Promotion of Fruits and Vegetables Consumption: Results of a School-Based Intervention in a Sample of 13-15 Years Old Italian Students

Giacomo Lazzeri[1,*], Valentina Pilato[1], Andrea Pammolli[1], Rita Simi[1], Daniela Galeone[2], Emanuela Balocchini[3], Mariano Vincenzo Giacchi[1] and the Research Group Project (See Appendix)

[1]*CREPS - Centre of Research for Health Education and Promotion, University of Siena, Via Aldo 2, 53100 Siena, Italy*

[2]*Italian Ministry of Health, Department of Public Health and Innovation, Via G. Ribotta 5, 00144, Rome, Italy*

[3]*Tuscany Regional Health Authority, Via Alderotti 26/N, 50139 Florence, Italy*

Abstract: *Background*: The *…e vai con la frutta* (let's go with fruit) project was designed to respond to the worrying low consumption of fruits and vegetable in the large portion of population, especially in youth. The main objective was to increase fruit and vegetable consumptions at school level.

Methods: In 2010/11, we randomly selected subjects from middle and high schools in five Italian regions. The subjects were randomly divided into two groups: intervention (I) and control (C). A questionnaire on fruits and vegetables consumption was administered, at the baseline as well as at end of the period. The sample size was evaluated on the expected frequency of 0.5 for a binomial random variable, of ± 1.54% with IC of 95%.

Results: These results confirmed that adolescent students at baseline survey eat less than the amount of fruits and vegetables consumption recommended by the International guidelines. After the intervention time, we observed an increment in fruits and vegetables consumptions both in middle and high school students. Regarding the impact of the intervention on the factors like knowledge, attitudes and behaviour, there was a positive change in the behaviour only in the intervention group, in coherence with the consumption variations examined.

Conclusions: This study is the first time that fruits and vegetables were offered at such a large scale through vending machines at schools in five regions. Several vending companies under this project agreed to revise the list of healthy snacks offered to eliminate those clearly classified as junk foods.

Keywords: School based intervention, Italian students, healthy vending machines, availability, accessibility.

INTRODUCTION

Fruits and vegetables (FV), as a group of food, are low in energy density, high in water content, and significant source of dietary fibre [1-2]. Several studies have tested the hypothesis that an increment of FV consumption promotes weight loss or improves body weight regulation in youth [3-6]. Nevertheless, a recent review concluded that the relationship between FV intake and adiposity among children remains unclear [7]. The 2002 Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases recommends that general population should consume at least 400 g of FV per person per day, i.e. approximately equivalent to five servings [8]. Most of the European and North American children and adolescents fail to reach this target recommendation [9-11]. The WHO population-based approaches to childhood obesity prevention recommend: structures to support policies and interventions; population-wide policies and initiatives; community-based interventions [12]. Components that have been most successful in implementing those recommendations include the use of multiple media channels to promote specific messages about the benefits of FV consumption, hands-on skill building, active provision of FV in schools, and the involvement of teachers, peers and parents in delivering the programme [13]. A systematic review in 2006 suggests the importance of multi-component interventions (duration of at least 12 months) such as increase access to FV among the whole school community, teacher training and curriculum integration, peer leadership and encouragement, canteen staff involvement, parents agreement and involvement both at home and at the school [14]. In addition, recent studies recommend multi-component interventions, which are not only school-based, but also community-based [15,16]. Therefore, a number of studies emphasise the importance of availability and accessibility of FV for reaching the target recommendation of youth's FV intake [14-21]. As students spend most of their time in school, therefore, the school's environment has a major influence on their dietary behaviours [22]. Therefore,

*Address correspondence to this author at the CREPS - Centre of Research for Health Education and Promotion, University of Siena, Italy;
Tel: 0039 0577 234156; Fax: 0039 0577 234090;
E-mail: giacomo.lazzeri@unisi.it

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schools are the most natural setting for implementing interventions to improve the consumption of FV [14,17,23]. In fact, many programs such as fresh fruit and vegetable program [24], National school fruit scheme [25], Gimme 5 [26], Norwegian school fruit program [27], Dutch school Gruiten project [28] promoting the consumption of FV around the world are carried out in schools.

