FOOD COMPOSITION AND ANALYSIS

Diet quality of Italian yogurt consumers: an application of the probability of adequate nutrient intake score (PANDiet)

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ABSTRACT
The diet quality in yogurt consumers and non-consumers was evaluated by applying the probability of adequate nutrient intake (PANDiet) index to a sample of adults and elderly from the Italian food consumption survey INRAN SCAI 2005–06. Overall, yogurt consumers had a significantly higher mean intake of energy, calcium and percentage of energy from total sugars whereas the mean percentage of energy from total fat, saturated fatty acid and total carbohydrate were significantly lower than in non-consumers. The PANDiet index was significantly higher in yogurt consumers than in non-consumers, (60.58 ± 0.33 vs. 58.58 ± 0.19, p < 0.001). The adequacy sub-score for 17 nutrients for which usual intake should be above the reference value was significantly higher among yogurt consumers. The items of calcium, potassium and riboflavin showed the major percentage variation between consumers and non-consumers. Yogurt consumers were more likely to have adequate intakes of vitamins and minerals, and a higher quality score of the diet.

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Introduction

Yogurt is considered an excellent source of high-quality protein, calcium, phosphorus, magnesium, zinc, B vitamins, riboflavin, and niacin. The Italian Guidelines for Healthy Eating suggest eating three servings (each of 125 g) of milk or yogurt per day (Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione 2003). Also the Dietary Guidelines for Americans (USDA 2010) recommend three servings of dairy products and the Dietary Guidelines for Advisory Committee have recently underlined the importance of dairy intake, not just for calcium, but for a multitude of other nutrients as well (Heaney 2013).

Recent studies showed beneficial effect of yogurt consumption on health. In particular, yogurt consumption was found to be inversely associated with weight gain (Mozaffarian et al. 2011), common carotid artery intima-media thickness, metabolic syndrome (Babio et al. 2015), and type II diabetes (Chen et al. 2014) and positively associated with bone mineral density (Sahni et al. 2013) (Adolfsson et al. 2004). It has also been shown to be beneficial for gastrointestinal health, and several aetiological mechanisms that might drive a protective effect against colorectal cancer (Pala et al. 2011).

Yogurt consumption may help to improve overall nutrient intake (Webb et al. 2014) and to maintain metabolic well-being as part of a healthy, energy-balanced dietary pattern (Wang et al. 2013; Zhu et al. 2015).

In Italy yogurt consumption has grown considerably over the last decades: from 4.3 g/day in the 1980s (Saba et al. 1990), to 16.8 g/day in the 1990s (Turrini et al. 2001), up to 21.0 g/day in 2005–06 (Leclercq et al. 2009). Despite this increase, yogurt consumption is less than that observed in many other European countries: Spain, adults: 55.7 g/day; France, adults: 64.9 g/day; Germany, adults: 44.6 g/day; elderly: 51.8 g/day; Belgium, adults: 39.1 g/day; elderly: 43.3 g/day; Poland, adults: 18.7 g/day; elderly: 27.4 g/day; Hungary, adults: 33.4 g/day; elderly: 33.6 g/day (European Food Safety Agency 2011). Such a low consumption of yogurt compared to most European countries could in part be explained by the fact that there has always been a strong tradition of cheese manufacture in Italy (Abeni et al. 2006). Yogurt is the most recent dairy products and its appearance in Italian industrial production started only in the 1940s (Abeni et al. 2006). It was extensively produced and differentiated only since the late 1980s (Bonanno 2012).

In 2005–2006, the ‘Milk, milk products and substitutes’ food group represented the main source of calcium.
that contributed to 53% of the calcium intake in the Italian population. Italians consume almost 5 servings of cheese per week, slightly more than 1 serving of yogurt per week and about 7 portions of milk per week, against the three recommended daily servings of milk and yogurt (Leclercq et al. 2009).

The aim of present paper was to compare the diet quality of yogurt consumers and non-consumers in terms of food intake and nutrient adequacy through the PANDiet index for Italian adults and elderly.

