



Food safety and nutrition: Improving consumer behaviour

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ABSTRACT

Consumer awareness of food safety and nutrition is a major issue in relation to healthy lifestyles and disease prevention. Improper consumer food management has been implicated in a large number of cases of foodborne illnesses. To reduce the risk of foodborne illness, consumers must be willing to change behaviours that are not consistent with safe food storage and preparation practices. Change in such behaviours is strongly related to consumer knowledge of proper food handling practices. At the same time there is public consciousness of the role of diet in contributing to the health status, but this awareness has not led to sufficient improvement of eating habits. What people buy and eat and the way they manage food depends not only on the individual but also on social, cultural, economic, and environmental factors. Identifying an effective strategy to improve consumers' behaviour is a concern for politicians and health promoters. Non-targeted spreading of generic information is one strategy, but seems to be relatively unsuccessful. This paper describes an innovative and effective methodology to improve the level of consumer awareness towards healthier food choices and safer behaviours based on a holistic approach. This strategy could be adopted to better disseminate information regarding healthy foods on a large scale and at a relatively low cost, obtaining significant benefits in terms of primary prevention and contributing to the amelioration of food management at the consumer level.

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1. Introduction

In industrialised countries, where the problem of food security is generally absent, health problems related to food refer to two main factors: food safety and nutritional risks. Considering together these "food related" pathologies, the burden of disease in western countries is impressive (Havelaar et al., 2010).

The World Health Organization (WHO) and Food and Agriculture Organization (FAO) define a food commodity as safe when free from all hazards, which may make food injurious to the health of the consumers whether for chronic or acute consequences (FAO 2003). This concept may assume a number of conjugations that include both microbiological, chemical and physical hazards and nutritional aspects.

Foodborne diseases are a worldwide public health problem and have also acquired a significant relevance in developed countries following food safety crises that have interested Europe over the last few decades, such as the recent *E. coli* O104 outbreak (Rasko et al. 2011).

Zoonotic bacteria are the most common cause of foodborne diseases in Europe accounting for almost 50% (including bacterial toxins but not taking into account the unknown causative agents) of all verified foodborne outbreaks (EFSA, 2011). These infections are mainly acquired through the ingestion of contaminated food of animal origin, nevertheless other sources are also possible: direct contact with infected animals (including pets), consumption of vegetables and water contaminated by animals or food of animal origin (cross-contamination), environmental sources, or person-to-person transmission. According to the United States Department of Agriculture (USDA), foodborne illness costs the US economy \$10–83 billion per year (Mead et al., 1999). The Centers for Disease Control and Prevention (CDC) estimates that 76 million foodborne illnesses, including 325,000 hospitalizations and 5000 deaths, occur in the United States each year (FDA–CFR, 2004). No similar calculations are available for Europe as a whole, but an indication of the magnitude of costs could be taken from a recent paper which assessed total annual costs of illness and disease burden due to STEC O157 infection in Holland, the costs were estimated at €9.1 million and €4.5 million, respectively (Tariq, Haagsma, & Havelaar, 2011). Nonetheless the true economic impact of foodborne illnesses is difficult to quantify as a great percentage of these infections are

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unreported for several reasons, mainly due to the relatively mild symptoms that do not induce the infected people to visit a general practitioner (FCC Consortium, 2010).

At the same time developed countries face chronic diseases that are the result of unhealthy eating habits and of physical inactivity which lead to a high incidence of overweight people and to an obesity epidemic (CDS, 2003). Such behaviours not only produce detrimental effects on the health of individuals, but also create societal burdens such as social exclusion, loss of production and increased medical costs, among others, which pose a serious threat to social welfare.

In the prevention of major chronic degenerative diseases, the fundamental role of diet nutritional quality has been demonstrated by several scientific studies that examined the relationship between diet, overweightness, obesity and cancer, cardiovascular disease and diabetes (Kant, 2010). In Italy overweightness and obesity are common conditions that tend to increase with age and mainly affect poorer and less well educated people (Gallus et al., 2006).

The 2003 WHO report concluded that about 40% of reported foodborne outbreaks in the WHO European regions, over the previous decade, were caused by food consumed in private homes (WHO, 2003). The report cites several factors as “critical for a large proportion of foodborne diseases” including use of contaminated raw food ingredients, contact between raw and cooked foods, and poor personal hygiene by food handlers.

The safety measures taken by consumers, therefore, play a critical role in the prevention of foodborne illnesses as the consumption phase is the last step of the “from farm to fork” food chain and the only one beyond the official checks performed by the competent authorities involved in assuring food quality. Preventing food-related infections at the consumer level relies on a combination of good hygiene practices during food preparation, cooking and storage. Consumers have responsibilities dealing with purchasing, storage, food provision and processing and need to be conscious of the nature of and risks related to food product consumption.

The importance of implementing primary prevention by promoting correct behaviour in all age groups, prior to the onset of symptoms, is repeatedly emphasized in the international literature and strong empirical evidence suggests that tailoring messages to the recipients' individual needs is the most effective approach (Kreuter, Oswald, Bull, & Clark, 2000). In fact, even though a great deal of effort has been made to modify health-related behaviours by using educational campaigns which communicate general health messages, the effectiveness of these kind of campaigns still remains unclear (Glanz, Sallis, Saelens, & Frank, 2005).

