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The role of primary school teachers' nutrition training in healthy eating promotion

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Abstract

Background: The prevalence of overweight and obesity in childhood makes intervention imperative, and schools provide a privileged setting in which to undertake this work. Teachers have the potential to influence children's eating behaviour through nutrition education and by acting as positive role models. We conducted a case–control study in 14 primary schools in Italy to assess the impact of a nutrition training programme (NTP) for primary school teachers on school children's eating habits.

Methods: From participating schools, 11 volunteer teachers attended the NTP (trained teachers; TT), and as a control, we identified a group of teachers (untrained teachers; UT) who did not attend the NTP but who were interested in participating in the study. The effect of NTP intervention was evaluated on 599 children in the TT group and 536 in the UT group, respectively, using the KidMed questionnaire to assess adherence to a Mediterranean diet.

Results: Overall adherence to a Mediterranean diet was low in 24.3%, medium in 56.6% and high in 19.1% of the children's population, with an overall median score of 5 (−3 to 12). Compared with the UT group, children in the TT group had a significantly higher adherence to a Mediterranean diet (Wilcoxon test *p*-value = .012) and showed significantly healthier habits regarding fast-food consumption, the eating of sweets and breakfast composition.

Conclusions: Study findings demonstrate the efficacy of an indirect intervention for primary school children through intensive nutrition training for teachers. When planning future nutrition education in primary school, the role models offered by teachers should drive the interventions developed.

Keywords

Dining hall, Mediterranean diet, nutrition training programme, teachers, schoolchildren

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Background

Over the past 40 years, the prevalence of overweight and obesity in childhood has increased in almost all parts of the world (Di Cesare et al., 2019). In the World Health Organization's (WHO) European region today, one child in three is overweight or obese (Nittari et al., 2019). In the coming years, socioeconomic inequalities and transitions in eating patterns could further increase this prevalence in lower-middle-income countries (Di Cesare et al., 2019; Tremmel et al., 2017). This scenario is troubling with regard to health consequences both in childhood and later during adulthood.

Several chronic non-communicable diseases are strongly related to obesity, including type 2 diabetes, cardiovascular disease, asthma, obstructive sleep apnoea and some forms of cancer (Llewellyn et al., 2016; Umer et al., 2017). Furthermore, childhood obesity is linked to the increased risk of mental health problems, reduced self-esteem and lower quality of life (Bleich et al., 2018; Sutaria et al., 2019). There is growing evidence that childhood overweight and obesity often persist in adulthood, increasing morbidity and mortality risks. In addition to the substantial reduction in quality of life, people with obesity incur medical costs approximately 30% higher than people of healthy weight, creating an economic burden on healthcare systems (Geserick et al., 2018; Simmonds et al., 2016). International guidelines state that healthy eating is essential for good development in children, contributing to maintaining normal weight and protecting against the development of chronic non-communicable diseases (Weihrauch-Blüher et al., 2018). Given the seriousness of the situation, WHO (2014) has set the target of 'no increase in childhood obesity by 2025' as part of the Comprehensive Implementation Plan for Maternal, Infant and Young Child Nutrition.

Several studies have shown how eating habits and patterns acquired during childhood may influence whole lifespan eating behaviours (Dudley et al., 2015). In 1986, the Ottawa Charter for Health promotion stated that 'Health is created and lived by people within the settings of their everyday life; where they learn, work, play, and love'. According to this statement, the settings in which children 'learn, work, play and love' are among the most suitable for health educational interventions and are ideal for overweight and obesity prevention efforts (Gerritsen et al., 2016). School time is a major part of children's daily routine, and in Italy school lunches often supply one-third of daily calories (Ministero della Salute, 2010; Linee di Indirizzo Nazionale per la Ristorazione Scolastica). Moreover, most children attend school regularly for several months every year, allowing for protracted intervention. Finally, school infrastructures, environments and staff have been shown to positively affect child eating habits and health (Dudley et al., 2015; Llargués et al., 2017).

Several studies have reported statistically significant changes in eating habits and favourable effects following school-driven educational interventions (Archero et al., 2018; Micha et al., 2018; Roccaldo et al., 2017). Among the environmental factors in schools, teachers, as role models, especially in primary school settings, have the power to influence children's eating behaviour through nutrition education, the avoidance of unhealthy practices and positive role modelling. Previous studies revealed that to induce behaviour change in students, teachers need to be trained on various nutrition topics and feel confident about their ability to deliver nutrition education (Hall et al., 2016; Metos et al., 2019). Trained teachers (TT) can be key partners in helping children develop knowledge and skills, and in improving eating habits. Different intervention strategies have been tested, and a teachers' 'enhanced curriculum' approach seems to be the most effective (Bleich et al., 2018; Dudley et al., 2015). TT can develop activities related to healthy eating, integrated with games or cooking workshops, without affecting scheduled teaching programmes. In addition, TT who share lunchtime with their students have the opportunity to act as positive role models. Nutrition research has demonstrated that when teachers model positive behaviours such as

consuming fruit and vegetables, or avoiding sugar-sweetened beverages, students are more likely to adopt these behaviours (Hall et al., 2016; Laguna et al., 2020; Perikkou et al., 2013).

According to numerous studies and PREDIMED results, the Mediterranean diet offers an ideal approach to healthy eating (Kargin et al., 2019). The abundance of vegetables, fruit, whole cereals, legumes and extra-virgin olive oil, and the low intake of sweets and trans fatty acids, typical of a Mediterranean diet, exert a protective effect, reducing the risk of several diseases, including cardiovascular diseases, type 2 diabetes, hypertension and some cancers (Rees et al., 2019; Schwingshackl et al., 2017). Moreover, a Mediterranean diet can reduce weight gain and promote long-term weight loss (Mancini et al., 2016). Healthy eating is beneficial at all ages, but in childhood it lays the foundations for later well-being, growth and cognitive development (Buja et al., 2019).

Despite the established benefits of a Mediterranean diet, in the past few years, a move towards a 'Western Diet' model has been observed in many people living in the Mediterranean area, with an increase in consumption of simple carbohydrates, saturated fats and processed foods (Archero et al., 2018; Ricci et al., 2014). Tailored strategies to promote continued adherence to healthy eating models such as the Mediterranean diet represents a public health priority. Informed by these considerations, this study aimed to evaluate the effects of a nutrition training programme (NTP) for primary school teachers in modulating schoolchildren's eating habits.