Following the strategy "Gaining Health" [29], the Italian Ministry of Health launched the *…e vai con la frutta* project in 2009 with the aim of implementing and evaluating specific actions to increase fresh FV consumption by ensuring easy access to FV and the healthy choices at schools in five regions. The following regions participated in this project: Tuscany (coordinator), Apulia, Campania, Marche and Sicily. In this project, we primarily focussed on school setting, educational interventions and access to FV (only in high school), and also involved students, teachers and parents. In this paper we present the results of 2010/11 school year of middle (M) and high (H) school's intervention programme. The schools were divided randomly into two categories: intervention (I) and control (C). The specific objective of this study was to increase the consumption of FV in I-group at least one portion per day during the exposure period, both in M and H schools. The indicator was set at the average consumption of FV assessed at the beginning and at the end of the study period.

METHODS

Design and Participants

In the 2010/11 school year, we randomly selected samples from M and H schools who already participated in the 2009/10 Health Behaviour in School-aged Children (HBSC) study [30, 31]. In the M schools, the intervention was characterised by the use of educational packages for students and families, while the intervention in the H schools was characterised by the use of educational packages and fresh FV offer in the vending machines for students and teachers. FV consumption was assessed with self-administered FV-questionnaire (FV-Q) at the beginning (t_0) and end of the intervention (t_1) in both I and C schools. To select the subjects we used a cluster sampling method. The length of time between t_0 and t_1 was three months. Here, the primary sampling unit consisted of the classrooms selected according to a systematic procedure from the list of M and H school (public and private) of the five participating regions, and sorted alphabetically. For each school, one class was selected based on the levels of education desired in the project. An second school was also selected as reserve in case of non-acceptance by the first choice school.

The classes were classified according to age, and assigned to the groups of 'I' through a process of randomization. Previous a conservative estimation of 25 students per class, presumably 1000 students of "I" and 1000 of "C" group, both in M and H schools, would expect to be surveyed. Then, schools (classes) were matched between the first and the final detection. After the process of recruitment and compliance 2195 students in M and 2023 students in H schools were involved. For accuracy of our estimation, we evaluated on the expected frequency of 0.5 for a binomial random variable of ± 1.54% with IC of 95%.

Questionnaire

The questionnaire consisted of 20 questions and included four sections covering the followings:

- Personal data (age, gender, height, weight, nationality)
- Knowledge
- Attitudes
- Behaviour

Specially trained teachers and Local Health Unit personnel administered the questionnaires in the school classrooms. The responses on attitudes and knowledge were recorded in a six-point scale that ranged from extremely confident to not confident. The questionnaire was drawn up using validated questions by other study [30-32].

Educational Packages

Educational instruments such as "*Forchetta e scarpetta"* and "*Open mind"* were used to stimulate the interest and to develop skills in students towards a healthy lifestyle.*"Forchetta e scarpetta"* (book and DVD), edited by the project "OKKIO alla Salute" [32] consists of five different educational units: breakfast, fruit and vegetables, healthy eating, sedentary and movement. It was also accompanied by a handbook for teachers.*"Open mind"* (DVD), edited by research group, consists of three different educational units: healthy diet, consumption of FV and physical activity. It is also accompanied with a handbook for teachers.

Healthy Vending Machines in H Schools

Specific agreements were signed with the vending machines company to instal new vending machines showing details of products offered, prices and graphic kits with healthier food choices in I schools. The intervention time was originally designed to span throughout the school year. However, because of the complexity and the long time needed to edit and sign the agreement, the stocking of vending machines was only for three months, from February to May 2010.