Following such considerations, the “White Paper on food safety” by the European Commission gives a central role to consumer information on both food safety and nutritional aspects, as the essential prerequisite to guarantee informed choices (Commission of the European Communities, 2000).

In recent years, a significant amount of research, as reviewed by Snyder LB, has been carried out in order to identify strategies for modifying consumer hygiene during food management and it has been demonstrated that traditional theoretical approaches can raise awareness, but do not necessarily change behaviour (Snyder, 2007). If good hygiene practices (such as hand washing) are to become a universal norm, a multi-dimensional promotion, which engages the public, is needed to persuade people to change their behaviour (Elder, Ayala, Slymen, Arredondo, & Campbell, 2009).

The project presented in this paper is based on the principle that food has to be considered holistically, targeting both safety and nutritional aspects, since increased awareness in both sectors generally encourages healthy eating and good habits, and prevents acute and chronic diseases. This double intervention is innovative

in this sense and, to our knowledge, no other similar programs have been done in Italy.

Specifically, the aim of this work is to evaluate how the participation in a series of seminars covering different topics related to food safety and nutrition, produce modifications in behaviour and awareness of consumers. Moreover, the research allowed us to collect data on Italian consumer behaviour, which will be useful for further studies and risk assessments.

2. Methods

2.1. Study design

Between December 2010 and May 2011 the Veneto Region (Italy) in collaboration with the Istituto Zooprofilattico Sperimentale delle Venezie, conceived a multi-dimensional health campaign called “Alimentinsalute” (Branca, Nikogosian, & Lobstein, 2006; Commission of the European Communities, 2007; DGRV n.4432/2007; DGRV n° 4434/2007; Mantovani et al., 2010; Spinelli, Lamberti, Baglio, Andreozzi, & Galeone, 2008; WHO, 2006), according to the EU Commission “White Paper on food safety” approach “from farm to fork” (Commission of the European Communities, 2000). The aim of the campaign was to improve knowledge of foodborne communicable and non-communicable diseases in order to reduce the risk related to the *consumer phase*. The main communication goal was to guarantee transparent and complete information about food products, their nutritional components, production processes, their traceability and labelling, the risks related to incorrect storage and handling, and other information related to food seasonality and availability in the Veneto Region. The training programme was conducted by nutritionists and veterinarians expert in food safety, through public seminars that took place in the Vicenza province (North-East of Italy). A total of thirteen cycles of eight seminars for each cycle were conducted and a pre-test and post-test questionnaire was administered to participants in order to evaluate their knowledge and behaviour in relation to foodborne diseases and nutrition, before and after the campaign. The educational approach was specifically inspired by “habit theory” in which habit formation is an important part of behaviour change interventions because habitual behaviours are elicited automatically and are therefore likely to be maintained (Lally, Chipperfield, & Wardle, 2008). Lessons were frequent and aimed to promote healthy behaviour by giving advice on repetition of good practices in stable contexts and thereby fostering the development of automaticity. In fact repeating an eating or activity behaviour in a consistent context has been found to result in increased automaticity following an asymptotic curve (Lally, Wardle, & Gardner, 2011).

The intervention involved volunteers aged 20–92 years enrolled from among those who attended the adults and elders public University weekly program. Even though University courses are not only for elderly people, the majority of students were older than sixty-five, mainly retired, and played an active role in the care of their grandchildren while the parents worked.

Considering the increased level of general health of the population and better medical treatments, proportionally more of the elderly, with an active role in food purchasing and preparation, will be present in developed countries. These elderly are often more vulnerable to foodborne diseases and nutrition-related health problems as a result of a weakened immune system that increases the risks of complications and an intrinsic metabolic frailty (Havelaar et al., 2010). Nevertheless elderly people are rarely the target of health education campaigns and were never the target of such campaigns when they were young, even though it is well known that paying more attention to food management can reduce the incidence of age-related health problems.

The lessons were based on the following topics: i) the Mediterranean food pyramid in the context of the Italian national guidelines for healthy eating (INRAN, 2003), ii) the role of nutrition in non-communicable disease prevention, iii) the quality of food (seasonality, local food, organic food, Genetically Modified Organisms (GMO), iv) emerging foodborne pathogens and the role of consumers in risk reduction, v) risks connected with ready-to-eat vegetable consumption, vi) proper food preparation, cooking and storage, vii) the Hazard Analysis and Critical Control Points (HACCP) principles in the food chain control and, finally, viii) media literacy education: the role of the media in the manipulation of consumer's food choices. Teaching material consisting of multimedia, movies, gadgets and printed material, were sent to each participant at the end of each course cycle. An example of the teaching material was the interactive educational nutrition brochure called "Carrello intelligente" (Smart Shopper) which calculates weekly food and drink intake through self-evaluation questionnaire of eating habits. The consumer could then compare personal answers with the recommended weekly intake set out by the Italian guidelines for healthy eating. The brochure also contained a list of suggestions to practice healthy habits in the context of food safety.