The study was conducted in Brescia in the North of Italy and the effectiveness of the intervention was evaluated using the validated KidMed Questionnaire, in which higher values are indicative of better adherence to a Mediterranean diet and good diet quality (García Cabrera et al., 2015).

Methods

Participants and Procedure

This study was carried out as part of the *Alimentarsi – Impariamo mangiando* (Feeding Yourself – Learning while You Eat) nutrition project,[1] launched by the Brescia Municipality during the 2015 World EXPO Feeding the Planet, Energy for Life event and further developed by a Scientific Committee in 2016 in partnership with the Brescia Municipality, *Servizi per il Diritto allo Studio, Servizio Mensa*. General topics addressed as part of the Alimentarsi project included a focus on local food and diverse food traditions, healthy eating habits, food supply chain management, reducing food waste, food safety and sustainability, and surplus food redistribution. As part of the project, an NTP called *Conoscere l'alimentazione per educare* (knowing about nutrition to educate) was developed for teachers at public primary schools in the Brescia municipality area. The course, totally free and recognised by the Italian *Ministero dell'Istruzione, dell'Università e della Ricerca* (MIUR, 2020), provided participants with training credits. From among local primary school teaching staff, a group of 11 volunteers attended a 50-hour *Conoscere l'alimentazione per educare* NTP and took a final exam during the 2016–2017 school year. The course was organised in collaboration with Brescia University and the Catholic University of Brescia, and included three modules as follows:

- Nutrition and health (consisting of eight lessons covering basic nutritional knowledge, healthy eating patterns with particular focus on a Mediterranean diet, non-communicable diseases and food safety principles);
- Taste, cultures and food sustainability (comprising six lessons on sensory analysis, the sustainable food chain, eating patterns, food recycling and waste reduction);
- Communication methods towards nutrition education and informed choices (consisting of six lessons on food advertising and labels, and communication skills).

Subsequently in the 2017–2018 school year, the 11 volunteers attended an 18-hour additional course to enhance their ability to teach other teachers about healthy eating and promote positive eating behaviour, and to strengthen interpersonal and professional relationships through the co-planning of nutrition education interventions for primary school students. These 11 volunteer teachers attended the courses outside working hours and obtained a supplementary curriculum training certificate. During the same school year, volunteer teachers, hereafter referred to as TT, conducted a variety of self-structured nutrition education interventions with the children they taught. Besides classroom learning, they organised food laboratories, cooking activities and games to translate the nutrition knowledge acquired during NTP into practical activities integrated into usual d teaching programmes. Importantly, TT acted as the providers of nutrition information to students, parents and colleagues. All spent lunchtime with their students, spontaneously modelling positive eating behaviours.

As a control, from among the primary schools actively involved in the Alimentarsi project, we identified a group of teachers, hereafter referred to as untrained teachers (UT), who did not attend the *Conoscere l'alimentazione per educare* NTP, but who were still interested in participating in the study.

During the 2017–2018 school year, teachers from both the trained and control groups taught in the third, fourth and fifth year classes[2] of 14 different primary schools in the city of Brescia and took lunch with their students in the school dining hall. Schools actively involved in the project were evenly distributed throughout the municipal area (Figure 1).

Schools where teachers followed the NTP are identified as 1–7 and schools where teachers did not attend an NTP from 8 to 14 (Table 1). Children attending schools 1–7 were named the TT group, and children attending schools numbered 8–14 were named the UT group. Both TT and UT children were involved in the Alimentarsi project, and the effect of the teacher training was assessed by comparing the eating habits of the TT group schoolchildren with those of the UT schoolchildren. All the activities related to the Alimentarsi project, including the KidMed (Mediterranean diet Quality Index for children and adolescents) questionnaire, were submitted for parental approval during annual meetings with teachers. The research team was unaware of the students' identities.

Instruments

To evaluate children's eating habits, we estimated adherence to a Mediterranean diet using the KidMed questionnaire. This instrument is self-administered and focuses on specific food habits characteristic of the Mediterranean region (Serra-Majem et al., 2004). KidMed scores are calculated from responses to 16 yes/no questions concerning the consumption of fruit, vegetables, fish, legumes, pasta and rice, cereals, grains, olive oil, yoghurt, cheese and sweets. Some specific questions about breakfast and fast-food habits are also included.

One point was assigned for each 'yes' response regarding healthy food habits, and one point was deducted for responses representing unhealthy eating habits. The total score can range from −4 to 12, and Mediterranean diet adherence is categorised as follows. A score of $\geqslant 8$ reflects optimal adherence to a Mediterranean diet; 4–7, medium adherence; and $\leqslant 3$, a low diet quality based on Mediterranean diet D principles. We used a validated Italian version of the KidMed questionnaire (Archero et al., 2018; Spinelli and Nardone, 2016). Questionnaires were distributed after the conclusion of the school programme, which included the self-structured educational activities (in the TT group) or the regular school programme (in the UT group). The questionnaires were completed by children in the presence of teachers, who were not allowed to influence children's answers, but were available to assist in comprehending the questions. Data were collected between February 2018 and April 2018.