Special graphics kits were designed to ensure the fresh healthy vending and increase students' access to healthy food and beverage options. Refrigerated healthy vending machines offered the following options: fresh fruit salads, fresh fruit, baby carrots, sugar-free fruit pulp, fruit yogurt, dried fruit, snack parmesan cheese and crackers, tarallino extra virgin olive oil (dry bagel), gluten-free rice crackers, cereals bars, biologic snack, sugar-free fruit smoothie, water, 100% and 70% fruit juice, UHT white milk and chocolate milk. Additionally, fresh fruit salads, fresh fruit and baby carrots were offered at 30% price reduction, to encourage the choice of healthy foods compared to unhealthy snacks [33, 34].

Statistical Analyses

The all categorical variables were expressed in number of cases (%), and the continuous variables with mean (SD). The normality of distribution variables was checked by the test Kolmogorov-Smirnov. The chi square's test was performed to compare the proportions in independent groups, while the t-test for paired groups and independent groups were performed for comparing the means. To evaluate the changes in knowledge, attitudes and behaviours, the factorial analysis was implemented with the principal components extraction method. The Varimax method was applied. To draw the number factors was used the Gutmann's method and the explained variance. The factorial scores were estimated with the regression method. The comparisons between factorial scores, were done by the t-test for independent and paired groups. Results with $p<0.05$ were considered as statistically significant. The analysis was performed with SPSS (v.20.0).

RESULTS

Anthropometric Characteristics

Data was obtained from a total sample of 3408 students. Table **1** presents the anthropometric characteristics (age, weight, height and BMI) of the two groups (M and H schools) for the two arms (I and C). No difference is highlighted, and the two groups appear to be homogeneous with respect to the variables considered.

FV Consumption

The distribution of the FV mean consumption in M and H schools is shown in Table **2**.

First (t_0) vs. second survey (t_1) in 'I' and 'C' classes

Table 1: Partecipants and Antropometric Data

Characteristic	Intervention	Control	Totale paired
Middle school			
n	857	936	1793
Age	12.1 (0.5)	12.1 (0.5)	12.1 (0.51)
Weight	48.4 (10.0)	48.2 (9.9)	48.3 (10.0)
Height	156.5 (8.8)	156.8 (9.0)	156.5 (9.8)
BMI	19.7 (3.2)	19.6 (3.4)	19.8 (5.5)
High school			
n	833	782	1615
Age	16.3 (0.6)	16.2 (0.6)	16.3 (0.6)
Weight	61.8 (11.5)	63.7 (12.0)	62.7 (11.8)
Height	169.6 (8.4)	171.1 (8.9)	170.4 (8.7)
BMI	21.3 (2.8)	21.6 (3.1)	21.4 (3.0)

The continuous variables are expressed with mean (SD).

Table 2: Distribution of FV Mean Consumption in M and H Schools

	Intervention		Control		Interv vs. Contr
Characteristic	**Basal (t_0)**	**3 month (t_1)**	**Basal (t_0)**	**3 month (t_1)**	
Middle school					
fruit	1.74 (1.12)	[a]1.86 (1.10)	1.72 (1.12)	1.72 (1.11)	[b]0.12 (0.05)
vegetables	1.11 (0.90)	[a]1.29 (0.94)	1.15 (0.87)	[a]1.22 (0.97)	[b]0.11 (0.04)
High school					
fruit	1.41 (0.99)	[a]1.54 (1.00)	1.41 (0.98)	1.41 (0.95)	[b]0.12 (0.04)
vegetables	1.01 (0.77)	[a]1.15 (0.79)	1.04 (0.80)	[a]1.12 (0.84)	0.05 (0.04)

The continuous variables are expressed with mean (SD); [a] t-Student, basal vs. 3 month, $p<0.05$; [b] t-Student, intervention vs. control, $p<0.05$.