2.2. Questionnaire, food safety outcomes and potential confounders

The same questionnaire, in the Italian language, was administered pre- and post each cycle. Due to defections that normally occur during long-term courses for elderly people who participate on a voluntary basis, not all the subjects who answered the pre-course questionnaire answered the post-course questionnaire. The questionnaire was divided into three main sections and is available on request. In the first part, information on respondents characteristics (age, gender, involvement in food purchasing and cooking, previous foodborne diseases) was collected; in the second part (22 items), called "food-safety", consumer behaviours as attitudes, hygiene and cooking practices were examined; in the third section (17 items), called "nutritional safety", food consumption frequency and eating habits were investigated. The "food-safety" questions were selected according to Medeiros et al. that identified an association between food handling errors and the most frequent foodborne illnesses (Medeiros, Hillers, Kendall, & Mason, 2001) while the nutritional part of the questionnaire had the form of a Food Frequency Questionnaire that takes into account the eating habits that increase the risk of overweight, obesity and the onset of diseases related to them.

A selection of questions useful for the study purpose were coded as categorical ordinal variables ranging from 1 (worst practice) to 4 (best practice). The items in the food safety section were totalled to give a food-safety score, ranging from 22 (worst practice) to 88 (best practice) and food consumption habits were totalled to give a nutritional safety score, ranging from 17 (worst habits) to 68 (best habits). As suggested by Medeiros et al. (Medeiros et al., 2001), in order to target practices most likely to result in illness, food-safety score was successively divided into 4 sub-groups (keep food at safe temperatures, adequate cooking, avoid cross-contamination and avoid foods from unsafe sources).

The *keep food at safe temperatures* sub-group ranged from 6 (worst practice) to 24 (best practice) and was composed of 6 items from the food-safety section.

The *adequate cooking* sub-group ranging from 6 (worst practice) to 24 (best practice) was composed of 6 items from the food-safety section and investigated consumer habits related to reading food tags and the way of cooking meat.

The *avoid cross-contamination* sub-group ranged from 5 (worst practice) to 20 (best practice) and was composed of 5 items from the food-safety section and considers consumer personal hygiene

before, during and after purchasing and cooking; proper food handling, which includes both hand hygiene and utensil hygiene involving the same pathogen risks.

The *avoid foods from unsafe sources* sub-group ranged from 5 (worst practice) to 20 (best practice) and was composed of 5 items from the food-safety section referred to ready-to-eat foods that are processed or produced in a way that does not inactivate pathogens.

Items concerning nutritional safety were divided into two groups: the healthy habits and the obesogenic behaviours.

The healthy habits group (12 items), ranging from 12 (worst habits) to 48 (best habits), in turn includes two sub-groups concerning the daily adequacy of meal distribution (3 items) and the weekly adequacy of food choice (9 items) respectively. The obesogenic behaviours group (5 items), ranging from 5 (worst behaviours) to 20 (best behaviours), includes factors within people's dietetic habits that are well known to contribute to weight gain.

2.3. Data entry and statistical analyses

Participants autonomously filled the questionnaires and self-reported responses were entered into an electronic database (Access 2009, Microsoft Corporation, Redmond, WA), and each entry was validated comparing the original questionnaires and the database records.

Categorical data were summarized as counts with percentages and continuous data as median with interquartile difference (IQD). Comparisons of variables across time (pre and post-course) were performed by Pearson Chi-squared test or by Kruskal–Wallis test as appropriate. To evaluate the effectiveness of the course and to study the difference in behaviour and awareness of consumers, an adjusted proportion (with the 95% confidence interval, 95%CI) of subjects with outcome scores higher than the median, considered before the intervention, were calculated using logistic regression models adjusting for potential confounders (gender, age, number of family members, responsibility for food purchasing, handling and cooking in the household). Comparisons of outcome scores (food safety that includes the four sub-groups scores and nutritional safety which includes healthy habits, daily adequacy of meals distribution, weekly adequacy of food choice and obesogenic behaviours sub-groups) over time (before and after the intervention) were evaluated.

3. Results and discussion

3.1. Demographics characteristics

A number of 746 questionnaires were administered, 595 of which were filled in the pre-course questionnaire and 151 in the post-course. More than half of the respondents were females (77.9% for the pre-course, 80.1% for the post-course), the median number of family members was 2 (Table 1), more than 94% of participants were responsible for food purchasing in the household and about 90% were responsible for food handling and cooking. Only 2% of participants reported to have had a confirmed foodborne disease.

3.2. Overall intervention effectiveness

The adjusted proportion of subjects that in the post-course reached a higher (or equal) score than the pre-course median increased from 47.6% to 60.5% in the case of food safety and from 45.3% to 59.2% for nutritional safety ($p < 0.001$) (Table 2).

Meta-analytic results identified the average change of behaviour to define health campaigns to be successful in an intervention community or group, from pre-campaign to post-campaign. The results showed that health communication campaigns that include the use of the mass media and avoid coercion have an average effect

Table 1
Sample demographic description.