Methods

Subjects

The last Italian nationwide dietary survey INRAN SCAI 2005–2006 was conducted from October 2005 to December 2006 on 3323 subjects aged 0–97 years. Only adults and elderly (+18 years old) were included in the present study. Food consumption was self-recorded by subjects for three consecutive days on hard-copy diaries structured by meal. The survey was organised in order to represent an adequate share of working days and week-end days. All foods, beverages, food supplements and medicines ingested had to be registered (Leclercq et al. 2009). A detailed description of the study design, participation rate, eligibility criteria and survey protocol are given by Leclercq et al. (2009) and Sette et al. (2011, 2013).

Data on height and weight were self-reported and body mass index (BMI) was calculated for each participant except for one woman for whom there was no weight. The final sample included 2797 subjects.

Yogurt consumers were defined as those subjects who have consumed yogurt at least once in the three days of survey, the cases in which the yogurt was consumed as an ingredient of a recipe were excluded; 636 (22.7%) subjects were identified as yogurt consumers according to this definition.

Food data

Food items were classified into 15 food groups and 51 subgroups. The average daily consumption of foods was assessed using ad hoc developed software for each individual (Leclercq et al. 2009). All amounts were expressed in grams of raw food edible part. Daily amount was calculated by summing up each single eating occasion intake and then dividing by the number of days of intake recorded. The ‘Food Energy and Nutrient Composition Database’ (Sette et al. 2011) was used to estimate the intake of energy, macro-nutrients, dietary fibre, vitamins (thiamine, riboflavin, vitamin C, vitamin B6, retinol and b-carotene, vitamin A as retinol equivalents, vitamin E, vitamin D, vitamin B12, dietary folate equivalent (DFE) (Ruggeri 2004)) and minerals (iron, calcium, phosphorous, magnesium, potassium, zinc). Total carbohydrate, total fat, polyunsaturated fatty acids (PUFA), saturated fatty acids (SFA) were expressed as percentage of total energy intake (excluding alcohol), protein intake was expressed per kilogram of body weight. The energy density (ED) was calculated by dividing the energy content (in kilocalories) by the weight of foods consumed (g), excluding beverages, (Vernarelli et al. 2013). The total sodium intake was underestimated because its calculation was based on the dietary records which did not include salt added at the table and during cooking.

Diet quality index

The probability of adequate nutrient intake (PANDiet) index aims to measure the overall diet quality of an individual through the probability of having adequate nutrient intake. The PANDiet index is based on two scores, adequacy and moderation, and takes into account the number of days of dietary survey, the mean intake, the day-to-day variability of intake, the inter-individual variability and the nutrient reference values. It was previously validated on French Nutrition and Health Survey data (Etude Nationale Nutrition Santé – ENNS 2006–2007), French Sample and the US National Health and Nutrition Examination Survey data (NHANES 2007–2008) and US sample (Verger et al. 2012).

This index was calculated for each nutrient, at the individual level. The Italian Dietary Reference Values (LARN) (Società Italiana di Nutrizione Umana 2014), reported in Table 1, and the data of iron distribution of the Institute of Medicine Food and Nutrition Board (Institute of Medicine Food and Nutrition Board (IOM) 2001) were used to calculate the PANDiet index.

The PANDiet index was calculated as mean of the adequacy and the moderation scores, multiplied by 100 (Verger et al. 2012). The adequacy score (average of the probability of adequacy for nutrients for which usual intake should be above a reference value) was calculated considering the Estimating Average Requirement (EAR) or the Adequacy Intake (AI) of the following nutrients: protein, total carbohydrate, total fat, PUFA, dietary fibre, vitamin A, thiamine, riboflavin, niacin, vitamin B6, DFE, vitamin B12, vitamin C, vitamin D, vitamin E, calcium, magnesium, zinc, phosphorous, potassium and iron. The moderation score (average of the probability of adequacy for nutrients for which usual intake should not exceed a reference value) takes into account the Upper Levels (UL) of the following nutrients: total carbohydrate, total fat, SFA, cholesterol, sodium. In addition a penalty value
Table 1. Dietary reference values used for the calculation of PANDiet index.

