



Consumption of whole grain food and its determinants in a general Italian population: Results from the INHES study

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Abstract *Background and aims:* Whole grain (WG) food consumption is associated with lower risk of cardiovascular disease, cancer and neurological diseases. The aim of this study was to assess the consumption of WG food and its major demographic, socioeconomic, psychosocial and behavioral determinants in a general Italian population.

Methods and results: Data were from the Italian Nutrition & Health Survey (INHES), a telephone-based survey established in 2010–2013 including 9422 participants aged ≥ 5 years from all over Italy. WG food intake was assessed by the European Food Propensity Questionnaire and included bread, pasta, breakfast cereals, biscuits and WG soups. WG consumption was categorized as none, occasional (< 1 time/week) and regular (≥ 1 time/week). Overall, 26.9% of the sample reported a regular consumption of WG food (27.2% of adults aged 20–97 y, and 21.9% of children/adolescents aged 5–19 y). In both age-groups, the major food source contributing to total WG intake was WG bread followed by WG pasta. Among adults, greater consumption of WG was associated with healthier lifestyle (e.g. sport activity), and higher educational level. Eating meals outside of the house in adults, and spending > 2 h/day watching TV in children/adolescents were inversely associated with WG intake.

Conclusions: The percentage of WG consumers in Italy in 2010–2013 appears to be quite low and still below that recorded in other countries of Europe where consumption is frequently over 50 percent. WG consumption is likely to be influenced by socioeconomic status and is associated with a number of psychosocial factors, meal patterns and eating-related behaviors.

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Introduction

In numerous epidemiological studies consumption of whole grain (WG) products is associated with lower risk of chronic diseases such as coronary heart disease [1], stroke [2], type 2 diabetes [3] and colon-rectal cancer [4]. Moreover, habitual consumption of WG foods may contribute to

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improved adiposity indices in children and adults [5] and appears to exert benefits also for cardiovascular risk markers, such as blood pressure, insulin sensitivity and plasma cholesterol [6,7]. WG consumption of any population is difficult to study, as presently, there is no universally accepted definition of WG [8].

Recently, the Health Grain Forum, a not-for-profit consortium of academics and industry working with cereal foods, suggested that a food may be labeled as “whole grain” if it contains >30% whole-grain ingredients in the overall product and more whole grain than refined grain ingredients, both on a dry-weight basis [9]. Moreover, countries including the USA, Canada, Denmark and Australia have specific dietary guidelines on WG intake but others, as Italy, do not explicitly indicate the amount of WG to be consumed, rather they only suggest to regularly consume cereals preferably whole [10].

In particular, in the US the recommended daily consumption is of at least 85 g/d [11] for adults and 42 g/d for children [12], while in Denmark is set at 75 g/10 MJ (2388 kcal) per day [13].

The Mediterranean diet pyramid recommends the consumption of one or two servings of cereals at each main meal (in the form of bread, pasta, rice, couscous and others), preferably whole grain [14].

The latest updated data on WG consumption in Italy derive from the INRAN-SCAI 2005–06, a cross-sectional survey conducted on a representative sample of 1300 households randomly selected and stratified into the four main geographical areas of Italy (North-West, North-East, Centre, South and Islands). This study showed that WG products, over the 3-day survey period, were consumed in only a quarter of Italian children and adults, with mean intakes being substantially lower than quantitative WG recommendations [15].

The aim of this study was twofold: first, to assess the WG intake in a large sample of the Italian population recruited all over Italy within the Italian Nutrition & Health Survey (INHES); second, to investigate major demographic, socioeconomic, psychosocial and behavioral factors possibly associated with the consumption of WG foods, in order to provide new evidence for appropriate intervention strategies at population level.

Methods

Study population

The INHES Study is a 3-year telephone-based survey on nutrition and health specifically designed to collect information on dietary habits (quality, quantity and meal patterns), food choice determinants, and food health awareness of the Italian population according to different geographical distribution (Northern, Central and Southern Italy), age, gender and socioeconomic status.

Between November 2010 and November 2013, 9422 women and men aged ≥ 5 years from all over Italy were enrolled. A full description of the study design is reported in the [supplementary material](#).