	Pre-intervention (n = 595)	Post-intervention (n = 151)	p
Gender (female, %)	450 (77.9)	121 (80.1)	0.545 ^a
Age median (IQD)	66 (60–72)	67 (62–75)	0.034 ^b
Number of family members (median, IQD)	2 (2–4)	2 (1–3)	0.010 ^b
Responsible for the food shopping in the household (%)	525 (94.1)	142 (97.3)	0.126 ^a
Responsible for food handling and cooking (%)	520 (91.2)	140 (92.7)	0.559 ^a

^a Pearson Chi-square test.^b Kruskal-Wallis test.

of about 5 percentage points ($r = 0.05$) in USA (Snyder, 2001) and reach the same range of success on average in Europe (Grilli, Ramsay, & Minozzi, 2002). Starting from this consideration our results, that show an average effect of 10 percentage points, clearly demonstrate the success of the intervention both in the food safety and nutritional safety contexts. In fact, coherently with previous studies, our results clearly show a shift of the median value that increased from 67 in the pre-test to 69 in the post-test and from 48 to 50 for food safety and nutritional safety respectively (Fig. 1). A total shift of the distribution towards higher scores in the post-test can also be observed, as indicated in Fig. 1.

As shown in Fig. 1, both the food safety and nutrition safety score distributions are shifted versus higher values even in the pre-course phase. This means that before the course consumers already had a good level of awareness of the safe food management practices and the healthy food intake. However, they were still able to ameliorate their awareness as a consequence of acquired knowledge on the risks connected with unhealthy food habits.

This result could be explained also by considering that consumers enrolled in this study were volunteers that autonomously decided to follow a training programme, showing greater sensitivity towards these topics and probably higher motivation to change compared to the average population.

The level of consumer awareness appears to be different between males and females. In fact females started the course with a high level of concern about food safety issues while males lacked awareness of the practices required for safe food preparation but at the end of the course a similar score level was reached by both

Table 2
Changes* in the outcomes scores before and after the intervention.

Scores	Pre-intervention		Post-intervention		p-values
	%	[95%CI]	%	[95%CI]	
Safety-food	47.6	[43.3–52.0]	60.5	[51.7–68.6]	0.010
Nutritional safety	45.3	[40.9–49.7]	59.2	[50.5–67.4]	0.006
Avoid cross-contamination	26.1	[22.4–30.2]	38.2	[30.2–47.0]	0.007
Avoid foods from unsafe sources	33.0	[29.1–37.3]	34.6	[26.9–43.2]	0.736
Adequate cooking	46.0	[41.7–50.3]	50.4	[41.8–59.0]	0.374
Keep food at safe temperatures	45.6	[41.3–49.9]	57.5	[48.8–65.7]	0.017
Virtuous habits	58.0	[53.9–62.0]	67.2	[58.6–74.7]	0.057
Daily adequacy meals	67.1	[63.1–70.9]	66.7	[58.1–74.3]	0.916
Weekly food choice	53.7	[49.7–57.7]	64.8	[56.2–72.6]	0.024
Obesogenic behaviors	57.7	[53.6–61.6]	67.8	[59.2–75.3]	0.037

*Expressed as proportion (with the 95%CI) of subjects with an outcome score higher than median calculated before intervention, obtained through logistic regression models adjusting for age, gender, sample size, number of family members, responsible for the food shopping in the household, responsible for food handling and cooking. The bold values represent the p-values that are statistically significant ($p < 0.05$).

genders (data not shown). Anyway the female change can still be counted as a success because they have been able to improve on an already good situation. The improvement can be observed both for the food safety and the nutrition safety sections.

In particular the major statistically significant differences ($p < 0.05$) observed for the food safety section are related to the following items:

- reading the labels information concerning cooking and conservation of food products available in the market;
- safe usage of kitchen utensils in order to avoid cross-contamination;
- the correct usage of food packaging materials with the aim of improving food conservation.

As far as the nutritional safety context is concerned, the main changes ($p < 0.05$) regarded the increase of fruit and vegetables daily consumption, the decrease of saturated fatty snacks consumption and the improvement of olive oil use instead of butter and/or margarine.

3.3. Food-safety intervention effectiveness

The food safety intervention effectiveness was separately assessed for each of the four proposed sub-groups:

3.3.1. Avoid cross-contamination

This section has largely been focused on the importance of hand washing to decrease foodborne diseases by suggesting the best practices (use of warm water and soap) and the length of hand washing during food preparation. At the same time theoretical instructions concerning cross-contamination prevention aimed to deal with the risk of food-contamination as the consequence of using unclean or not perfectly cleaned utensils previously used for the preparation of raw meat. As indicated in Table 2 a statistically significant increase in the score between pre- and post-test can be observed. The adjusted proportion of subjects with a Cross Contamination prevention score higher than the median (calculated from the pre-course responses) ranged from 26.1% (95%CI 22.4%–30.2%) in the pre-course to 38.2% (95%CI 30.2–47.0) in the post-course test ($p = 0.007$). This result shows that the issue was effectively dealt with and that participants were probably impressed by the given instruction and motivated to change.