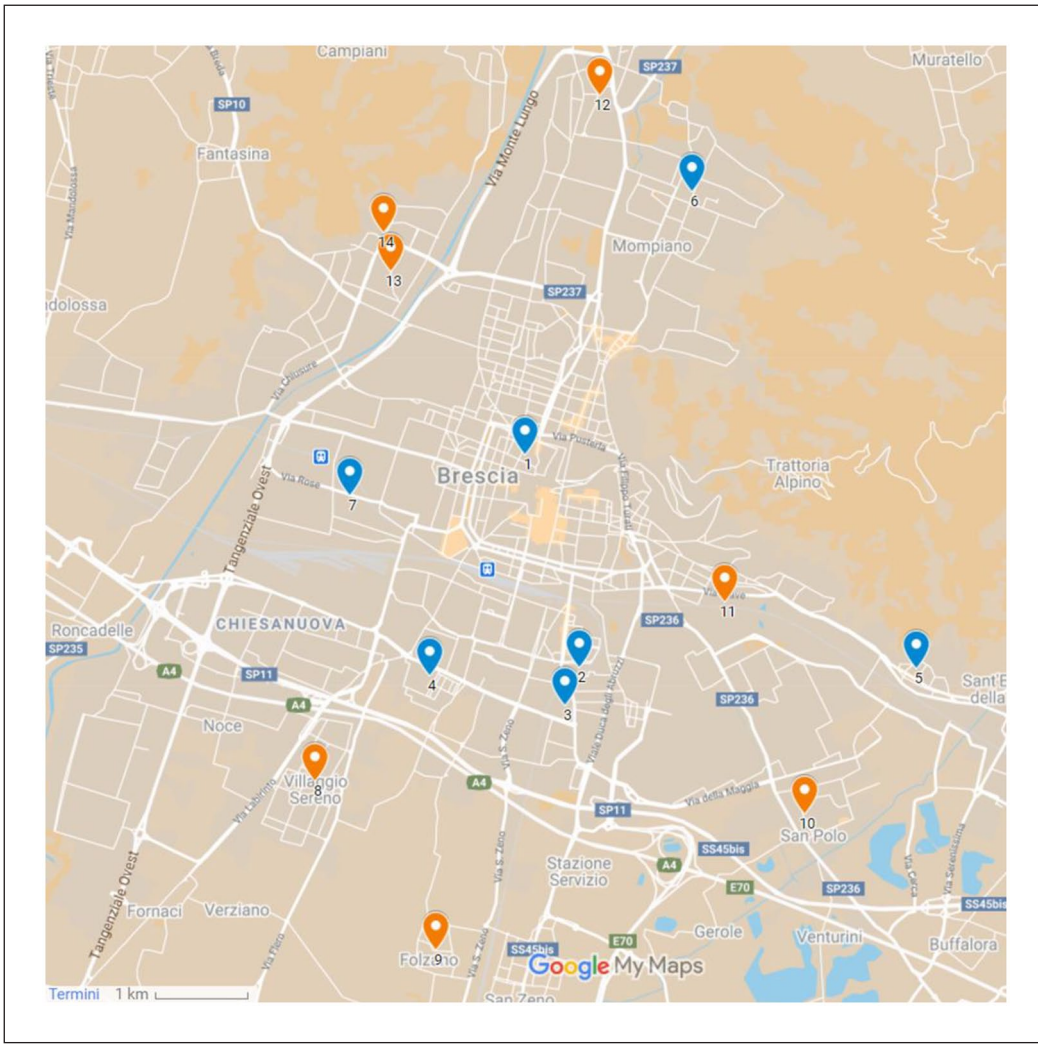

Figure 1. Location of schools in the municipal area of Brescia. Schools 1–7 were TT schools and schools 8–14 were UT schools.

Data analysis

We computed the following descriptive statistics: means, standard deviations (SDs), medians, first and third quartile (Q1 and Q3 respectively), and range (min–max). For qualitative variables, absolute numbers and percentages (%) were calculated.

To test whether subsamples originated from the same distribution, we used the non-parametric Wilcoxon (two subsamples) or Kruskal–Wallis tests (more than two subsamples). In the case of the second text, when p-values were significant ($<.05$) we checked the results obtained by conducting a post hoc analysis with Holm correction (Codenotti et al., 2016; Dancelli et al., 2013; Marziano et al., 2019; Salvi et al., 2019).

Table 1. Descriptive statistics for the sample.

	School description			Gender		Class level		
	School code	Number of involved classes	Number of students	Number of girls (%)	Number of boys (%)	3rd year (%)	4th year (%)	5th year (%)
TT	1	3	47	18 (38.3)	29 (61.7)	0	0	47 (100.0)
	2	6	130	64 (49.2)	66 (50.8)	0	66 (50.8)	64 (49.2)
	3	2	39	19 (48.7)	20 (51.3)	0	19 (48.7)	20 (51.3)
	4	6	99	47 (47.5)	52 (52.5)	0	54 (54.5)	45 (45.5)
	5	5	91	51 (56.0)	40 (44.0)	41 (54.0)	23 (25.3)	27 (29.7)
	6	6	143	67 (46.9)	76 (53.1)	0	65 (45.5)	78 (54.5)
	7	5	50	23 (46.0)	27 (54.0)	0	26 (52.0)	24 (48.0)
TT-Total	**7 schools**	**33**	**599**	**289 (48.2)**	**310 (51.8)**	**41 (6.8)**	**253 (42.2)**	**305 (50.9)**
	School code	Number of classes involved	Number of students	Number of girls (%)	Number of boys (%)	3rd year (%)	4th year (%)	5th year (%)
UT	8	6	126	57 (45.2)	69 (54.8)	0	61 (48.4)	65 (51.6)
	9	3	59	30 (50.8)	29 (49.2)	17 (28.8)	21 (35.6)	21 (35.6)
	10	4	72	34 (47.2)	38 (52.8)	0	27 (37.5)	45 (62.5)
	11	5	103	44 (42.7)	59 (57.3)	0	55 (53.4)	48 (46.6)
	12	5	84	37 (44.0)	47 (56.0)	28 (33.3)	20 (23.8)	36 (42.9)
	13	2	39	20 (51.3)	19 (48.7)	0	22 (56.4)	17 (43.6)
	14	3	53	30 (56.6)	23 (43.4)	0	21 (39.6)	32 (60.4)
UT-Total	**7 schools**	**28**	**536**	**252 (47.0)**	**284 (53.0)**	**45 (8.4)**	**227 (42.3)**	**264 (49.3)**

TT: trained teachers; UT: untrained teachers.

To test differences between proportions in the two subgroups, we used a *z*-test with Yates continuity correction.

The most significant associations between the KidMed Index and selected qualitative variables are represented by means of boxplots, where the title reports the *p*-values obtained when the Wilcoxon or Kruskal test was applied to the data. Each graph also reports the median value of the KidMed Index (represented by a red dashed line). In this way, it is clear which subgroups show better Mediterranean diet adherence compared with the median value of the entire population.

Human subjects approval

The study was carried out as a part of the Alimentarsi project, and all the activities, including the evaluation of eating habits, gender and age, were described in detail to children's parents during annual meetings with teachers. Parents gave their oral agreement for the participation of their children in the programme. In accordance with European General Data Protection Regulations (GDPR – EU 2016/679), and feedback from the *Comitato Etico della Provincia di Brescia*, the anonymous nature of data collection and the research team's inability to access sensitive personal data meant that the study did not require formal ethics approval.

