7–12-year-old students, 5.2% of boys and 4.8% of girls; and in 13–18-year-old students, 4.7% of boys and 2.7% of girls did not have enough knowledge in this area. Attitude toward not adding salt to food served was desirable, i.e., only 11.6% of boys and 13.3% of girls in 7–12-year-old and 16.8% of boys and 13.9% of 13–18-year-old girls had an undesirable attitude. About skipping one of the main meals for thinness, the general attitude was undesirable. In 7–12-year-old students, 73.4% of boys and 72% of girls; and in 13–18-year-old students, 66.3% of boys and 74.3% of girls believed in skipping one meal. According to daily breakfast consumption, 73.6% of boys and 68.2% of girls aged 7–12 years and 67.2% of boys and 56.3% of girls with 13–18 years of age stated that they had breakfast every day. About the use of mayonnaise and ketchup in the diet of students, generally, mayonnaise is the most common type of salad flavor [Appendix 3].

Knowledge/attitude/practice toward low physical activity or inactivity

In students aged 7–12 years, 2.8% of boys and 1.4% of girls; and in the 13–18–year-old students, 2% of boys and 1.6% of girls did not have enough knowledge about the necessity of daily exercise. In 7–12-year-old students, 73.5% of boys and 74.4% of girls, and in 13–18-year-old students, 75% of boys and 82.5% of girls were unaware about the causes of physical inactivity and sedentary lifestyle. In 7–12-year-old students, 10.8% of boys and 9.1% of girls, and in 13–18-year-old students, 13.3% of boys and 13.9% of girls were unaware about adverse health effects of physical inactivity and sedentary habits. Regarding the effects of prolonged screen time, most students of both genders had favorable attitude. Regarding the importance of daily walking for overweight/obesity prevention, in 7–12-year-old students, 93% of boys and 93% of girls; and in 13-18-year-old students, 90.9% of boys and 93.1% of girls agreed with this attitude.

This survey showed that the screen time of most of the students was 1–3 h a day. The frequency of vigorous exercises was higher in boys in both age ranges, while the rate of light exercises was higher among girls [Appendix 4].

Discussion

The IRAN-ECHO program is being conducted under the framework of the WHO-ECHO study. It has different parts and is being conducted in six provinces. It is scheduled to be implemented at national level in the near future. It is expected that, by its life course interventions, it could help in primordial and primary prevention of NCDs.

The early findings of the baseline data of the quasi-experimental survey of this program provided comprehensive scientific evidence for the importance of actionoriented policy in the prevention and control of overweight/obesity and health promotion of children and adolescents.

Our previous study showed that escalating trends of excess weight among young children are alarming and should be considered by providers of interventional preventive programs at national and regional levels.[8]

Malik and Willett showed in a review that children and teenagers are gradually accustomed to eating harmful foods such as sweetened beverages, pizza, and hamburgers, as well as physical inactivity, playing computer games, and spending long time in front of the TV.[15] Accordingly, inappropriate food habits and physical inactivity are considered the main underlying causes of childhood obesity and overweight.

The findings of the present study showed that, in general, the knowledge about the low nutritional value of unhealthy snacks such as potato chips, puffs, industrial juices, and carbonated drinks was not appropriate. Almost half of children and adolescents consumed carbonated beverages and nonalcoholic beer.

A study on 1441 children aged 6–12 years in Mexico City showed unhealthy eating habits to be correlated with the risk of obesity. Teachers and parents must join forces to shape healthy food intake habits.[16]

Most children believed that industrial juices were suitable alternatives to fruits. The attitude toward the consumption of yogurt drinks (Dough) instead of soft drinks to prevent obesity showed that most children and adolescents had a favorable attitude. The attitude of children and adolescents toward the use of water instead of carbonated beverages and industrial juices was not favorable; this pattern existed in all six provinces studied.