3.3.2. Avoid foods from unsafe sources

This section was specifically dedicated to the transfer of information about the food production technologies stressing the concept of the importance of hazards analysis and critical control points (HACCP). Despite the application of HACCP rules, also ready-to-eat food eventually contains environmental bacteria that could potentially provoke human illness caused by unsafe consumer food management. As indicated in Table 2, in this case no relevant deviance between the pre- and post- course scores can be observed ($p > 0.05$). This effect might be explained considering that elderly do not routinely use ready-to-eat food, making it difficult to achieve a significant improvement towards risks connected with this topic.

3.3.3. Adequate cooking

This part was dedicated to emphasizing the importance of adequate cooking as a check mechanism to inactivate or kill zoonotic pathogens potentially present in food of animal origin such as meat, eggs and raw milk. Previous surveys conducted in Europe have shown that almost 90% of people recognized that undercooking is a risk factor associated with food poisoning (Redmond & Griffith, 2002) but only 20% knew which temperature should be

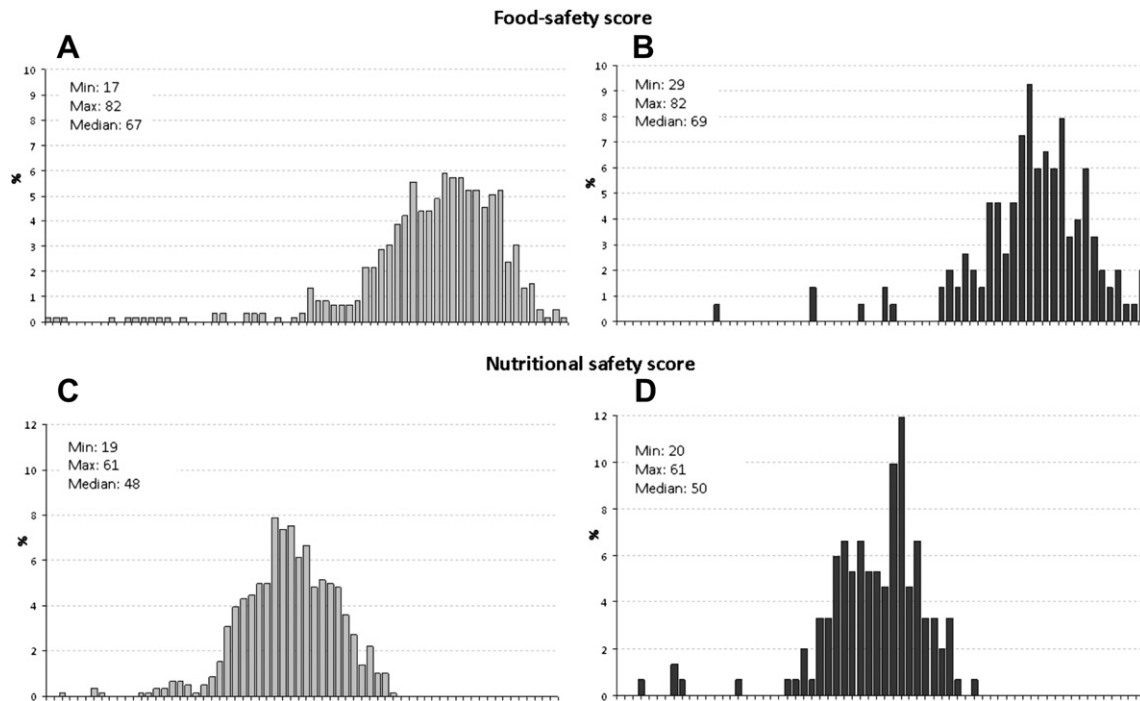


Fig. 1. Pre-intervention (light grey bars) and post-intervention (dark grey bars) distribution crude scores for *food safety* (A and B) and *nutritional safety* (C and D).

reached inside the food to consider it well cooked. In our case 80% of people declared that they have never eaten uncooked or not well cooked chicken or other meat, but less than 20% usually read the food labels in order to know the correct cooking suggestion. However the overall results for this section showed a high pre-intervention score but a not statistically significant score difference between pre- and post-intervention ($p = 0.374$).

3.3.4. Keep food at safe temperature

Numerous microbiological studies have demonstrated the presence of pathogenic bacteria in food prepared and consumed at home (Altekruse, Yang, Timbo, & Angulo, 1999; Byrd-Bredbenner, Schaffner, & Maurer Abbot, 2010; Mattik et al., 2003; Scott & Herbold, 2010). Pathogenic contamination of such foods indicates the importance of consumers being well aware of the storage practices in order to minimize the proliferation of microorganisms. Previously conducted studies found that few people knew the exact temperature at which chilled foods should be kept (13%) and on average only 30% of people know the correct temperature that a refrigerator should have (28). In addition a recent study performed by our Institute on a population of employers has demonstrated that the average fridge temperature is higher than which is intended to be safe ($0-4^{\circ}\text{C}$) (manuscript in preparation). In our study 14% and 25% of responders used cool shoppers to transport home refrigerated and frozen products respectively, and only 10% declared to never thaw food at room temperature. Nevertheless participants reached a high level of awareness at the end of the course (57.5%, 95%CI 48.8%–65.7%), as indicated in Table 2 ($p = 0.017$). This trend confirms the global success of the campaign in promoting a gain in awareness of practices that prevent foodborne illnesses.