Results

The study involved 1135 children aged from 8 to 11 years (median = 10; $M \pm SD = 9.542 \pm 0.820$), of which 599 were in the TT group (representing 52.8% of the whole sample) and 536 were in the UT group (47.2%). In relation to gender, 541 were girls (47.7% of the sample) and 594 were boys (52.3%). Descriptive statistics for the entire sample are presented in Table 1: gender and class distribution are reported for each school involved. The gender balance in the TT group was comparable to the UT group, and there was no statistically significant difference between the two groups (data not shown).

The percentage of students attending the 3rd, 4th and 5th class levels in the TT group was also comparable to the percentages of the UT group, and there was no statistically significant difference between the two groups (data not shown).

In Table 2, KidMed's responses for the TT and UT group and for the whole sample can be found. The difference between the TT group's answers and the UT group answers achieved

Table 2. KidMed responses.

Variables in KidMed answers	TT group (*N* = 599)	UT group (*N* = 536)	Number of students (*N* = 1135)	*p*-value
Consumption of fruit or fruit juice once a day				.397
N-Miss	1	0	1	
No	197 (32.9%)	164 (30.6%)	361 (31.8%)	
Yes	401 (67.1%)	372 (69.4%)	773 (68.2%)	
Consumption of a second fruit or fruit juice every day				.795
N-Miss	1	0	1	
No	329 (55.0%)	299 (55.8%)	628 (55.4%)	
Yes	269 (45.0%)	237 (44.2%)	506 (44.6%)	
Consumption of raw or cooked vegetables once a day				.670
N-Miss	0	2	2	
No	207 (34.6%)	191 (35.8%)	398 (35.1%)	
Yes	392 (65.4%)	343 (64.2%)	735 (64.9%)	
Consumption of raw or cooked vegetables more than once a day				.234
N-Miss	1	1	2	
No	364 (60.9%)	344 (64.3%)	708 (62.5%)	
Yes	234 (39.1%)	191 (35.7%)	425 (37.5%)	
Consumption of fish at least 2–3 times a week				.495
N-Miss	3	1	4	
No	282 (47.3%)	264 (49.3%)	546 (48.3%)	
Yes	314 (52.7%)	271 (50.7%)	585 (51.7%)	
Eating more than once a week at a fast-food restaurant				<.001
N-Miss	1	1	2	
No	497 (83.1%)	394 (73.6%)	891 (78.6%)	
Yes (items with a negative score [−1])	101 (16.9%)	141 (26.4%)	242 (21.4%)	

(Continued)

Table 2. (Continued)

Variables in KidMed answers	TT group ($N=599$)	UT group ($N=536$)	Number of students ($N=1135$)	p-value
Consumption of beans more than once per week				.168
N-Miss	1	0	1	
No	289 (48.3%)	281 (52.4%)	570 (50.3%)	
Yes	309 (51.7%)	255 (47.6%)	564 (49.7%)	
Consumption of pasta or rice almost every day (⩾5 times a week)				.772
N-Miss	3	0	3	
No	192 (32.2%)	177 (33.0%)	369 (32.6%)	
Yes	404 (67.8%)	359 (67.0%)	763 (67.4%)	
Consumption of cereals or grain (bread, etc.) for breakfast				.034
N-Miss	4	1	5	
No	244 (41.0%)	253 (47.3%)	497 (44.0%)	
Yes	351 (59.0%)	282 (52.7%)	633 (56.0%)	
Consumption of nuts at least 2–3 times a week				.141
N-Miss	8	2	10	
No	342 (57.9%)	332 (62.2%)	674 (59.9%)	
Yes	249 (42.1%)	202 (37.8%)	451 (40.1%)	
Consumption of olive oil at home				.869
N-Miss	1	0	1	
No	64 (10.7%)	59 (11.0%)	123 (10.8%)	
Yes	534 (89.3%)	477 (89.0%)	1011 (89.2%)	
Skipping breakfast (Negative item)				.749
N-Miss	3	4	7	
No	517 (86.7%)	458 (86.1%)	975 (86.4%)	
Yes (items with a negative score [−1])	79 (13.3%)	74 (13.9%)	153 (13.6%)	
Consumption of dairy products at breakfast (yoghurts, milk, etc.)				.063
N-Miss	0	0	0	
No	177 (29.5%)	132 (24.6%)	309 (27.2%)	
Yes	422 (70.5%)	404 (75.4%)	826 (72.8%)	
Consumption of commercially backed goods or pastries at breakfast				.518
N-Miss	1	0	1	
No	155 (25.9%)	130 (24.3%)	285 (25.1%)	
Yes (items with a negative score [−1])	443 (74.1%)	406 (75.7%)	849 (74.9%)	
Consumption of 2 yoghurts and/or cheese (40 g) daily				.588
N-Miss	3	1	4	
No	410 (68.8%)	360 (67.3%)	770 (68.1%)	
Yes	186 (31.2%)	175 (32.7%)	361 (31.9%)	
Consumption of sweets several times every day				<.001
N-Miss	1	1	2	
No	422 (70.6%)	315 (58.9%)	396 (35.0%)	
Yes	176 (29.4%)	220 (41.1%)	737 (65.0%)	

statistical significance in relation to eating at a fast-food restaurant ($p < .001$), the consumption of cereals or grains for breakfast ($p = .034$), and the daily consumption of sweets ($p < .001$).

The schools involved in the project were evenly distributed across the municipal area. Both TT and UT schools were present in each of the five zones of Brescia City (north, south, west, east and centre). Regarding family composition, TT and UT groups were broadly similar. However, the percentage of the foreign citizens was significantly higher in the TT schools compared with the UT schools (Table A in the supplementary data; $p = .02$; *Comune di Brescia, Servizi, Indagini Statistiche*[3]).

Overall, adherence to Mediterranean diet was low (KidMed Index $\leqslant 3$) in 24.3%, medium (KidMed Index between 4 and 7) in 56.6% and high (KidMed Index $\geqslant 8$) in 19.1% of the whole population. The overall KidMed's median score was 5, ranging from −3 to 12, and the $M \pm SD$ was 5.280 ± 2.502. In Table 3, we report Mediterranean diet adherence for the TT group (Schools 1–7) and the UT group (Schools 8–14). We observed that in schools where teachers had been trained, the percentage of children with high adherence to a Mediterranean diet was 21%, while in UT schools only 17% of the students reached that figure. Low adherence to a Mediterranean diet was recorded by 22.4% of the TT students, while in the UT group, 26.5% of students reported this same result. These differences, grouped by high and low adherence, did not reach statistically significance (p-values with the two-proportions z-test were .0879 and .1219, respectively).