It is well documented that consumption of SSBs is correlated to weight gain in most observational studies.[17,18] However, some studies did not confirm this.[19] Children who drink SSBs also tend to eat fast foods and to spend more time watching TV that in turn would lead to overweight and obesity.[20]

The baseline data of the quasi-experimental survey of this program showed that the attitude of children and adolescents on not adding salt to table food was at a desirable level. About sugar consumption, almost half of all children and adolescents consumed sugar daily. The attitude of children and adolescents about skipping one of the main meals for losing weight was not desirable. The performance of children and adolescents was good in terms of daily breakfast intake. Breakfast as part of a healthy diet and lifestyle can positively impact on children's health and prevention of obesity.[21]

More than 90% of children and adolescents were aware of the necessity of regular physical activity for health. Most participants believed that daily walking is one of the best

ways to prevent obesity and overweight. Findings about the attitude of children and adolescents in regard to the harmful health effects of prolonged screen time showed that most children and adolescents believed that this behavior and incorrect position in front of the TV had harmful effects on health.

Our previous study showed that the time spent on screen activities is considerably high in Iranian children and adolescents. It should be decreased by improving public awareness and by providing facilities for regular daily physical activity for students' leisure times.[22]

It is documented that the joint association of prolonged screen time and low physical activity correlates with abdominal obesity, overweight, and cardiometabolic risk factors.[23]

Chen and Wang[24] showed that, when people played computer games or watched TV, they ate high-calorie and unhealthy foods that lead to obesity, overweight, and false satiety. This is one of the most important reasons for skipping main meals that have high nutritional value. Therefore, education of students and even their parents is essential to the development of desirable nutritional behaviors and prevent overweight/obesity in childhood. Mazurek and Wenstrup[25] believed that there was a false cycle between undesirable nutritional habits and wrong behaviors and that the use of digital entertainment devices plays a significant role in this. It seems that one of the best ways to reduce the effect of the increasing use of computers and digital devices is education of children and their parents and to change their unhealthy behaviors.

A study on Australian students, aged 9–16 years, showed that overweight and obesity were more strongly correlated with screen time than physical activity. Screen time may be an important target for interventions aimed at reducing childhood overweight and obesity.[26]

Baseline data of the quasi-experimental study of our program showed that the sleeping hours at night were unfavorable in both 7–12 and 13–18 age groups. Saunders *et al*.[27] showed that not having enough sleep at night led to consumption of high-calorie foods and physical inactivity, which are the main causes of obesity.

The quasi-experimental study of our program faced some limitations. Similar to other questionnairebased studies, the problems of underestimation or overestimation of the time spent on screen time or physical activity and the recall bias should be taken into account. This is the first comprehensive plan of prevention and control of overweight in Iranian children and adolescents and comprehensive analysis of determinants of weight disorders at national level in a sample representative of the pediatric population in Iran. A high quality control of data collection was the other strength of this study.

Conclusions

IRAN-ECHO program is presenting the feasibility of conducting the WHO-ECHO recommendations in Iran. Childhood obesity decreases the physical, social, and psychological behavior of children and is a known risk factor for adult obesity and NCDs. Improving the health condition of this generation and the next is important. The scope of potential policy recommendations to decrease childhood obesity is extensive and includes various elements. This program considered multisectoral interventions through two population and individual approaches. The multicomponent interventions of the IRAN-ECHO program address the obesogenic environment by considering the life course dimensions. Our program is committed to working at national level toward a collective goal of ECHO and its health consequences.

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Conflicts of interest

There are no conflicts of interest.