3.4. Nutritional safety intervention effectiveness

The set of behaviours that meet the definition of healthy eating include not only the choice of healthy foods from a nutritional point

of view, but also their distribution in daily meals. For this reason it was decided to further group the healthy habits items into *daily adequacy of meals* items and *weekly adequacy of food choice*. Several studies have shown that the energy intake of normal and underweight persons is more evenly distributed throughout the day than that of the obese (Bellisle, Rolland-Cachera, Deheeger, & Guillaud-Bataille, 1988). Moreover breakfast consumption is directly correlated to body mass index (BMI), as breakfast eaters tend to have lower BMI than breakfast skippers (Gibson & O'Sullivan, 1995), and obese individuals are more likely to skip breakfast or consume less energy at breakfast (Ortega, Redondo et al., 1998; Ortega, Requejo et al., 1998; Summerbell, Moody, Shanks, Stock, & Geissler, 1996; Wolfe, Campbell, Frongillo, Haas, Melnick, 1994). For this reason skipping breakfast is not an effective way to manage weight and an "on-the-run" meal style may also lead to less healthy weight management. Our results showed that 81% of respondents habitually consume breakfast but less than 20% make snacking in the morning or in the afternoon.

Similarly, excessive portion size and high energy-dense foods or drinks can contribute to the calorific volume of energy intake (Rolls, Roe, & Meengs, 2006), while lack of time or motivation, laziness or injury may be reasons for insufficient energy expenditure (Egger, Pearson, Pal, & Swinburn, 2007). Within these broad factors, there are several specific factors that may influence an individual. For example, it could be presumed that some individuals might tend to favour particular foods, such as sweets and that the consumption of french fries, ice cream or savouries, or too much high energy soft drink or fruit juice, leads to a failure in the control of body energy balance (Egger et al., 2007). As indicated in Table 2, a statistically significant change in the participants' awareness towards weekly food consumption, the score of which increased from 53.7 to 64.8 ($p = 0.024$), can be observed. At the same time a significant decrease in obesogenic behaviours was detected, as suggested by the change in the outcome scores before and after the intervention. These two results clearly demonstrate the success of the intervention strategy in improving participants' awareness of

the role of appropriate food choices for a healthy lifestyle. On the other hand, as can be also seen in Table 2, behaviours related to daily adequacy of meals changed to a lesser extent than behaviours related to choosing healthy foods. This is probably due to the fact that daily temporal organization is more difficult to modify than the change in the qualitative composition of the diet. As suggested by Conner et al. because in many cases, meals are consumed at the same place and time, it can be assumed that eating timing behaviour is in large part habitual and for this reason less prone to be improved (Conner, Norman, & Bell, 2002).

4. Conclusions

Consumers are expected to be responsible for proper food management practices including storage and preparation of food in their home.

However, it has been reported that consumers are frequently unaware of their role in the prevention of foodborne diseases (Byrd-Bredbenner et al., 2007) and underestimate the incidence of foodborne diseases and the frequency of serious consequences. Consumer failure to associate domestic food handling practices with foodborne illnesses is considered a serious impediment in convincing them to change inappropriate food-handling practices (Parry, Miles, Tridente, Palmer, & South and East Wales Infectious Disease Group, 2004). Research shows that habitual behaviour is fundamentally different from non-habitual behaviour (Rothman, Sheeran, & Wood, 2009): enacting habitual behaviour appears to be more dependent on the environmental influences compared to enacting non-habitual behaviour, that is driven by intentional control. Consequently, traditional health educational approaches may be insufficient to change habitual behaviour (McIntosh, Christensen, & Acuff, 1994).

Moreover research on health-related behaviours suggest that individuals use rationality when they are aware of and have some knowledge about the cause-effect relationship between the correct behaviour and the health benefits (Mari, Tiozzo, Capozza, & Ravarotto, in press; Prochaska, 2008). However, knowledge acquisition alone does not automatically produce the corresponding behaviour, nor will it necessarily lead to appropriate changes in behaviour. Nevertheless, knowledge improvement allows consumers to make informed choices regarding their actions, so that the accuracy and the extent of acquired information could be of major significance. Finally, educational approaches based on targeting specific information by offering concrete examples and suggesting appropriate strategies aimed at changing unhealthy habits, may have greater chances of success.

For the above described reasons and on the basis of the achieved results the methodology described in this paper might be usefully adopted to disseminate health related information on a large scale at a relatively low cost, leading to significant benefit for primary prevention and contributing to the amelioration of food management at the consumer level.