Figure 2(a) shows the boxplots stratified for the 14 schools involved in the analysis: light blue represents the schools in the TT group, while grey represents the schools in the UT group. Red

Table 3. Mediterranean diet adherence, according to the three different thresholds of KidMed Index, in TT and UT schools.

	TT			
	Low $N = 134$ (22.4%)	Medium $N = 339$ (56.6%)	High $N = 126$ (21%)	Total $N = 599$
School code (TT)				
1	14 (29.8%)	23 (48.9%)	10 (21.3%)	47
2	30 (23.1%)	72 (55.3%)	28 (21.5%)	130
3	5 (12.8%)	29 (74.3%)	5 (12.8%)	39
4	25 (25.2%)	57 (57.6%)	17 (17.2%)	99
5	15 (16.5%)	56 (61.5%)	20 (22.0%)	91
6	40 (28.0%)	72 (50.3%)	31 (21.7%)	143
7	5 (10.0%)	30 (60.0%)	15 (30.0%)	50
	UT			
	Low $N = 142$ (26.5%)	Medium $N = 303$ (56.5%)	High $N = 91$ (17%)	Total $N = 536$
School code (UT)				
8	26 (20.6%)	73 (58.0%)	27 (21.4%)	126
9	19 (32.2%)	28 (47.4%)	12 (20.3%)	59
10	24 (33.4%)	42 (58.3%)	6 (8.3%)	72
11	42 (40.8%)	44 (42.7%)	17 (16.5%)	103
12	16 (19.0%)	55 (65.5%)	13 (15.5%)	84
13	8 (20.5%)	25 (64.1%)	6 (15.4%)	39
14	7 (13.2%)	36 (67.9%)	10 (18.9%)	53

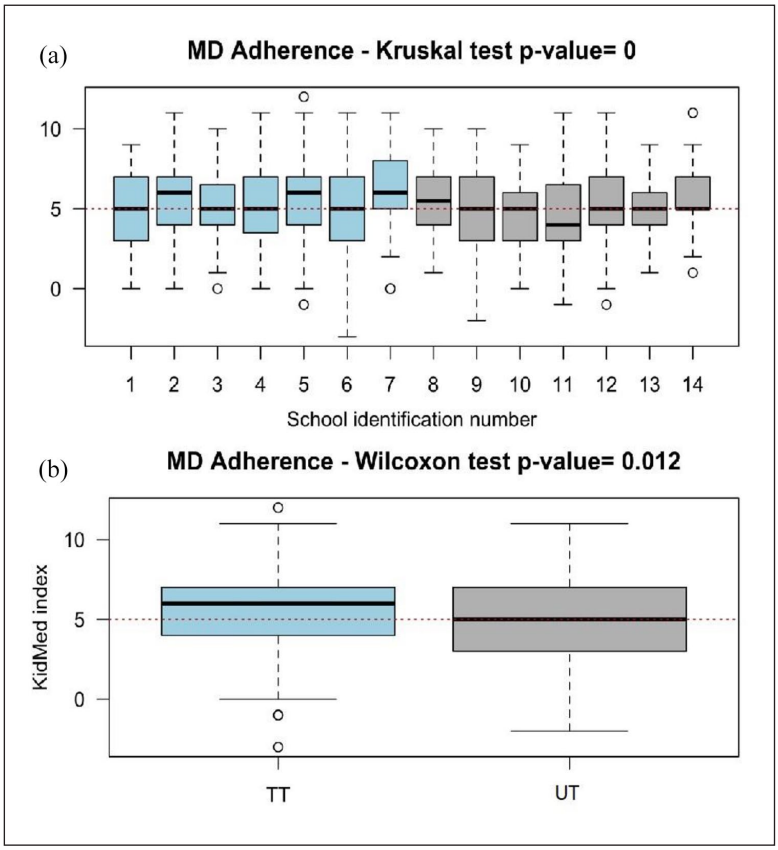

Figure 2. Boxplot on Mediterranean diet adherence stratified for: (a) schools, (b) trained teacher (TT) and control (untrained teacher, UT) group.

The two figures show boxplots on Mediterranean diet adherence as measured by KidMed Index score, stratified with respect to two different qualitative variables. In (a), Mediterranean diet adherence is stratified with respect the 14 schools involved in the analysis. In light blue are the TT schools; UT schools are in grey. A dashed red line identifies the median value of the KidMed Index computed using the entire sample. The table title reports a *p*-value = 0 for the Kruskal test. In post hoc analysis we found that School 7 (TT group) was significantly different from schools 10 and 11 (UT group) (*p*-value equals to .0004 and .0025, respectively). In (b), the KidMed Index score is stratified with respect to TT (light blue) and control UT groups (in grey). The dashed red line identifies the median value of KidMed Index computed for the entire sample. The table title reports the *p*-value = .012 for the Wilcoxon test result.

dashed lines indicate the median value of the KidMed Index, equal to 5, computed for the entire sample. The Kruskal test identified a significant relationship between the two sub-populations, TT versus UT schools, and the KidMed Index (Kruskal test *p*-value = 0). When focusing on single schools and employing post hoc analysis, we noted that Mediterranean diet adherence in school 7 (in the TT group) was significantly different to that in schools 10 and 11 (UT control group) (*p*-value equals .0004 and .0025, respectively). Analysing global adherence of the TT group versus the UT group to a Mediterranean diet using the Wilcoxon test, we found a significantly higher adherence to a Mediterranean diet in children whose teachers had participated in the NTP (Wilcoxon test *p*-value = .012; Figure 2(b)).

Table 4. Response distribution by group, gender, class and age.