For the purpose of the present study, we omitted subjects with missing information on WG consumption (3.1%) or missing values for major variables of interest (1.6%). A total of 8421 adults (aged >19 y) and 561 young subjects (aged ≤ 19 y) were finally included in the analyses.

The INHES Study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Ethical Committee of the Catholic University of Rome. Verbal informed consent was obtained from all subjects and was witnessed and formally recorded.

Dietary assessment

Data on food intake were collected through the Italian version of the European Food Propensity Questionnaire according to methods described elsewhere [16].

Total WG food intake was estimated by using information from five different WG food groups: WG bread, WG pasta, WG breakfast cereals, WG biscuits (including also crackers and breadsticks) and WG soups. For each food item, frequency of consumption was collected by the following question: “How frequently do you eat (e.g.) WG pasta?” and possible answers were: ‘never’, ‘once a month or less frequent’, ‘less than 3 times a month’, ‘2–3 times/month’, ‘1–2 times a week’, ‘3–4 times a week’, ‘5–6 times a week’, ‘every day’, ‘more than 1 time/day’. The total consumption of WG was obtained by summing the frequency (converted into times/week) of consumption of each WG food group. The study population was eventually categorized as non-WG food consumers, consuming WG < 1 time/week and consuming WG ≥ 1 time/week.

Adherence to the Mediterranean diet in the adult sample was evaluated by using the MedDietScore as proposed by Panagiotakos [17] including 10 food groups (fruits, vegetables, legumes, potatoes, fish, red meat, poultry, dairy products, alcoholic beverages, olive oil). As compared to the original score, we did not include WG cereals.

The final score potentially ranged from 0 to 50, the latter reflecting maximal adherence. For analysis purposes, the score was also used as exact tertiles.

Adherence to the Mediterranean diet in the young sample was evaluated by using the KIDMED index (Mediterranean Diet Quality Index) for children and teenagers [18], classified as follows: good (≥ 6 points, indicating an optimal Mediterranean diet); average (4–5 points); and poor (≤ 3 points).

The reasons for consumption of WG products was assessed through the question “What do you think about WG products?” with four possible answers (‘they are healthier than regular ones’, ‘they are more natural’, ‘other’, ‘do not know’). Data on reasons for non-consumption of WG was obtained by the question “Why don’t you eat WG products?” with four possible answers (‘dislike’, ‘lack of knowledge’, ‘hard to cook’ or ‘other’). The questionnaire on consumption of WG was administered to a random subgroup of the sample ($n = 5805$).

Meal patterns

Meal patterns comprised either patterning of main meals (breakfast, lunch, dinner) or context of main meals, such as meals eaten out of the home, or eating meals in front of the television or when using PC. Information on daily amount of time spent in watching TV/using PC was also collected and categorized as \leq or > 2 h/d.

Socioeconomic and psychosocial factors

Education was based on the highest qualification attained and was categorized as up to primary school (corresponding to ≤ 5 years of study), lower secondary ($>5 \leq 8$ years), upper secondary ($>8 \leq 13$ years), post-secondary (>13 years).

Present occupation was assembled into 6 groups: manual, non-manual, housewife, retired, student and unemployed. Marital status was categorized as married/living in a couple, single, separated/divorced and widowed.

Self-rated health was assessed by the question "How would you rate your health status" and possible answers ranged from 'very good' to 'bad' [19]. Adverse life events (yes/no) during the last year included questions related to health (e.g. serious illness or death), job (e.g. retired, job loss), or interpersonal situations (e.g. divorce, problem with friend or relative).

Information on occupational and family-related stress was obtained by the question "How often have you experienced stress in your workplace/family?" with answers ranging from 'never' to 'always'. Financial-related stress was rated as none/little, moderate and a lot. Job control was considered as none/little, moderate-good, fairly good and not working/unascertained.

Assessment of covariates

Previous diagnosis of diabetes, hypercholesterolemia, hypertension, cardiovascular disease and cancer was self-reported and categorized as no/yes. In adults, body mass index was calculated by using self-reported measurements of height and weight, calculated as kg/m^2 and grouped into three categories as normal (<25), overweight ($\geq 25 < 30$) or obese (≥ 30). BMI in children/adolescents was categorized according to specific values for children considering sex and age [20]. Engagement in sport activity was considered as a dichotomous variable (yes/no).

