

Results of European Heart Network Pilot Project “A Vending Machine for a Friend”

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Abstract: Children often grow up in obesogenic environments that promote unhealthy diets. Consequently, many European children are overweight. Vending machines (that usually distribute foods rich in fat, sugar, salt and calories) located in schools are one factor that contributes to this. The aim of the pilot project “A vending machine for a friend” of the Italian Society for Cardiovascular Prevention (SIPREC) in collaboration with the Lithuanian Heart Association (LHA) and under the aegis and sponsorship of the European Heart Network (EHN), has been to regulate and improve the nutritional quality of food and beverages served in vending machines, cafeterias and school canteens. In the pilot project were included 3 Italian and 2 Lithuanian high schools. Seventy-eight Italian students and seventy-eight Lithuanian students in the 2nd and 3rd year of high school, joined the intervention group, undertaking to consume only foods and beverages from “healthy” vending machines and healthy snacks in the cafeteria, versus seventy-seven Italian students and ninety-seven Lithuanian students in the 2nd and 3rd year of high school who were part of the control group. The intervention has also included an education and training program on healthy food dedicated to the students and to the teachers. The results of the Body Mass Index (BMI) in the intervention group (-2.1% in the Italian intervention group versus +0.0% in the control group and -2.2% in the Lithuanian intervention group versus +0.5% in the control group), and of the questionnaire administered after the seminars (+53.4% of improvement in the Italian intervention group versus just +2.5% in the control group, and +21.6% of improvement in the Lithuanian intervention group versus +3% in the control group), indicates the good results achieved by the students who have participated in the project. “Healthy” vending machines together with educational programs might be a good strategy for creation of a healthy nutritional environment in high schools to tackle overweight and obesity in adolescents. Bigger studies are needed to prove concept.

Keywords: High-School Students, Vending Machines, Healthy Nutrition

1. Introduction

According to the United Nations' Convention on the Rights of the Child, every child has the right to grow up in a healthy environment [1]. However, children often grow up in unhealthy environments that promote the development of obesity, mostly adopting obesogenic diets and lifestyle.

Consequently, many European children are overweight. According to data from WHO-Europe, 29% of children aged 7-9 years in the participating countries were living with overweight, including obesity. Prevalence was higher among boys (31%) than girls (28%) [2, 3]. The broader diffusion of unhealthy behaviors during the COVID-19 pandemic has contributed to the grow of this phenomenon [4]. It is indeed a

worrisome fact that in many European countries, the observed decline in cardiovascular events and death may begin to increase again in the near future [5]. We could, in fact, witness in the next generations a reverse in the gains in life expectancy that have been achieved over the past decades in our adult generations, with related problems of economic sustainability of national health systems.

This is particularly true for Italian children, where the shift away from traditional healthy foods and physical activity (between 2000 and 2021 sedentary lifestyles increased from 22.3% to 27.2%) has led to a prevalence of overweight which reached 36.9% in children and adolescents aged 5-19 years old (+39.1% since 1980), one of the worst rates in Europe [6, 7]. On the contrary, Lithuanian children and adolescents aged 5-19 years old have one of the lowest rates in Europe for being overweight (20,6%). However, the Lithuanians have had a very high percentage increase since 1980 (+84.2%) [7].

With reference to the “obesogenic environment” vending machines (located strategically in public venues such as schools) are one factor, while not the only one, that contributes to this environment. Indeed, traditional vending machines usually distribute foods rich in fat, sugar, salt and calories [8]. Therefore, the students do not have the option of making healthy choices. Moreover, the unregulated marketing of unhealthy products targeting children, has a negative influence on children’s dietary preferences, purchasing behavior and consumption [9].

The project “A vending machine for a friend” has been developed by the Italian Society for Cardiovascular Prevention (SIPREC) in collaboration with the Lithuanian Heart Association (LHA), who are both active in promoting healthy lifestyles at the national and European levels, within the European Heart Network (EHN) which sponsored and financed the project. Undertaken in alliance with high school teachers, the project has a simple, technically and commercially feasible, zero-cost strategy: to replace traditional vending machines with those stocked with medium to small portion sizes and low-fat, low-sugar, low-salt and low-calorie ‘healthy’ options. And in cases where the vending machines were not located in the school, the objective was to regulate and improve the nutritional quality of food and beverages served in the cafeterias and school canteens. Besides creating healthy environment to permit healthier choices in snacking, the intervention has also included an education and training program on healthy food, dedicated to the students and to the teachers to build their educational and communication skills on nutrition.