| Items                  | Adequacy score | Moderation score |
|------------------------|----------------|------------------|
|                        | Reference value* | Variability | Reference value* | Variability |
| Total carbohydrate (% En) | 45              | 0%              | 60          | 0%              |
| Total Fat (% En)       | 20              | 0%              | 35          | 0%              |
| SFA (% En)             | –               | –               | 10          | 15%             |
| Cholesterol (mg)       | –               | –               | 1600; 2000  | 15%             |
| Sodium (mg)            | –               | –               | 1300       | –               |
| Protein (g/kg)         | 0.71            | 13.8%           | –           | –               |
| PUFA (% En)            | 5               | 15%             | Tolerable upper intake | – |
| Dietary fibre (g)      | 25              | 10%             | –           | –               |
| Vitamin A (mg)         | 400; 500        | 15%             | 3000       | –               |
| Thiamine (mg)          | 0.9; 1.0        | 15%             | –           | –               |
| Riboflavin (mg)        | 1.1; 1.3        | 15%             | –           | –               |
| Niacin (mg)            | 14              | 15%             | 900         | –               |
| Vitamin B6 (mg)        | 1.1; 1.4        | 15%             | 25          | –               |
| DFE (µg)               | 320             | 10%             | 1000       | –               |
| Vitamin B12 (µg)       | 2               | 10%             | –           | –               |
| Vitamin C (mg)         | 60; 75          | 15%             | –           | –               |
| Vitamin D (µg)         | 10              | 15%             | 100         | –               |
| Vitamin E (mg)         | 1.1; 1.3        | 15%             | 300         | –               |
| Calcium (mg)           | 800; 1000       | 15%             | 2500       | –               |
| Magnesium (mg)         | 170             | 10%             | 250         | –               |
| Zinc (mg)              | 8; 10           | 15%             | 25          | –               |
| Phosphorous (mg)       | 580             | 15%             | –           | –               |
| Potassium (mg)         | 3900            | 15%             | –           | –               |
| Iron                   | –               | Based on tables by IoM | – |

*A Source: dietary reference intake of nutrients and energy for the Italian population (SINU, 2014).
†% of daily energy.
‡The reference values are reported for females and males.
§Source: Institute of Medicine Food and Nutrition Board (IOM) 2001.

The approach for the validation consists of: valuation of the correlation between the single item scores and the PANDiet index; investigation between the PANDiet index and the ED, gender, smoking habits; evaluation of the association between the PANDiet index and the food intake.

According to the validation strategy, the main statistical indicators (mean, standard error (mean ± SE) and Spearman correlation coefficient) were calculated for the quartile distribution for each item of the PANDiet index in order to test whether the PANDiet would fit with the Italian data. Linear models were performed to assess the associations between the PANDiet index (dependent variable) and sex, age, smoking habits and ED of the diet; and food intakes. The results were also compared to the French and the US samples. All the analyses were performed using SAS version 9.2. (SAS Institute Inc., Cary, NC).

Results

Yogurt consumers and non-consumers

22.7% of subjects were yogurt consumers, of which 69% were women and 82% non-smokers. The mean age and BMI of yogurt consumers were significantly lower ($p < 0.001$) ($46.2 ± 16.4$ years and $23.8 ± 3.6$ kg/m$^2$) compared to non-consumers ($49.4 ± 17.2$ years and $24.7 ± 3.9$ kg/m$^2$). Overall, yogurt consumers had a significantly higher ($p < 0.001$) mean intake of energy, calcium and percentage of energy from total sugars whereas the mean percentage contributions from total fat, SFA and total carbohydrates were significantly lower ($p < 0.001$) compared to non-consumers (Table 2). The food group ‘Milk, milk products and substitutes’ was the main source of calcium providing 51.0% and 57.7% of this mineral, for non-consumers and yogurt consumers, respectively. Within this food group, ‘Cheese and substitutes’ sub-group provided 34.7% of calcium intake for non-consumers and 29.3% for yogurt consumers followed by ‘Milk, milk based beverages’ which contributed to 16.2% and 15.1%, respectively, lastly the contribution of ‘yogurt’ was equal to 13% (data not shown).