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References

1. Kelishadi R, Poursafa P. A review on the genetic, environmental, and lifestyle aspects of the early-life origins of cardiovascular disease. Curr Probl Pediatr Adolesc Health Care 2014;44:54-72.
2. Zalilah MS, Khor GL, Mirnalini K, Norimah AK, Ang M. Dietary intake, physical activity and energy expenditure of Malaysian adolescents. Singapore Med J 2006;47:491-8.
3. Grimes CA, Riddell LJ, Campbell KJ, Nowson CA. Dietary salt intake, sugar-sweetened beverage consumption, and obesity risk. Pediatrics 2013;131:14-21.
4. Baygi F, Dorosty AR, Kelishadi R, Qorbani M, Asayesh H, Mansourian M, *et al.* Determinants of childhood obesity in representative sample of children in North East of Iran. Cholesterol 2012;2012:875163.
5. Kelishadi R. Childhood overweight, obesity, and the metabolic syndrome in developing countries. Epidemiol Rev 2007;29:62-76.
6. Lobstein T, Baur L, Uauy R. IASO international obesity task force: Obesity in children and young people: A crisis in public health. Obes Rev 2004;Suppl 1:4-104.
7. Bahreynian M, Kelishadi R, Qorbani M, Motlagh ME, Kasaeian A, Ardalan G, *et al.* Weight disorders and anthropometric indices according to socioeconomic status of living place in Iranian children and adolescents: The CASPIAN-IV study. J Res Med Sci 2015;20:440-53.
8. Kelishadi R, Haghdoost AA, Sadeghirad B, Khajehkazemi R. Trend in the prevalence of obesity and overweight among Iranian children and adolescents: A systematic review and meta-analysis. Nutrition 2014;30:393-400.

9. Klumbiene J, Petkeviciene J, Vaisvalavicius V, Miseviciene I. Advising overweight persons about diet and physical activity in primary health care: Lithuanian health behaviour monitoring study. BMC Public Health 2006;6:30.
10. Noori R, Moghaddam M. Relationship between prevalence of overweight and obesity as well as lifestyle and level of physical fitness in adult. Iran J Endocrinol Metab Shahid Beheshti Univ Med Sci Health Serv 2012;14:241-7.
11. van Sluijs EM, McMinn AM, Griffin SJ. Effectiveness of interventions to promote physical activity in children and adolescents: Systematic review of controlled trials. BMJ 2007;335:703.
12. Azadi A, Anosheh M, Alhani F. The effect of implementation of health promotion program in school to control risk factors for obesity in adolescents. Iran South Med J 2007;11:153-62.
13. Commission on Ending Childhood Obesity. Report of the Commission on Ending Childhood Obesity. Geneva: World Health Organization; 2016. Available from: http://www.who.int/end-childhood-obesity/en/. [Lsat accessed on 2017 May 12].
14. de Onis M, Onyango AW, Borghi E, Garza C, Yang H, WHO Multicentre Growth Reference Study Group, *et al.* Comparison of the World Health Organization (WHO) Child Growth Standards and the National Center for Health Statistics/WHO International Growth Reference: Implications for child health programmes. Public Health Nutr 2006;9:942-7.
15. Malik VS, Willett WC, Hu FB. Global obesity: Trends, risk factors and policy implications. Nat Rev Endocrinol 2013;9:13-27.
16. Vilchis-Gil J, Galván-Portillo M, Klünder-Klünder M, Cruz M, Flores-Huerta S. Food habits, physical activities and sedentary lifestyles of eutrophic and obese school children: A case-control study. BMC Public Health 2015;15:124.
17. Dubois L, Farmer A, Girard M, Peterson K. Regular sugar-sweetened beverage consumption between meals increases risk of overweight among preschool-aged children. J Am Diet Assoc 2007;107:924-34.
18. Kelishadi R, Mansourian M, Heidari-Beni M. Association of fructose consumption and components of metabolic syndrome in human studies: A systematic review and meta-analysis. Nutrition 2014;30:503-10.
19. O'Connor TM, Yang SJ, Nicklas TA. Beverage intake among preschool children and its effect on weight status. Pediatrics 2006;118:e1010-8.
20. de Ruyter JC, Olthof MR, Seidell JC, Katan MB. A trial of sugar-free or sugar-sweetened beverages and body weight in children. N Engl J Med 2012;367:1397-406.
21. Jääskeläinen A, Schwab U, Kolehmainen M, Pirkola J, Järvelin MR, Laitinen J, *et al.* Associations of meal frequency and breakfast with obesity and metabolic syndrome traits in adolescents of Northern Finland Birth Cohort 1986. Nutr Metab Cardiovasc Dis 2013;23:1002-9.
22. Jari M, Qorbani M, Motlagh ME, Heshmat R, Ardalan G, Kelishadi R, *et al.* A nationwide survey on the daily screen time of Iranian children and adolescents: The CASPIAN-IV study. Int J Prev Med 2014;5:224-9.
23. Heshmat R, Qorbani M, Shahr Babaki AE, Djalalinia S, Ataei-Jafari A, Motlagh ME, *et al.* Joint association of screen time and physical activity with cardiometabolic risk factors in a national sample of Iranian adolescents: The CASPIANIII study. PLoS One 2016;11:e0154502.
24. Chen HJ, Wang Y. Do weight status and television viewing influence children's subsequent dietary changes? A National Longitudinal Study in the United States. Int J Obes (Lond) 2015;39:931-8.
25. Mazurek MO, Wenstrup C. Television, video game and social media use among children with ASD and typically developing siblings. J Autism Dev Disord 2013;43:1258-71.
26. Maher C, Olds TS, Eisenmann JC, Dollman J. Screen time is more strongly associated than physical activity with overweight and obesity in 9- to 16-year-old Australians. Acta Paediatr 2012;101:1170-4.
27. Saunders TJ, Gray CE, Poitras VJ, Chaput JP, Janssen I, Katzmarzyk PT, *et al.* Combinations of physical activity, sedentary behaviour and sleep: Relationships with health indicators in school-aged children and youth. Appl Physiol Nutr Metab 2016;41:S283-93.