2. Materials and Methods

2.1. Project Timelines

Because of the COVID-19 pandemic with the first lockdown and the second ‘mini lockdown’, the study took 28 months, not the expected 12 months, to allow the sequential execution of all the phases:

- 1) February-March 2020: identification of the participating high schools, 3 Italian of which 1 located in Rome (Giorgi-Woolf high school), 1 in Latina (Alessandro Manzoni High school) and 1 in Priverno (Teodosio Rossi, high school) (Figure 1A), and 2 Lithuanian of which 1 in Vilnius (Adam Mickevicius Lyceum) and 1 in Panevezys (Minties Gymnasium) (Figure 1B), identification of the logo for the Italian and Lithuanian schools (Figure 2A and 2B, respectively), meetings with deans, science teachers, student representatives and retailers to illustrate the project; training and motivation sessions to the science teachers and students of the participating schools held by experts in nutrition and cardiovascular prevention of SIPREC and LHA; meeting with retailers to organize the installation of “healthy” vending machines and/or the sale of “healthy” snacks in the cafeteria;
- 2) September-October 2021: installation of “healthy” vending machines and/or availability of healthy snacks in the cafeteria; baseline nutritional questionnaire (30 multiple choice questions) and measurement of body mass index (weight in kilograms divided by the square of height in meters, BMI) for the enrolled students (intervention and control groups). In agreement with the science teachers, 78 Italian students and 78 Lithuanian students in the 2nd and 3rd year of high school, joined the intervention group on a voluntary basis, undertaking to consume only foods and beverages from “healthy” vending machines and healthy snacks in the cafeteria, versus 77 Italian students and 97 Lithuanian students in the 2nd and 3rd year of high school who, on voluntary basis, were part of the control group that undertook to consume only foods and beverages from “traditional” vending machines and the cafeteria; an educational seminar with the students of the intervention groups and their teachers held by experts in nutrition and cardiovascular prevention of SIPREC and LHA;
- 3) April-May 2022: repetition of the baseline questionnaire and of the BMI measurement at the end of the project to evaluate the knowledge gained and the clinical benefit of the study. The mean averages and standard deviations (SD) were used to describe the distribution of the continuous variables. The statistical significance of the differences in the parameters measured in both groups was assessed using Student’s T test and, for parameters with multiple measurements, with the Analysis of Variance (ANOVA). Statistical significance was set at $p < 0.05$;
- 4) From September 2022, dissemination of the project results and nutrition guidelines by invited lectures (Italian experts took part in seminars in Lithuania and vice versa) to promote lifestyle changes in both countries in the participating and other schools, college of nutrition, universities, medical congresses and through interviews on traditional and new media.



Figure 1. Participating in the project are cities from Italy (A, marked in circles) and Lithuania (B, marked in circles).



Figure 2. Logos of the project with all participating partners in Italy (A) and Lithuania (B).

2.2. Nutritional Content in Cafeterias and Vending Machines

Foods of the "Friendly Machines":

1) rusks, crispbread and crackers with low saturated fats and without trans-fatty acids, low-calories fitness bars

- (<90 Kcal per piece), biscuits (<100 Kcal per packet)
- 2) chips or other types of vegetable baked chips
- 3) low-fat natural yogurt, low-fat natural drinking yogurt
- 4) natural fruit juice with no added sugar (200 ml per drink)
- 5) dried fruit, nuts (30 g packet)
- 6) water, 150 ml of tea with no added sugar, "Zero" or

"Light" soft drinks

It would have been ideal if we could have also included fresh fruit, but the issue of perishability made this impossible.

Foods of the Italian cafeteria:

- 1) tuna and tomato sandwiches
- 2) bresaola or turkey breast or fat-free ham and salad leaf or tomato sandwiches
- 3) chips or other types of vegetable baked chips
- 4) low-calories fitness bars (<100 Kcal per piece)
- 5) biscuits (<100 kcal per packet)
- 6) low-fat natural yoghurt or low-fat natural drinking yogurt
- 7) fresh fruit, natural fruit juices with no added sugar (200 ml per drink)
- 8) dried fruit (30 g sachet)
- 9) water, 150 ml of tea with no sugar added, "Zero" or "Light" soft drinks.

Foods of the Lithuanian cafeteria:

- 1) lower sugar content (up to 5 g/100 g/ml)
- 2) low salt content (up to 1 g/100 g/ml)
- 3) no genetically modified organisms (GMO)
- 4) animal fats were replaced by oils
- 5) dairy products with fat content up to 2.5%
- 6) biscuits and cereals with more than 6 g/100 g fiber
- 7) preference for whole grain products
- 8) no sugar sweetened drinks, with preference for water
- 9) fresh vegetables and fruits
- 10) preference to white meat and fish
- 11) no food additives (sweeteners, E102, 104, 110, 120 etc.)
- 12) no products with trans fats.