Middle Schools

At baseline (t_0) 105 classes were involved, and a total of 2,195 questionnaires were completed and returned; at end (t_1) 102 classes completed a total of 2,107 questionnaires. After cleaning data and pairing the questionnaires, we got a total of 97 classes out of 105 (92.4%) with 1,793 questionnaires divided into 47 I-classes (857 completed questionnaires) and 50 C-classes (936 completed questionnaires). After three months of intervention, the consumption of fruit significantly increased only in the I-group (1.74 vs. 1.86, $p<0.05$), while the consumption of vegetables increased significantly in both groups: in I-group (1.11 vs. 1.29, $p<0.05$), and in the C-group (1.15 vs. 1.22, $p<0.05$) (Table **2**).

High Schools

At baseline (t_0), 96 classes were involved, and a total of 2,023 questionnaires completed and returned; at the end (t_1) 92 classes completed a total of 1,864 questionnaires. After cleaning data and pairing the questionnaires, we got a total of 89 classes out of 96 (92.7%) with 1,615 questionnaires divided into 45 I-classes (833 completed questionnaires) and 44 C-classes (782 completed questionnaires). After three months of intervention, we found the similar trend as observed for the M schools; the consumption of fruit increased significantly in the I-group (1.41 vs. 1.54, $p<0.05$), while the consumption of vegetables significantly increased both in the I-group (1.1 vs. 15.1, $p<0.05$) and C-group (1.04 vs. 1.12, $p<0.05$) (Table **2**).

Variations in Schools: Intervention vs. Control

Middle Schools

Comparing the variations between the two measurements for the two groups, we observed an increase of 0.12 of fruits and 0.11 of vegetables consumption in the I-group, which is significantly higher compared to the C-group ($p<0.05$) (Table **3**).

High Schools

Comparing the variations between the two measurements for the two groups, we observed increase only in fruits consumption in the I-group, which is significantly higher compared to the C-group (0.12, $p<0.05$) (Table **3**).

Table 3: Distribution of Children who Eat FV 5 a Day (F 3; V 2)

Characteristic	Intervention		Control		Interv vs. Contr
	Basal (t_0)	**3 month (t_1)**	**Basal (t_0)**	**3 month (t_1)**	
Middle school					
Fruit (3t/day)	138 (16.1)	[a]179 (20.9)	126 (13.5)	143 (15.3)	[b]3.0
Vegetables (2t/day)	172 (20.1)	[a]233 (27.2)	209 (22.3)	206 (22.0)	[b]6.8
High school					
Fruit (3t/day)	87 (10.4)	[a]110 (13.2)	89 (11.4)	76 (9.7)	1.1
Vegetables (2t/day)	183 (22.0)	[a]228 (27.4)	164 (21.0)	181 (23.1)	[b]3.3

The variables are expressed with number of cases (%); [a] chi-square, basal (t0) vs. 3 month (t1), $p<0.05$; [b]chi-square, intervention vs control, $p<0.05$.

Consumption of FV According to Recommendations

Table **3** presents the distribution of children according to the proper consumption of FV as recommended by the guidelines (Food: three portions a day; Vegetable: two portions a day).

First (t_0) vs. second survey (t_1) in 'I' and 'C' classes

Middle Schools

Three months after the intervention, the fruits consumption (16.1% vs. 20.9%, p<0.05) as well as vegetables consumption (20.1% vs. 27.2% p<0.05) increased significantly only in the I-group.

High Schools

Three months after the intervention, we found the similar trend both in the I and M-schools; the fruit consumption (10.4% vs. 13.2%, p<0.05) as well as vegetable consumption (22.0% vs. 27.4%, p<0.05) increased significantly in the I group .

Variations in Schools: Intervention vs.Control

Middle Schools

Comparing the variations between the two measurements for the two groups, we observed significantly higher increase in fruit (3.0%) and vegetable (6.8%) consumptions in the I-group compared to that of the C-group (p<0.05).

High Schools

Unlike the middle school, we observed a significant increase only in the vegetable consumption (3.3%) in the I-group when compared to the C-group (p<0.05).

Knowledge, Attitudes and Behaviour

The results derived from the factor analysis performed for the two groups (M and H schools) are presented in Tables **4** and **5**.