	KidMed questions	Total (*N* = 1135)	Group		Gender		Class			Age			
			TT (*N* = 599)	UT (*N* = 536)	*F* (*N* = 517)	*M* (*N* = 578)	III (*N* = 131)	IV (*N* = 479)	V (*N* = 524)	8 (*N* = 118)	9 (*N* = 354)	10 (*N* = 479)	11 (*N* = 106)
1	**Consumption of fruit or fruit juice once a day**[1]	773 (68.2%)	401 (67.1%)	372 (69.4%)	363 (70.2%)	383 (66.4%)	**77 (58.8%)**	**324 (67.8%)**	**371 (70.8%)**	69 (58.5%)	240 (68.0%)	341 (71.2%)	69 (65.1%)
2	**Consumption of a second fruit or fruit juice every day**[1]	506 (44.6%)	269 (45.0%)	273 (44.2%)	233 (45.2%)	255 (44.1%)	56 (42.7%)	222 (46.4%)	228 (43.5%)	53 (44.9%)	158 (44.8%)	219 (45.7%)	43 (40.6%)
3	**Consumption of raw or cooked vegetables once a day**	735 (64.9%)	392 (65.4%)	343 (64.2%)	**353 (68.5%)**	**355 (61.4%)**	79 (60.8%)	304 (63.3%)	352 (67.2%)	71 (60.7%)	223 (63.2%)	322 (67.2%)	68 (64.2%)
4	**Consumption of raw or cooked vegetables more than once a day** [1]	425 (37.5%)	234 (39.1%)	191 (35.7%)	**219 (42.4%)**	**192 (33.3%)**	56 (42.7%)	172 (36.1%)	197 (37.6%)	54 (45.8%)	128 (36.3%)	175 (36.6%)	38 (35.8%)
5	**Consumption of fish at least 2-3 times a week** [1]	585 (51.7%)	314 (52.7%)	271 (50.7%)	**247 (48.0%)**	**323 (56.1%)**	61 (46.6%)	245 (51.6%)	279 (53.2%)	59 (50.0%)	184 (52.3%)	253 (53.0%)	57 (53.8%)
6	**Eating more than once a week at a fast-food restaurant**[2]	242 (21.4%)	**101 (16.9%)**	**141 (26.4%)**	**91 (17.6%)**	**141 (24.4%)**	**31 (23.7%)**	**118 (24.7%)**	**93 (17.8%)**	27 (22.9%)	83 (23.4%)	91 (19.1%)	21 (19.8%)
7	**Consumption of beans more than once per week**[1]	564 (49.7%)	309 (51.7%)	255 (47.6%)	**274 (53.1%)**	**275 (47.6%)**	57 (43.5%)	243 (50.7%)	264 (50.5%)	56 (47.5%)	175 (49.4%)	251 (52.5%)	53 (50.0%)
8	**Consumption of pasta or rice almost every day (⩾5 times a week)**[1]	763 (67.4%)	404 (67.8%)	369 (67.0%)	356 (69.1%)	382 (66.2%)	81 (61.8%)	315 (65.9%)	366 (70.1%)	72 (61.0%)	230 (65.2%)	338 (70.7%)	75 (70.8%)
9	**Consumption of cereals or grain (bread, etc.) for breakfast**[1]	633 (56.0%)	**351 (59.0%)**	**282 (52.7%)**	294 (57.0%)	309 (53.8%)	71 (54.2%)	264 (55.2%)	297 (57.1%)	64 (54.2%)	180 (51.0%)	283 (59.3%)	56 (53.3%)
10	**Consumption of nuts at least 2–3 times a week**[1]	451 (40.1%)	249 (42.1%)	202 (37.8%)	213 (41.4%)	225 (39.4%)	52 (39.7%)	205 (43.2%)	194 (37.4%)	50 (42.4%)	143 (41.0%)	191 (40.1%)	35 (33.3%)

(Continued)

Table 4. (Continued)

KidMed questions	Total (*N* = 1135)	Group		Gender		Class			Age			
		TT (*N* = 599)	UT (*N* = 536)	*F* (*N* = 517)	*M* (*N* = 578)	III (*N* = 131)	IV (*N* = 479)	V (*N* = 524)	8 (*N* = 118)	9 (*N* = 354)	10 (*N* = 479)	11 (*N* = 106)
11 **Consumption of olive oil at home**[1]	1011 (89.2%)	534 (89.3%)	477 (89.0%)	**472 (91.5%)**	**502 (86.9%)**	112 (85.5%)	424 (88.5%)	474 (90.6%)	99 (83.9%)	317 (89.5%)	433 (90.4%)	95 (90.5%)
12 **Skipping breakfast**[2]	153 (13.6%)	79 (13.3%)	74 (13.9%)	64 (12.5%)	81 (14.1%)	**5 (3.8%)**	**78 (16.4%)**	**70 (13.5%)**	**6 (5.1%)**	**44 (12.5%)**	**67 (14.1%)**	**24 (22.9%)**
13 **Consumption of dairy products at breakfast (yoghurts, milk, etc.)**[1]	826 (72.8%)	422 (70.5%)	404 (75.4%)	378 (73.1 %)	422 (73.0%)	98 (74.8%)	352 (73.5%)	375 (71.6%)	89 (75.4%)	256 (72.3%)	363 (75.8%)	73 (68.9%)
14 **Consumption of commercially backed goods or pastries at breakfast**[2]	849 (74.9%)	443 (74.1%)	406 (75.7%)	382 (73.9%)	437 (75.7%)	102 (77.9%)	351 (73.4%)	396 (75.6%)	**93 (78.8%)**	**246 (69.5%)**	**378 (79.1%)**	**73 (68.9%)**
15 **Consumption of 2 yoghurts and/or cheese (40 g) daily**[1]	361 (31.9%)	186 (31.2%)	175 (32.7%)	156 (30.2%)	195 (33.9%)	39 (30.0%)	146 (30.5%)	176 (33.7%)	36 (30.8%)	102 (28.8%)	170 (35.7%)	32 (30.2%)
16 **Consumption of sweets several times every day**[2]	396 (35.0%)	**176 (29.4%)**	**220 (41.1%)**	173 (33.6%)	210 (36.3%)	43 (32.8%)	166 (34.7%)	186 (35.6%)	40 (33.9%)	118 (33.3%)	172 (36.0%)	43 (41.0%)

Numbers and percentage were referred to 'yes' answers; the table reports the distribution of 'yes' answers by trained teachers (TT) and untrained teachers (UT) group, gender (female, F; male, M), class (III; IV; V) and age (8; 9; 10; 11); bold characters refer to statistically significant results.

[1]Items with a positive score (+1).

[2]Items with a negative score (−1).