Appendixes

Appendix 1: Characteristics of study participants in the quasi-experimental survey

	Total	Boy	Girl
Number of participants (%)	7149	3561 (49.8)	3588 (50.2)
Weight status, *n* (%)			
Underweight	265 (3.7)	138 (3.9)	127 (3.5)
Normal	6339 (88.7)	3054 (85.5)	3285 (91.6)
Overweight/obese	545 (7.6)	369 (10.4)	176 (4.9)
Socioeconomic status, *n* (%)			
Low	2392 (33.5)	1317 (37)	1075 (30)
Intermediate	2385 (33.4)	1113 (31.3)	1272 (35.5)
High	2367 (33.1)	1127 (31.7)	1240 (34.6)

Appendix 2: Knowledge/attitude/practice toward overweight/obesity in the quasi-experimental survey

	7-12 year old		13-18 year old	
	Boy, *n* (%)	Girl, *n* (%)	Boy, *n* (%)	Girl, *n* (%)
Knowledge				
Adverse effects of overweight/obesity				
Unaware	808 (51.1)	944 (59.5)	1049 (53)	1306 (65.3)
Semi-aware	330 (20.9)	292 (18.4)	441 (22.3)	437 (21.8)
Aware	443 (28)	350 (22.1)	489 (24.7)	258 (12.9)
Causes of overweight/obesity				
Unaware	255 (16.1)	345 (21.7)	316 (16)	484 (24.2)
Semi-aware	537 (34)	546 (34.4)	727 (36.8)	815 (40.7)
Aware	789 (49.9)	969 (43.9)	935 (47.2)	702 (35.1)
Attitude				
Risk of obesity for adulthood metabolic disorders				
Desirable	1397 (88.4)	1345 (84.8)	1586 (80.1)	1655 (82.7)
No attitude	111 (7)	137 (8.6)	275 (13.9)	226 (11.3)
Undesirable	72 (4.6)	105 (6.6)	118 (6)	119 (6)

Appendix 3: Knowledge/attitude/practice toward dietary habits in the quasi-experimental survey