Ethical approval and informed consent: before starting the study, the protocol was submitted to the participant schools. The teachers and students received information which described the procedures in detail, followed by the

acceptance by the students and their parents. Participation in the project was on a voluntary basis. The respect of privacy for the management of personal data has been guaranteed by the fact that all data collected have been treated in total anonymity and have been analyzed in aggregate form in compliance with the EU Regulation (GDPR 2016/679). All participants and their parents received clarifications where there were doubts of any kind, through the provision of the researchers' contacts. The possibility of withdrawing from the project at any time was guaranteed.

Conflict of interest: the authors and all the research group members declare the complete absence of conflict of interests.

3. Results

Average age of the 155 Italian high school students at the beginning of the project was 16.7 years with gender distribution of 71 girls (45.8%) and 84 boys (54.2%). Average baseline weight of all participants in Italy was 67.6 kilograms, height 172.6 centimetres. Considering the BMI, 4.0% students were classified as being underweight, 16.0% overweight and 4.0% obese.

Average age of the 175 Lithuanian high school students at the beginning of the project was 16.4 years with the gender distribution of 85 girls (48.6%) and 90 boys (51.4%). Average baseline weight of all participants in Lithuania was 67.2 kilograms, with a height 174.1 centimeters. Considering the BMI, 3.4% students were classified as being underweight, 10.0% as overweight and 5.7% as obese.

BMI result at the end of the project versus baseline: -2.1% in the Italian intervention group versus 0% in the control group, $p < 0.05$ (Table 1); -2.2% in the Lithuanian intervention group versus +0.5% in the control group, $p < 0.05$ (Table 2).

Table 1. The clinical benefit of intervention according to BMI changes in Italian students. BMI, body mass index.

| | Number of students | Baseline BMI | Final BMI | Difference (%) |
|---------------------|--------------------|--------------|-----------|----------------|
| Intervention group | | | | |
| Roma | 21 | 24.6 | 23.9 | -2.8 |
| Latina | 23 | 23.8 | 23.3 | -2.1 |
| Priverno | 34 | 23.3 | 23.0 | -1.3 |
| All Italian schools | 78 | 23.8 | 23.3 | -2.1 |
| Control group | | | | |
| Roma | 26 | 21.0 | 21.1 | +0.5 |
| Latina | 22 | 22.1 | 22.0 | -0.5 |
| Priverno | 29 | 21.7 | 21.6 | -0.5 |
| All Italian schools | 77 | 21.6 | 21.6 | +0 |

Table 2. The clinical benefit of intervention according to BMI changes in Lithuanian students. BMI, body mass index.

| | Number of students | Baseline BMI | Final BMI | Difference (%) |
|------------------------|--------------------|--------------|-----------|----------------|
| Intervention group | | | | |
| Vilnius | 43 | 23.1 | 22.7 | -1.7 |
| Panevezys | 35 | 22.5 | 21.9 | -2.7 |
| All Lithuanian schools | 78 | 22.8 | 22.3 | -2.2 |
| Control group | | | | |
| Vilnius | 52 | 20.4 | 20.6 | +1.0 |
| Panevezys | 45 | 22.2 | 22.1 | -0.5 |
| All Lithuanian schools | 97 | 21.3 | 21.4 | +0.5 |

Results of the questionnaire administered at the end of the

project versus baseline: +53.4% of improvement in the Italian

intervention students' group versus +2.5% in the control group, $p < 0.001$ (Table 3); +21.6% of improvement in the Lithuanian intervention group versus +3% in the control group, $p < 0.01$ (Table 4).

Table 3. The knowledge gained with intervention according to the questionnaire results in Italian students.

| | Number of students | Baseline score (out of 30) | Final score (out of 30) | Improvement of knowledge (%) |
|---------------------|--------------------|----------------------------|-------------------------|------------------------------|
| Intervention group | | | | |
| Rome | 21 | 15.1 | 23.9 | +58.3 |
| Latina | 23 | 16.9 | 25.2 | +49.1 |
| Priverno | 34 | 16.8 | 25.6 | +52.4 |
| All Italian schools | 78 | 16.3 | 25.0 | +53.4 |
| Control group | | | | |
| Rome | 26 | 15.4 | 15.5 | +0.7 |
| Latina | 22 | 17.1 | 17.5 | +2.3 |
| Priverno | 29 | 16.5 | 17.2 | +4.2 |
| All Italian schools | 77 | 16.3 | 16.7 | +2.5 |

Table 4. The knowledge gained with intervention according to the questionnaire results in Lithuanian students.