Results for food intakes were reported in Table 3. ‘Sweet products and substitutes’, ‘Vegetables, fresh and processed’, ‘Fruit fresh and processed’ and ‘Water and other non-alcoholic beverages’ mean intakes were significantly higher ($p < 0.001$) among yogurt consumers, $36.6 ± 1.3$, $237.0 ± 4.5$, $244.6 ± 6.4$ and $986.4 ± 17.1$, respectively, compared to non-consumers, $30.9 ± 0.7$, $217.4 ± 2.4$, $210.4 ± 3.4$ and $813.7 ± 9.2$, respectively.

The mean intakes of the ‘Milk, milk products and substitutes’ subgroup did not show any relevant system was used: a value equal to 0 was set when the average intake of a nutrient exceeded the upper tolerable limit of intake.

The score ranges from 0 to 100, the higher the score the better the diet quality.

Statistical analysis

Mean and standard deviation (SD) were calculated to synthesise the food and nutrient intake distribution. The mean nutrient intakes, expressed as percentage of energy, excluding alcohol to remove the effect on the calculation of the percentage of macronutrients such as SFA and total fat on energy intake, were calculated using the residual-method (Willett et al. 1997) adjusted by gender; the residual-method was not applied for calcium because it does not influence the energy intake. The ANOVA test, adjusted for gender, was also performed to check the differences in mean intake of food groups between yogurt consumers and non-consumers.

Since the PANDiet index did not follow a normal distribution the Kruskal – Wallis test was applied to check whether differences between yogurt consumers and non-consumers were statistically significant at level of single items score.

The supplemental materials (Table S1 and S2) present the results to validate the Italian version of the PANDiet index. The approach for the validation consists of: valuation of the correlation between the single item scores and the PANDiet index; investigation between the PANDiet index and the ED, gender, smoking habits; evaluation of the association between the PANDiet index and the food intake.

According to the validation strategy, the main statistical indicators (mean, standard error (mean ± SE) and Spearman correlation coefficient) were calculated for the quartile distribution for each item of the PANDiet index in order to test whether the PANDiet would fit with the Italian data. Linear models were performed to assess the associations between the PANDiet index (dependent variable) and sex, age, smoking habits and ED of the diet; and food intakes. The results were also compared to the French and the US samples. All the analyses were performed using SAS version 9.2. (SAS Institute Inc., Cary, NC).
difference except for the yogurt intake as consequence of the assumption of the present analysis. The mean intake of the yogurt was 91.9 g/d and the 95th percentile was 208.3 g/d that is less than two portions of yogurt.

**PANDiet index**

Overall, the mean of the PANDiet index was significantly higher in yogurt consumers than in non-consumers (60.48 ± 0.33 versus 58.58 ± 0.19, p < 0.001).

### Table 2. Mean and standard deviation (SD), of the BMI, age, nutrients intake by yogurt consumers and non-consumers: Italian National Food Consumption Survey INRAN-SCAI 2005–06.

| Category                | Non-consumers Mean SD | Yogurt consumers Mean SD | p*  |
|-------------------------|-----------------------|--------------------------|-----|
| **BMI**                 | 24.7 3.9              | 23.8 3.6                 | *** |
| **Age (years)**         | 49.4 17.2             | 46.2 16.4                | *** |
| **Nutrient Intake**     |                       |                          |     |
| Energy (kcal)           | 2036.9 577.2          | 2104.5 659.0             | *** |
| ED (kcal g)             | 1.7 0.3               | 1.6 0.3                  | *** |
| Total Carbohydrate (%)  | 50.9 16.1             | 48.3 15.7                | *** |
| Total sugars ( % En)‡   | 15.7 6.9              | 17.6 7.5                 | *** |
| Total Fat (%)           | 40.5 12.9             | 37.8 12.1                | *** |
| Calcium (mg)            | 729 299               | 880 300                  | *** |

*Mean comparisons were analysed using T test. ***p < 0.001.
‡% of daily energy.
†Total sugars are those naturally present in milk, fruits and vegetables and added sugar.