Middle Schools

In M schools, we found a statistically significant difference only in the behaviour of I-group between the first (t_0) and second (t_1) survey (p=0.03). No statistically significant difference was observed in the C-group.

High Schools

In H schools, there was no statistically significant difference between the first (t_0) and second (t_1).

DISCUSSION

Based on the baseline survey, the results of this study revealed that despite public health recommendations, M and H students in Italy eat less

Table 4: Knowledge (K), Attitudes (A) and Behavior (B) of Middle School' Students

	[a]BASAL (t_0)				[b]3 MONTH (t_1)			
	K	**A**	**B**	**Comunalities**	**K**	**A**	**B**	**Comunalities**
How often you consume the vegetables?			0.85	0.73			0.87	0.77
How often you consume the fruit?			0.80	0.66			0.86	0.75
You think you should eat fruit at least once a day?	0.86			0.75	0.89			0.79
You think you should eat vegetables at least once a day?	0.80			0.69	0.86			0.78
I don't want to peel the fruit		0.78		0.66		0.78		0.51
The school fellows don't use to eat fruit in the play time		0.69		0.56		0.69		0.62
Eingevalue	1.19	1.05	1.81		1.25	1.03	1.95	
Explained variance	19.81	50.02	30.21		20.76	17.14	32.44	
Explained cumulative variance (%)	50.02	67.59	30.21		53.20	70.34	32.44	
Cronbach α	0.64	0.20	0.57		0.72	0.18	0.68	

[a]KMO measure of sampling adequacy =0.50.
[a]Bartlett's test of sphericity: χ^2 = 1075.62 (df=15; p<0.001).
[a]Determinant of correlation matrix = 0.54.
[b]KMO measure of sampling adequacy =0.50.
[b]Bartlett's test of sphericity: χ^2 = 1558.09 (df=15; p<0.001).
[b]Determinant of correlation matrix = 0.48.

Table 5: Knowledge (K), Attitudes (A) and Behavior (B) of High School' Students

	[a]BASAL (t_0)				[b]3 MONTH (t_1)			
	K	**A**	**B**	**comunalities**	**K**	**A**	**B**	**comunalities**
How often you consume the vegetables?			0.81	0.70			0.85	0.76
How often you consume the fruit?			0.80	0.66			0.84	0.73
You think you should eat fruit at least once a day?	0.85			0.74	0.88			0.79
You think you should eat vegetables at least once a day?	0.78			0.69	0.85			0.78
I don't want to peel the fruit		0.63		0.73		0.78		0.52
The school fellows don't use to eat fruit in the play time		0.82		0.49		0.70		0.62
Eingevalue	1.08	0.95	1.97		1.08	1.06	2.06	
Explained variance	18.07	15.83	32.89		18.00	17.58	34.42	
Explained cumulative variance (%)	50.95	66.78	32.89		52.42	70.00	34.42	
Cronbach α	0.63	0.17	0.58		0.69	0.20	0.66	

[a]KMO measure of sampling adequacy =0.51.
[a]Bartlett's test of sphericity: χ^2 = 1163.5 (df=15; p<0.001).
[a]Determinant of correlation matrix = 0.48.
[b]KMO measure of sampling adequacy =0.49.
[b]Bartlett's test of sphericity: χ^2 = 1527.19 (df=15; p<0.001).
[b]Determinant of correlation matrix = 0.38.