| | Number of students | Baseline score (out of 30) | Final score (out of 30) | Improvement of knowledge (%) |
|------------------------|--------------------|----------------------------|-------------------------|------------------------------|
| Intervention group | | | | |
| Vilnius | 43 | 12.8 | 16.5 | +28.9 |
| Panevezys | 35 | 14.8 | 17.5 | +18.2 |
| All Lithuanian schools | 78 | 13.9 | 16.9 | +21.6 |
| Control group | | | | |
| Vilnius | 52 | 16.5 | 17.5 | +6.1 |
| Panevezys | 45 | 16.2 | 16.5 | +1.9 |
| All Lithuanian schools | 97 | 16.4 | 16.9 | +3.0 |

4. Discussion

The results of the SIPREC, LHA and EHN project on the modification of the food of the vending machines and/or of the food in the cafeterias of the Italian and Lithuanian pilot schools have been evaluated analyzing the BMI of the students measured at project baseline and at the end of the project and through the evaluation of the questionnaire administered to the students at project baseline and at the end of the project.

The clinical benefit of the reduction of the BMI and the knowledge gained obtained in the intervention group versus the control group indicate that the goal of this pilot project has been reached.

Comparing the results of the Italian and the Lithuanian intervention groups, if the gain in knowledge on healthy nutrition after seminars was greater among Italians compared to Lithuanians (+53.4% versus +21.6%, respectively), the clinical benefit regarding the change in BMI was very comparable (-2.1% and -2.2%, respectively). Therefore, the adaptation of the vending machines/cafeterias content in the schools to the healthier ones, made quite a substantial impact on daily eating habits.

Moreover, there are other benefits of the project beyond these positive results in BMI and improvement of knowledge:

- 1) to educate children and raise their awareness means helping them to maintain healthy lifestyles when they become adults and transferring the message to their parents and their friends (peers to peers), using a language and style that young people easily understand [10-12]. This can be important to reach the goal to spread the healthy nutrition project beyond our duty of

disseminating our findings through publication in medical journals or by interviews in traditional and new media;

- 2) considering that cooperation with schools is of prime importance to tackle overweight and obesity, and to engage teachers increasing their educational and communication skills, since it is fundamental to have them as allies to prevent and reduce overweight and obesity in current and future students. Moreover, the school environment has the great goal of reducing socio-economic and cultural inequalities, since obesity is not only a question of personal responsibility, but may also depend on other factors, including the individual's level of education and training. This is a fundamental issue of health equity and the school environment is the ideal setting for health promotions and health literacy interventions;
- 3) In our project, the catering companies employed in the schools have become partners to support the endeavor to promote healthy foods at school. However, this is not always the case because catering companies often refuse to cooperate as a partner because they could be less mindful of such issues because their sales are booming. A simple and feasible solution would be to include a mandatory clause in all new tenders for vending machines stating that the successful retailer would be obliged to install a "mix" vending machine so that, alongside the traditional selection of food and beverages, at least 50% of the products sold are medium-to-small portion size, low in saturated fat (and do not contain trans fats), low in sugar (and have no added sugar), low in salt, low in calories;
- 4) the positive results of this pilot project, can be

extrapolated to broader use in Italian and Lithuanian schools by installing healthier vending machines through communication with the Ministries of Health in both countries. While the Lithuanian Ministry of Health, like several other European countries, is working actively on healthy nutrition in schools and kindergartens, in Italy, this is unfortunately not the case. Some years ago, Italy had an innovative draft legislation on the regulation of the nutritional quality of food and beverages sold in vending machines installed in public venues accessible to children and adolescents (and adults) [13]. However, this proposal was not debated by Parliament hence to date has not become law. Our goal, our hope is to collaborate with Members of Parliament on a mandatory regulation of the nutritional quality of the food and beverages sold in vending machines in Italy.

This observational project has certain limitations: its observational nature, the small sample size, the short observational period. However, this pilot phase of the project shows possible ways to impact growing tendencies in obesity in children and young adults in Europe and globally. Further research with a larger sample size and a longer follow-up period is warranted.

5. Conclusions

As Vytenis Andriukaitis, former European Commissioner for Health and Food Safety said, “We wish our children happiness, health and success. As adults we are responsible for making choices that prevent overweight and obesity in our kids. They deserve our strong commitment and action. Let’s break the childhood obesity vicious cycle together and now” [14], the global increase in obesity among children is not an unstoppable trend [15]. “Healthy” vending machines together with a dedicated educational program might be a good strategy for creating a healthy nutritional environment for children in schools and for helping to prevent overweight and obesity. Clearly the initiative needs to be reinforced through seminars and training sessions by nutrition (and healthy lifestyle) experts, in the schools for both the students and the teachers. The idea is to transform vending machines into a resource to promote healthy eating habits starting from the snacks that become a tool in an integrated nutrition education project that could involve the catering system (with reformulation of the offer) and the Parliament with a law that regulates the nutritional quality of food and beverages sold in vending machines installed in public venues accessible to children, adolescents and adults.

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