Regarding dietary habits, our analysis of the KidMed Questionnaire (Table 4) showed that 68.2% of children regularly consumed one portion of fruit a day, but only 44.6% took a second serving of fruit or juice (−34.6%). For comparison, 64.9% of children ate raw or cooked vegetables once a day, while additional portions of vegetables were consumed only by 37.5% of the population (−42.2%). Fish and legumes were regularly eaten by 51.7% and 49.7% of participants, respectively, likewise consuming nuts two or three times a week by 40.1% of participants, In all, 67.4% of students involved used to eat pasta or rice almost every day and, for breakfast, 56% of the same population consumed cereal or grains. Many of the children (89.2%) consumed olive oil at home, and most of them (72.8%) had dairy products such as milk or yoghurt for breakfast. Concerning items with a negative score, eating at a fast-food restaurant more than once a week was reported by 21.4% of participants. Furthermore, 74.9% of the population used to eat commercially baked goods or pastries for breakfast, while 13.6% of children skipped breakfast. Finally, 35% of the participating children reported the frequent consumption of sweets (Table 4).

Subsequent analysis of responses, grouped according to TT and UT groups, showed that schoolchildren in the TT group had a significantly lower frequency of eating at fast-food restaurants ($p < .001$) and of consumption of sweets, in comparison to the UT group ($p < .001$). Children in the TT group showed a significantly higher consumption rate of cereals and bread for breakfast, than UT schoolchildren ($p = .034$) (Table 4).

Table 4 shows the analysis of the KidMed Questionnaire's answers by gender, class attended and age. We observed that raw or cooked vegetable consumption was significantly higher in girls than boys, both daily (68.5% vs 61.4%; $p = .014$) and weekly (42.4% vs 33.3%; $p = .02$). Girls tended to eat more legumes than boys (53.1% vs 47.6%; $p = .068$) and to consume significantly more olive oil at home (91.5% vs 86.9%; $p = .015$). In contrast, boys ate significantly more fish than girls (56.1% vs 48.0%; $p = .007$). Comparison of results by gender showed significantly better adherence to a Mediterranean diet among girls than boys. The median values for both were equal to 5, but the Wilcoxon test showed the existence of two sub-populations (Wilcoxon test; $p = .007$). This result was due to higher variability in the male subgroup: the interquartile difference was 4 for boys and 3 for girls, while the range was 15 for boys and 12 for girls (Figure 3(a)).

The stratification of answers according to class attended showed a significant increase in fruit consumption going through the third and the fourth, to the fifth class (58.8% vs 67.8% vs 70.8%; $p = .030$), and a significantly lower frequency of eating at fast-food restaurants ($p = .023$). Interestingly, we observed a significant tendency to skip breakfast as the class increased ($p < .001$), confirmed by the stratification of answers according to students' age. In detail, we found a significant increase in the percentage of students who were used to skipping breakfast as they aged from 8 to 11 years (5.1% vs 12.5% vs 14.1% vs 22.9%; $p = .001$). Further analysis of responses in relation to students' age showed a significant reduction in the consumption of commercially baked goods or pastries for breakfast, in line with the growth of the children from 8 to 11 years of age ($p = .005$) (Table 4).

The Kruskal test analysis on the KidMed Index, stratified according to age and class attended, demonstrated a tendency (not significant) to increase Mediterranean diet adherence with an increase in a student's age (p-value = .225; see Figure 3(b) and (c)).

Discussion

The worldwide prevalence of overweight and obesity in children, associated with a general reduction in quality of life and predicting increased morbidity and mortality risks during adulthood, makes intervention imperative. International guidelines emphasise how healthy eating habits and

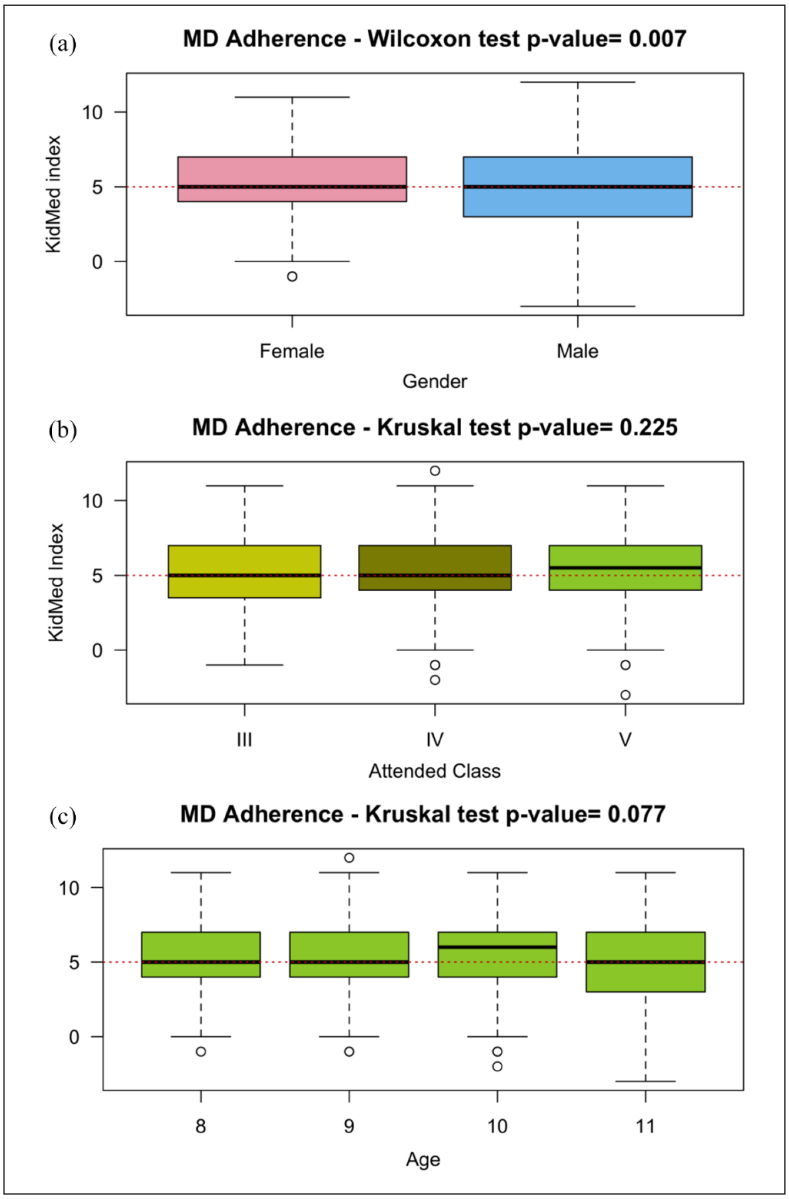

Figure 3. Boxplot on Mediterranean diet adherence, according to KidMed Index Score. Boxplot on Mediterranean diet adherence, as measured by the KidMed Index score, stratified for: (a) gender, (b) class attended and (c) age.