### Table 3. Mean and standard error (SE), of individual daily consumption by food category and non-consumers and yogurt consumers: Italian National Food Consumption Survey INRAN-SCAI 2005–2006.

| Types of food                        | Non-consumers Mean SE | Yogurt consumers Mean SE | p*  |
|--------------------------------------|-----------------------|--------------------------|-----|
| **Food groups**                      |                       |                          |     |
| Cereals, cereal products and substitutes | 258.4 2.1             | 261.1 4.0                |     |
| Pulses fresh and processed           | 10.9 0.5              | 13.1 0.9                 |     |
| Vegetables, fresh and processed      | 217.4 2.4             | 237.0 4.5                | *** |
| Potatoes, tubers and their products  | 50.1 1.2              | 53.8 2.2                 |     |
| Fruit, fresh and processed           | 210.4 3.4             | 244.6 6.4                | *** |
| Meat, meat products and substitutes  | 112.1 1.3             | 106.1 2.5                |     |
| Fish, seafood and their products     | 44.9 1.1              | 45.9 2.0                 | *** |
| Milk, milk products and substitutes   | 164.5 2.5             | 262.4 4.6                | *** |
| Oils and fats                         | 41.0 0.3              | 42.0 0.6                 |     |
| Alcoholic beverages and substitutes  | 105.7 3.2             | 106.7 5.9                |     |
| Sweet products and substitutes       | 30.9 0.7              | 36.6 1.3                 | *** |
| Meal substitutes                      | 0.1 0.0               | 0.0 0.0                  |     |
| Eggs                                 | 21.3 0.5              | 20.8 1.0                 |     |
| Water and other non-alcoholic beverages | 813.7 9.2            | 986.4 17.1               | *** |
| Miscellaneous                        | 3.20 0.09             | 3.20 0.14                |     |
| **Milk, milk products and substitutes- sub group** | |                          |     |
| Milk, milk based beverages           | 105.3 2.2             | 111.2 4.1                |     |
| Cheese and substitutes               | 58.3 0.9              | 57.7 1.7                 |     |
| Yogurt                               | 0.0 0.0               | 91.9 1.2                 | *** |
| Milk based desserts and substitutes  | 1.0 0.2               | 1.5 0.3                  | *** |

*Mean comparisons were analysed using ANOVA test adjusted for gender. *p < 0.05, **p < 0.01, ***p < 0.001.

### Table 4. Mean and standard error (SE) of the PANDiet index, moderation, adequacy score and individual items scores by non-consumers and yogurt consumers.

| PANDiet items               | Non-consumers Mean SE | Yogurt consumers Mean SE | p*  |
|----------------------------|-----------------------|--------------------------|-----|
| PANDiet index              | 58.58 0.19            | 60.48 0.33               | *** |
| Moderation score           | 52.66 0.42            | 50.71 0.73               |     |
| Total Carbohydrate         | 0.98 0.00             | 0.98 0.00                |     |
| Total Fat                  | 0.36 0.01             | 0.39 0.02                |     |
| SFA                        | 0.34 0.01             | 0.32 0.01                |     |
| Cholesterol                | 0.62 0.01             | 0.60 0.02                |     |
| Sodium                     | 0.59 0.01             | 0.59 0.01                |     |
| Adequacy score             | 64.5 0.33             | 70.28 0.53               | *** |
| Protein                    | 0.90 0.00             | 0.93 0.01                |     |
| Total Carbohydrate         | 0.60 0.01             | 0.66 0.02                |     |
| Total Fat                  | 0.99 0.00             | 1.00 0.00                |     |
| PUFA                       | 0.92 0.00             | 0.92 0.01                |     |
| Dietary fibre              | 0.19 0.01             | 0.24 0.01                |     |
| Vitamin A                  | 0.73 0.01             | 0.82 0.01                |     |
| Thiamine                   | 0.48 0.01             | 0.57 0.01                |     |
| Riboflavin                 | 0.62 0.01             | 0.79 0.01                |     |
| Niacin                     | 0.73 0.01             | 0.73 0.01                |     |
| Vitamin B₆                  | 0.86 0.00             | 0.91 0.01                |     |
| Folate                     | 0.48 0.01             | 0.56 0.01                |     |
| Vitamin B₁₂                 | 0.89 0.00             | 0.91 0.01                |     |
| Vitamin C                  | 0.70 0.01             | 0.79 0.01                |     |
| Vitamin D                  | 0.03 0.00             | 0.04 0.00                |     |
| Vitamin E                  | 0.45 0.01             | 0.52 0.01                |     |
| Calcium                    | 0.35 0.01             | 0.53 0.01                |     |
| Magnesium                  | 0.88 0.00             | 0.94 0.01                |     |
| Zinc                       | 0.70 0.01             | 0.78 0.01                |     |
| Phosphorous                | 0.97 0.00             | 0.98 0.00                |     |
| Potassium                  | 0.18 0.01             | 0.27 0.01                |     |
| Iron                       | 0.88 0.00             | 0.88 0.01                |     |