than the amount recommended for European children's FV consumption [10,35]. After the intervention, we observed an increment in FV intake for students in both M and H schools. In M-schools, fruit consumption significantly increased only in I-group, while vegetable consumption significantly increased in both I- and C-group(s), but the increase was significantly higher in I-group compared to C-group in both fruit and vegetable consumptions. Like M-school, fruit consumption significantly increased only in I-group for H-schools, with significant difference compared to the C-group. However, vegetable consumption significantly increased both in I and C group(s), not significantly higher in I-group compared to C-group. Despite the short duration of the use of the vending machines in the H schools (use of the educational package and FV offering by vending machines), we observed an increment in FV intake for both M (only educational intervention) and H schools. Our findings are in agreement with a recent systematic review, which concluded that the school-based interventions moderately improve fruit intake, but have minimal impact on vegetable intake [15,36]. Regarding the complex market aspects linked to the use of vending machines in school, a pilot project in Ontario evidences that replacing 50% of vending stock with healthier snacks resulted in a decline in vending revenues [37]. In order to avoid such impact of these economic aspects and at the same time to have a successful intervention, following Krølner and Rasmussen [18] we ensured to provide variety (see the options in methods), visibility (transition zone inside the school and specially designed graphics kits), quality (sugar-free, biologic, low-fat) convenience (fresh fruit salads, fresh fruit and baby carrots were targeted for 30% price reduction), time (always available) and methods of preparation (ready to use).

Relating the ambitious objective of this study to increase the prevalence of students who consume at least one portion of the fruit and vegetables a day, we observed a significant increment of the fruits and vegetables consumption for both M and H school students. However, the increase was less than one portion a day. This could be due to the brief intervention time. One could reach a hypothetical increment, which is more consistent and permanent when the intervention time is longer. According to the literature the most effective interventions to promote increasing of fruit and vegetable consumption used clear messages, reinforced by multiple strategies and family involvement, with repeated contacts for a longer period of time [38]. The point of purchase information as well presents highly effectiveness in changing behaviour only when combined with a long intervention [13]. Regarding the impact of the intervention on the factors like knowledge, attitudes and behaviour, we

found a positive change only in the behaviour of the students in I-group, in coherence with the consumption variations examined. The differences noted between M and H schools could be due to the different ages.

CONCLUSIONS

Despite the brief duration of the interventions in M and H schools, we found a little but significant positive differences on FV consumption in I-groups. According to the literature, an intervention which is more continuous can produce better and more permanent results. Based on our findings, we believe that it is important to create a more strict collaboration between school and public health personnel in charge with the economic sector of vending, aimed at further improving the FV and healthy foods offering. An important role must be played by the policy decision makers at national, regional and local levels to favour a different rules and organizations of the vending, even through e.g. a more diffusion of the healthy foods supplies. Approving, launching and applying policies that discourage junk foods and encourage healthy foods, could contribute to the affirmation of the good choices of the citizens, especially the young generation.

Basing on the our experience and others examined from the literature decision makers in public health must promote interventions over a long period of time, well methodological an theoretical structured and open to input from target groups. This is the first study which undertook the offerings of fruits and vegetables at such a large scale through the vending machines at schools in five regions. Several vending companies signed the agreement to revise the list of healthy snacks offered to eliminate those clearly classified as junk foods.

COMPETING INTERESTS

The authors declare that they have no competing interests. All authors were involved in the implementation of the study as well as read and approved the final manuscript.

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APPENDIX

The Research Group Project.

Italian Ministry of Health: Daniela Galeone (project coordinator), Maria Teresa Menzano, Maria Teresa Scotti; Toscana: Emanuela Balocchini (technical coordinator), Mariano Vincenzo Giacchi (scientific coordinator, University of Siena), Annamaria Giannoni (Regional coordinator), Valentina Pilato, Rita Simi, Andrea Pammolli, Giacomo Lazzeri, Margherita Primi, Daniela D'Angelo; Marche: Giordano Giostra and Elisabetta Benedetti (Regional coordinators), Simona Deintrona, Eufemia Ciarallo; Campania Region: Elvira Lorenzo and Cecila Mutone (Regional coordinators); Puglia: Savino Anelli, Maria Giovanna Rosa and Elisabetta Viesti (Regional coordinators), Roberto Carlà; Sicilia: Simonetta Rizzo and Maria Paola Ferro (Regional coordinators). Regional schools coordinators: Francesca Balestri (Toscana), Rosanna Catozzo (Marche), Bruno Galzerano (Campania), Maurizio Gentile (Sicilia).

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