The three figures report boxplots on Mediterranean diet adherence, according to KidMed Index score stratified respect two different qualitative variables. In (a), Mediterranean diet adherence is stratified by gender. The dashed red line identifies the median value of the KidMed Index computed for the entire sample. The Wilcoxon test showed the existence of two sub-populations (Wilcoxon test; $p = .007$). This was due to major variability in the boys subgroup: the interquartile difference was 4 (3–7) for boys and 3 (4–7), for girls, while the range was 15 (−3; 12) for boys and 12 (−1;11) for girls. In (b), Mediterranean diet adherence is stratified by class attended. The dashed red line identifies the median value of KidMed Index computed for the entire sample. The table title reports the p-value = .225 computed with the Kruskal test. In (c), Mediterranean diet adherence is stratified by age. The dashed red line identifies the median value of KidMed Index computed for the entire sample. The title reports the p-value = .077 computed using the Kruskal test.

active lifestyles are essential for the balanced development of children, and to protect them against chronic non-communicable disease (WHO, 2014; Wolfenden et al., 2016). In a recent longitudinal study, researchers found that overweight and obesity manifested early in childhood persisted throughout adolescence and into adulthood (Geserick et al., 2018). According to this finding and previous results, interventions to establish healthy lifestyle habits early in life, at primary school age, could be a favourable strategy for health promotion.

The large ZOOM8 study, evaluating Mediterranean diet adherence among the entire population of Italian children (8- to 9-year-olds), found poor overall adherence, with only 5.0% of children being 'high adherers' (Mediterranean diet score ⩾8). Of note, the ZOOM8 study also identified a North–South trend in adherence, with higher KidMed scores in large cities in the north of Italy (Roccaldo et al., 2014; Studio ZOOM8, n.d.). Adherence to Mediterranean diet throughout the entire population (good 19.7%, medium 56.2%, and low 24.1%), living in Brescia (http://demo.istat.it/index.php) was roughly comparable to that recently observed in Novara, another northern Italian city (good 19.0%, medium 60.3%, low 20.7%) (Archero et al., 2018).

Comparing our analysis with previous studies, we found conflicting results in terms of the influence of age on Mediterranean diet adherence. Archero et al (2018) observed an improvement in eating habits with increasing age, while Iaccarino-Idelson et al. (2017) reported the opposite trend. Similarly contrasting results were obtained in terms of the influence of gender: Rosi et al. (2020) observed significantly better adherence to a Mediterranean diet among girls compared with boys, yet other studies did not find any significant associations (Bonaccorsi et al., 2020). In our population, we observed a significant increase in KidMed scores from the third to fourth and fifth classes and we found that girls showed significantly better adherence to a Mediterranean diet than boys.

In this study, we analysed the impact of an indirect intervention to reach schoolchildren and improve their eating habits through their teachers, who had been trained in a 2-year structured NTP. A recent investigation supported by the Italian Ministry of Education, University and Research evaluating the nutrition education at all school levels, showed that, although healthy nutrition is perceived as a fundamental aspect of educational plans, with more than 70% of Italian schools describing nutrition education activities, most teachers manage this task independently. Approximately 60% of the teachers involved in the report declared individually seeking out nutrition education materials from national projects and websites without attending a specific training programme (*Ministero dell'Istruzione, dell'Università e della Ricerca*). In our study, after completing a structured NTP, teachers were able to engage their students in a range of nutrition education activities, making use of the nutrition knowledge and skills acquired during the courses.

The similarity between the TT and the UT children groups in gender balance and class level distribution suggests that these two external factors did not affect the efficacy of the teachers' training programme. All the schools involved in the present project were urban public institutions, with a homogeneous age structure. A strength of our study was the self-completion of the KidMed Questionnaire by the students, without the involvement of parents. Notwithstanding these strengths, further investigation could involve parents or guardians in surveys about their eating and lifestyle habits and family socioeconomic circumstances.

Limitations

This study has some limitations. First, data collection took place in only one part of the country, limiting generalisability. Second, lack of measurement of eating habits before the NTP did not allow us to evaluate the efficacy of the intervention in promoting change within the same population. Third, the absence of anthropometric data on schoolchildren sets limits on what can legitimately be concluded about Mediterranean diet regarding nutrition education, before and after the

NTP. It would be interesting to know whether teachers felt more confident in their ability to deliver education about healthy eating after participating in the NTP. Finally, although a Mediterranean diet is widely recognised as a healthy dietary pattern by organisations worldwide, it is not the only approach advocated and other dietary regimes are worthy of investigation in future work.

Conclusion

This study revealed a link between nutrition education for teachers and reported changes in students' eating habits. These findings signal the importance of nutrition education for teachers as part of broader efforts to improve the health of schoolchildren. Although Italy has developed a National Surveillance System, *OkkioallaSalute*, with the aim of tackling childhood obesity, interventions focused on teachers remain lacking (Nardone et al., 2015). A primary goal of our project was to create a team of teachers, who are experts in nutrition education skills. As suggested by Toussaint et al. (2019), our results seemed to indicate that TT could not only improve their own health, but also promote healthy habits through classroom work and role modelling at lunchtime. The relationship between teachers and primary school students is important in creating a 'disposition to learn', which is not the case for many more external interventions (Howes and Smith, 1995; Peralta et al., 2016). The presence of nutrition-TT within the school staff holds potential to promote communication between the school, the family and the community with respect to healthy eating behaviour.

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Supplemental material

Supplemental material for this article is available online.

Notes

1. https://www.comune.brescia.it/servizi/provveditorato/progetti/Alimentarsi/Pagine/Presentazione-del-progetto.aspx
2. The pupils involved were between 8 and 11 years of age.
3. http://www.comune.brescia.it/comune/indaginistatistiche/Pagine/analisi-famiglie-per-tipologia.aspx

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