References

- Altekruse, S. F., Yang, S., Timbo, B. B., & Angulo, F. J. (1999). A multi-state survey of consumer food-handling and food-consumption practices. *American Journal of Preventive Medicine*, 16, 216–221.
- Bellisle, F., Rolland-Cachera, M. F., Deheeger, M., & Guillaud-Bataille, M. (1988). Obesity and food intake in children: evidence for a role of metabolic and/or behavioral daily rhythms. *Appetite*, 11, 111–118.
- Branca, F., Nikogosian, H., & Lobstein, T. (2006). *The challenge of obesity in the WHO European Region and the strategies for response*. WHO Regional Office for Europe.
- Byrd-Bredbenner, C., Maurer, J., Wheatley, V., Schaffner, D., Bruhn, C., & Blalock, L. (2007). Food safety self-reported behaviors and cognitions of young adults: results of a national study. *Journal of Food Protection*, 70, 1917–1926.
- Byrd-Bredbenner, C., Schaffner, D. W., & Maurer Abbot, J. (2010). How food safe is your home kitchen? A self-directed home kitchen audit. *Journal of Nutrition Education and Behavior*, 42, 286–289.
- CDS—Centers for Disease Control, National Center for Chronic Disease Prevention and Health Promotion. (2003). Physical activity and good nutrition: essential elements to prevent chronic diseases and obesity. *Nutrition in Clinical Care*, 6, 135–138.
- Commission of the European Communities. White Paper on Food Safety, Brussels, 12 January 2000 COM (1999) 719 final.
- Commission of the European Communities. White Paper on a Strategy for Europe on Nutrition, Overweight and Obesity related health issues Brussels, 30.5.2007 COM(2007) 279 final.
- Conner, M., Norman, P., & Bell, R. (2002). The theory of planned behavior and healthy eating. *Health Psychology*, 21, 194–201.
- DGRV n° 4432/2007. Veneto Region Deliberation: “Attuazione dell’Unità di coordinamento per la sicurezza alimentare”, Delibera Giunta Regionale del Veneto.
- DGRV n° 4434/2007. Veneto Region Deliberation: “Tutela del consumatore: incentivazione all’utilizzo di alimenti sanitarimente e qualitativamente qualificati”, Delibera Giunta Regionale del Veneto.
- Egger, G., Pearson, S., Pal, S., & Swinburn, B. (2007). Dissecting obesogenic behaviours: the development and application of a test battery for targeting prescription for weight loss. *Obesity Reviews*, 8, 481–486.
- Elder, J. P., Ayala, G. X., Slymen, D. J., Arredondo, E. M., & Campbell, N. R. (2009). Evaluating psychosocial and behavioral mechanisms of change in a tailored communication intervention. *Health Education & Behavior*, 36, 366–380.
- European Food Safety Authority, European Centre for Disease Prevention and Control. (2011). Union Summary report on trends and sources of zoonoses zoonotic agents and food-borne outbreaks in 2009. *EFSA Journal*, 9, 2090.
- FCC Consortium. Analysis of the costs and benefits of setting a target for the analysis of reduction of Salmonella in slaughter pigs for European Commission Health and Consumers Directorate-General. SANCO/2008/E2/036 Final Report. June 2010.
- FDA—Food and Agriculture Organization of the United Nations and World Health Organization. (2003). *Assuring food safety and quality: Guidelines for strengthening national food control systems*.
- Food and Drug Administration—Center for Food Safety and Applied Nutrition (FDA—CFSA). (2004). *Produce safety from production to consumption: 2004 action plan to minimize foodborne illness associated with fresh produce consumption*. Available at <http://www.cfsan.fda.gov/~dms/prodpla2.html> Accessed 1.06.09.
- Gallus, S., Colombo, P., Scarpino, V., Zuccaro, P., Negri, E., Apolone, G., et al. (2006). Overweight and obesity in Italian adults 2004, and an overview of trends since 1983. *European Journal of Clinical Nutrition*, 60, 1174–1179.
- Gibson, S. A., & O’Sullivan, K. R. (1995). Breakfast cereal consumption patterns and nutrient intakes of British schoolchildren. *Journal of the Royal Society of Health*, 115, 336–370.
- Glanz, K., Sallis, J. F., Saelens, B. E., & Frank, L. D. (2005). Healthy nutrition environments: concepts and measures. *American Journal of Health Promotion*, 19, 330–333.
- Grilli, R., Ramsay, C., & Minozzi, S. (2002). Mass media interventions: effects on health services utilization. *Cochrane Database of Systematic Reviews*, Issue 1. Art. No.: CD000389.
- Havelaar, A. H., Brul, S., de Jong, A., de Jonge, R., Zwietering, M. H., & Ter Kuile, B. H. (2010). Future challenges to microbial food safety. *International Journal of Food Microbiology*, 30, S79–S94.
- INRAN. (2003). *Linee guida per una sana alimentazione italiana*.
- Kant, A. K. (2010). Dietary patterns: biomarkers and chronic disease risk. *Applied Physiology, Nutrition, and Metabolism*, 35, 199–206.
- Kreuter, M. W., Oswald, D. L., Bull, F. C., & Clark, E. M. (2000). Are tailored health education materials always more effective than non-tailored materials? *Health Education Research*, 15, 305–315.
- Lally, P., Chipperfield, A., & Wardle, J. (2008). Healthy habits. Efficacy of simple advice on weight control based on a habit-formation model. *International Journal of Obesity*, 32, 700–707.
- Lally, P., Wardle, J., & Gardner, B. (2011). Experiences of habit formation: a qualitative study. *Psychology Health & Medicine*, 16, 484–489.
- McIntosh, W. A., Christensen, L. B., & Acuff, G. R. (1994). Perceptions of risks of eating undercooked meat and willingness to change cooking practices. *Appetite*, 22, 83–96.
- Mantovani, C., Bissoli, F., Barison, B., Terreran, A., Losasso, C., Vanzo, A., et al. (2010). “Alimentinsalute”: a social marketing project for public health communication and education on food safety and nutrition in veneto region. In *Proceedings of ICER2010 Conference*.
- Mari S., Tiozzo B., Capozza D., & Ravarotto L. Are you cooking your meat enough? The efficacy of the Theory of Planned Behavior in predicting a best practice to prevent salmonellosis. *Food Research International*, doi:10.1016/j.foodres.2011.06.028, Key: citeulike:9544533.in press
- Mattick, K., Durham, K., Domingue, G., Jørgensen, F., Sen, M., Schaffner, D. W., et al. (2003). The survival of foodborne pathogens during domestic washing-up and subsequent transfer onto washing-up sponges, kitchen surfaces and food. *International Journal of Food Microbiology*, 85, 213–226.
- Mead, P. S., Slutsker, L., Dietz, V., McCaig, L. F., Bresee, J. S., Shapiro, C., et al. (1999). Food-related illness and death in the United States. *Emerging Infectious Diseases*, 5, 607–625.
- Medeiros, L. C., Hillers, V. N., Kendall, P. A., & Mason, A. (2001). Food safety education: what should we be teaching to consumers? *Journal of Nutrition Education*, 32, 108–113.