*PANDiet single items were analysed by using Kruskal – Wallis test. *p < 0.05, **p < 0.01, ***p < 0.001. Source: INRAN-SCAI 2005–06 Study.
The mean of the moderation score did not show any difference between the two groups (Table 4). Conversely, the mean of the adequacy score was significantly higher ($p < 0.001$) among yogurt consumers (70.28 ± 0.53) compared to non-consumers (64.50 ± 0.33). Single items in the adequacy score that were significantly higher among yogurt consumers are: total carbohydrate, total fat, PUFA, dietary fibre, thiamine, riboflavin, folate, vitamin C, vitamin A, vitamin B₆, vitamin B₁₂, vitamin E, niacin, vitamin D, zinc, calcium, magnesium, phosphorous, potassium and iron. The highest percentage variation was observed for calcium (34%), potassium (33%) and riboflavin (22%) between yogurt consumers and non-consumers.

Figure 1 shows that a PANDiet index higher is associated with a greater intake of milk, yogurt, vegetables and fresh fruit (in the case of yogurt consumers), and, conversely a PANDiet index lower is associated with an higher intake of processed meat, alcoholic beverages, cheese and a lower intake of fruit and vegetables, for both yogurt consumers and non-consumers.

Discussion

Although the energy intake of yogurt consumers was higher than in non-consumers the ED was significantly lower, suggesting that the yogurt consumers consumed foods with lower ED. This finding was confirmed by the higher mean intake of fruit and vegetables. The higher PANDiet index among yogurt consumers was also associated to lower intakes of meat products and higher intakes of fruit and vegetables, suggesting that consumers are more likely to adhere to the nutrient intake recommendations (Società Italiana di Nutrizione Umana 2014).

Recent publications found a lower risk of overweight and obesity among yogurt consumers which may also explain the lower mean of BMI in Italians yogurt consumers (Martinez-Gonzalez et al. 2014) (Mozaffarian et al. 2011). Previous research involving the same subjects of the present study found that yogurt consumers spent more time doing physical activity and were more interested in nutritional information, compared with non-consumers (D'Addezio et al. 2015).

The nutrient contribution of yogurt entails several minerals and vitamins, and a recent study identified yogurt as a good marker of diet quality (Weaver 2014). According to the Dietary Guidelines Adherence Index (DGAI) quality score, measured for the Framingham Heart Study offspring cohort, yogurt consumers had significantly improved diet quality scores compared to non-consumers and a lower prevalence of nutrient inadequacy (Wang et al. 2013). In addition an application of linear programming to individual diet modelling has shown that an increase of milk and yogurt consumption helps individuals to reach nutrient adequacy in French population (Clerfeuille et al. 2013). These results seemed to be confirmed also among Italian yogurt consumers who reported higher score for the PANDiet single items as calcium, potassium, phosphorus, riboflavin, vitamins B₆, C and B₁₂, niacin, magnesium and dietary fibre, than non-consumers, suggesting that yogurt consumers have better overall diet quality. This result may be also due to higher intake, by yogurt consumers, of food groups as fruit and vegetables. The higher consumption of food groups mentioned above could also partly explain the greater energy contribution from total sugars.