	7-12 years old		13-18 years old	
	Boy, *n* (%)	Girl, *n* (%)	Boy, *n* (%)	Girl, *n* (%)
Knowledge				
Main food groups				
Unaware	175 (11.1)	280 (17.6)	346 (17.5)	340 (17)
Semi-aware	355 (22.5)	411 (25.9)	541 (27.3)	615 (30.7)
Aware	1051 (66.5)	896 (56.5)	1092 (55.2)	1046 (52.3)
Low nutritional values of chips, snacks, industrial juices				
Unaware	86 (5.4)	113 (7.1)	192 (9.7)	124 (6.2)
Aware	1494 (94.6)	1473 (92.9)	1787 (90.3)	1876 (93.8)
Nonreplacement of industrial juices with fruits				
Unaware	149 (9.4)	157 (9.9)	205 (10.4)	148 (7.4)
Aware	1431 (90.6)	1428 (90.1)	1773 (89.6)	1852 (92.6)
The effects of high-caloric foods on overweight/obesity				
Unaware	83 (5.2)	76 (4.8)	94 (4.7)	54 (2.7)
Semi-aware	184 (11.6)	185 (11.7)	441 (22.3)	262 (13.1)
Aware	1314 (83.1)	1326 (83.6)	1444 (73)	1684 (84.2)
Attitude				
Nonuse of salt during eating				
Desirable	1298 (82.1)	1291 (81.3)	1331 (67.3)	1416 (70.8)
No attitude	100 (6.3)	85 (5.4)	316 (16)	306 (15.3)
Undesirable	183 (11.6)	211 (13.3)	332 (16.8)	279 (13.9)
Omitting one of the meals for thinness				
Desirable	279 (17.6)	298 (18.8)	423 (21.4)	323 (16.1)
No attitude	141 (8.9)	147 (9.3)	244 (12.3)	191 (9.5)
Undesirable	1161 (73.4)	1142 (72)	1312 (66.3)	1487 (74.3)
Practice				
Daily breakfast consumption				
Always	1164 (73.6)	1083 (68.2)	1330 (67.2)	1126 (56.3)
Sometimes	212 (13.4)	237 (14.9)	341 (17.2)	392 (19.6)
Rarely	143 (9)	171 (10.8)	233 (11.8)	342 (17.1)
Never	63 (4)	96 (6)	75 (3.8)	141 (7)

Appendix 4: Knowledge/attitude/practice toward low physical activity or inactivity in the quasi-experimental survey

	7-12 years old		13-18 years old	
	Boy, *n* (%)	**Girl, *n* (%)**	**Boy, *n* (%)**	**Girl, *n* (%)**
Knowledge				
Exercise necessity				
Unaware	45 (2.8)	23 (1.4)	40 (2)	31 (1.6)
Aware	1535 (97.2)	1564 (98.6)	1939 (98)	1968 (98.4)
Causes of immobility and sedentary lifestyle				
Unaware	1161 (73.5)	1177 (74.2)	1484 (75)	1649 (82.5)
Semi-aware	235 (14.9)	245 (15.4)	275 (13.9)	273 (13.7)
Aware	184 (11.6)	165 (10.4)	220 (11.1)	77 (3.9)
Disadvantages				
Unaware	170 (10.8)	144 (9.1)	263 (13.3)	277 (13.9)
Aware	1410 (89.2)	1443 (90.9)	1714 (86.7)	1722 (86.1)
Attitude				
The effects of spending more than 2 h a day on screen time				
Desirable	1412 (89.4)	1417 (89.3)	151 (78.4)	1619 (80.9)
No attitude	72 (4.6)	73 (4.6)	235 (11.9)	228 (11.4)
Undesirable	96 (6.1)	97 (6.1)	192 (9.7)	154 (7.7)
Daily walking for overweight/obesity prevention				
Desirable	1470 (93)	1475 (93)	1798 (90.9)	1863 (93.1)
No attitude	58 (3.7)	50 (3.2)	121 (6.1)	80 (4)
Undesirable	53 (3.4)	61 (3.8)	60 (3)	58 (2.9)
Practice				
Frequency of vigorous exercise in the last 2 weeks				
0	277 (17.5)	656 (41.3)	325 (16.4)	704 (35.2)
1-2	557 (35.2)	572 (36)	625 (31.6)	809 (40.4)
3-5	400 (25.3)	244 (15.4)	515 (26)	285 (14.2)
6-8	160 (10.1)	67 (4.2)	232 (11.7)	95 (4.7)
>9	188 (11.9)	48 (3)	282 (14.2)	108 (5.4)