- Ortega, R. M., Redondo, M. R., Lopez-Sobaler, A. M., Quintas, M. E., Zamora, M. J., Andres, P., et al. (1998). Associations between obesity, breakfast-time food habits and intake of energy and nutrients in a group of elderly Madrid residents. *Journal of American College of Nutrition*, 15, 65–72.
- Ortega, R. M., Requejo, A. M., Lopez-Sobaler, A. M., Quintas, M. E., Andres, P., Redondo, M. R., et al. (1998). Differences in the breakfast habits of overweight/obese and normal weight schoolchildren. *International Journal of Vitamin and Nutrition Research*, 68, 125–132.
- Parry, S. M., Miles, S., Tridente, A., Palmer, S. R., & South and East Wales Infectious Disease Group. (2004). Differences in perception of risk between people who have and have not experienced Salmonella food poisoning. *Risk Analysis*, 24, 289–299.
- Prochaska, J. O. (2008). Decision making in the transtheoretical model of behavior change. *Medical Decision Making*, 28, 845–849.
- Rasko, D. A., Webster, D. R., Sahl, J. W., Bashir, A., Boisen, N., Scheutz, F., et al. (2011). Origins of the E. coli Strain causing an outbreak of Hemolytic-Uremic Syndrome in Germany. *The New England Journal of Medicine*, Jul 27.
- Redmond, E. C., & Griffith, C. J. (2002). Consumer food handling in the home: a review of food safety studies. *Journal of Food Protection*, 66, 130–161.
- Rolls, B., Roe, L. S., & Meengs, J. S. (2006). Reductions in portion size and energy density of foods are additive and lead to sustained decreases in energy intake. *American Journal of Clinical Nutrition*, 83, 11–17.
- Rothman, A. J., Sheeran, P., & Wood, W. (2009). Reflective and automatic processes in the initiation and maintenance of dietary change. *Annals of Behavioral Medicine*, 38, S4–S17.
- Scott, E., & Herbold, N. (2010). An in-home video study and questionnaire survey of food preparation, kitchen sanitation, and hand washing practices. *Journal of Environmental Health*, 72, 8–13.
- Snyder, L. B. (2001). How effective are mediated health campaigns? In R. Rice, & C. Atkin (Eds.), *Public information campaigns* (3rd ed.). (pp. 181–190) Thousand Oaks, Calif: Sage.
- Snyder, L. B. (2007). Health communication campaigns and their impact on behavior. *Journal of Nutrition Education and Behavior*, 39, S32–S40.
- Spinelli, A., Lamberti, A., Baglio, G., Andreozzi, S., & Galeone, D. OKkio alla SALUTE: sistema di sorveglianza su alimentazione e attività fisica nei bambini della scuola primaria. Risultati 2008, Rapporti ISTISAN 09/24.
- Summerbell, C. D., Moody, R. C., Shanks, J., Stock, M. J., & Geissler, C. (1996). Relationship between feeding pattern and body mass index in 220 free-living people in four age groups. *European Journal of Clinical Nutrition*, 50, 513–519.
- Tariq, L., Haagsma, J., & Havelaar, A. (2011). Cost of illness and disease burden in The Netherlands due to infections with Shiga toxin-producing *Escherichia coli* O157. *Journal of Food Protection*, 74, 545–552.
- WHO—World Health Organisation. (2003). *Several foodborne diseases are increasing in Europe*. Press Release EURO/16/03.
- WHO. (2006). *The challenge of obesity in the WHO European Region and the strategies for response*. Istanbul.
- Wolfe, W. S., Campbell, C. C., Frongillo, E. A., Haas, J. D., & Melnick, T. A. (1994). Overweight schoolchildren in New York state: prevalence and characteristics. *American Journal of Public Health*, 84, 807–813.