![Figure 1](image-url)
The ‘Milk, milk products and substitutes’ food group is the most important source of calcium, and the calcium item score has reported the highest mean difference between yogurt consumers and non-consumers, suggesting that yogurt consumption (contributing here to 13% of calcium intake) may have a role in increasing calcium intake. Indeed non consumers do not seem to replace the shortfall of calcium with other foods of the ‘Milk, milk products and substitutes’ group or of other food groups. Past studies have found that yogurt supplementation significantly increased the intake of calcium (Massey 1984) and has a beneficial effect on weight loss (Chen et al. 2012). One hypothesis of the low consumption of milk products could be attributed to the prevalence of perception of lactose intolerance that is about 40% in Italy (Franzè & Bertele 2010). However, the results from other studies indicate that lactose is not a major cause of symptoms in patients either maldigester or normal, following usual intakes of dairy foods (Perino et al. 2009). The yogurt consumers are characterised by a good knowledge of the food-health relationship and accustomed to reading food labels therefore they do not perceive the lactose intolerance as a barrier (Heaney 2013).

It should be noted that the distribution percentage of mean intake for the quartiles of the PANDiet index points out that the association with the food groups, at the highest quartile, have the same trend both yogurt consumers and non-consumers, except for legumes consumption that was higher in non-consumers (Figure 1). This may be due to the PANDiet index that is based on nutrient intakes and it is not food specific. Moreover, the highest quartile indicates the best nutritional adequacy and a single food, such as yogurt, cannot be considered as a discriminant factor of the adequacy of the diet but could be allowed as a relevant indicator of global diet quality. Further analysis should also be carried out to understand how the choice to consume yogurt may influence other food choices or lifestyle habits.

A number of limitations should be noted within the present analysis. The lack of information about sodium intake from added salt makes the result for this specific item weaker than the potential information. Considering a high added salt consumption in Italy (Società Italiana di Nutrizione Umana 2014) we made the hypothesis that most of the subjects would have had a negative score for this item. As the consumption of yogurt is relatively low in Italy, a food frequency questionnaire would have been a more adequate tool to identify yogurt consumers. However, the food diary records are more suitable to calculate the PANDiet score. Further limitations on the consumption data and methodological issues have been discussed in detail by (Leclercq et al. 2009), (Sette et al. 2011) and (Verger et al. 2012).

The validation of the PANDiet index for the Italian population is lacking in data about chemical indicators of nutritional status. On the other hand, the main results are those expected and are in line with those obtained from the other two implementations of the PANDiet for French and American populations (Verger et al. 2012).

Conclusion

Our findings confirm that yogurt consumers had an overall higher diet quality. Given the low consumption of yogurt among Italian population, increasing yogurt intake may help to improve the intake of some shortfall vitamins and minerals, as part of a balanced diet.

Since the present analysis is an observational study, further investigation, such as long term intervention studies, would be useful to explore the effect of yogurt consumption, on nutritional status of Italians considering also the dietary habits and lifestyle.

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Disclosure statement

The authors declare that there is not conflict of interest

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The 'Milk, milk products and substitutes' food group is the most important source of calcium, and the calcium item score has reported the highest mean difference between yogurt consumers and non-consumers, suggesting that yogurt consumption (contributing here to 13% of calcium intake) may have a role in increasing calcium intake. Indeed non consumers do not seem to replace the shortfall of calcium with other foods of the 'Milk, milk products and substitutes' group or of other food groups. Past studies have found that yogurt supplementation significantly increased the intake of calcium (Massey 1984) and has a beneficial effect on weight loss (Chen et al. 2012). One hypothesis of the low consumption of milk products could be attributed to the prevalence of perception of lactose intolerance that is about 40% in Italy (Franzè & Bertele 2010). However, the results from other studies indicate that lactose is not a major cause of symptoms in patients either maldigester or normal, following usual intakes of dairy foods (Perino et al. 2009). The yogurt consumers are characterised by a good knowledge of the food-health relationship and accustomed to reading food labels therefore they do not perceive the lactose intolerance as a barrier (Heaney 2013).
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