Statistical analysis

Main characteristics of the study population across categories of weekly WG food consumption were presented as means with standard deviation (SD), or percentages.

Associations for categorical or continuous variables were evaluated by using general linear models adjusted for age groups (see Table 1 for definition of age groups) and sex (PROC GENMOD and PROC GLM in SAS for categorical and continuous variables, respectively).

Using multinomial ordered multivariable logistic regression analysis, odds ratios (ORs) with corresponding

95% confidence intervals (95%CI) were calculated to estimate the association of 3-level WG consumption (none vs occasional vs regular) with demographic and socioeconomic factors (Tables 2 and 3), meal patterns and eating-related behaviours (Table 4) or psychosocial factors (Table 5).

Dummy variables for missing values of each variable of interest were created. Two-sided P-value <0.05 was considered as statistically significant.

The data analysis was generated using SAS/STAT software, Version 9.4 of the SAS System for Windows[®]2009. SAS Institute Inc. and SAS are registered trademarks of SAS Institute Inc., Cary, NC, USA.

Results

Adults

Overall, 27.2% of adults (20–97 y) reported a regular consumption (≥ 1 time/week) of WG products (Table 1).

Among adults, regular WG intake was more prevalent in middle-aged subjects (50–64 years), in women and in subjects from Northern Italy and within those having a higher educational level (Table 1). Moreover, regular WG consumption was higher in adults with a non-manual occupation, and among single or separated/divorced, non-smokers, and for those engaged in some physical activity or with normal body weight (Table 1). Adherence to the Mediterranean diet was slightly higher in non-consumer/occasional consumers (Table 1).

Supplementary Figure 1A shows the percent contribution from five different WG food sources, (i.e. bread, pasta, cereals, biscuits, soup) to the total WG intake. The major food sources were represented by WG bread (53.3%) and WG biscuits (27.4%), followed by WG pasta (13.1%), while only 4.8% and 1.3% were contributed by WG breakfast cereals and WG soups, respectively.

Table 2 reports the association of demographic and socioeconomic factors with WG consumption in adult subjects, with occasional or regular WG food intake as opposed to non-consumers.

A clear educational gradient in WG intake emerged, with subjects with highest educational attainment (post-secondary) reporting higher odds of being either occasional (OR = 1.90; 95%CI 1.58–2.27) or regular consumers (OR = 1.59; 1.30–1.95). WG intake was also related to occupation, marital status and engagement in sport activities (Table 2).

Having breakfast out of home (OR = 0.59; 0.46–0.76 and OR = 0.43; 0.31–0.60, for occasional and regular WG consumption, respectively) was inversely associated with WG food intake, as compared to having breakfast at home, and the same was true for individuals having lunch out of home and for those having meals while watching TV (Table 4; Model 2b).

Finally, poor self-reported health status was inversely associated with regular WG food intake (OR = 0.44; 0.38–0.51) as well as moderate financial circumstances-

Table 1 Characteristics of the adult population (20–97 years) according to consumption of whole grain foods.

	Whole grain products intake				Unadjusted <i>p</i> value
	Whole sample	Non-consumers	Occasional consumers (<1times/week)	Regular consumers (≥1 times/week)	
N (%)	8421 (100)	4656 (55.3)	1475 (17.5)	2290 (27.2)	—
Age groups (y)					<0.0001
20–34	6.4	6.6	6.9	5.6	
35–49	28.4	26.3	31.7	30.8	
50–64	33.0	30.9	37.2	34.6	
65–74	20.8	22.7	17.6	18.9	
≥75	11.4	13.5	6.6	10.0	
Sex					<0.0001
Women	53.3	47.5	58.8	61.3	
Men	46.7	52.5	41.2	38.7	
Geographical area					<0.0001
Northern	40.5	39.8	36.9	44.2	
Central	16.7	16.1	20.3	15.5	
Southern	42.8	44.1	42.8	40.3	
Educational level					<0.0001
Up to primary	17.7	21.1	12.1	14.1	
Lower secondary	26.3	28.1	24.7	23.8	
Upper secondary	39.8	38.0	42.3	41.8	
Post-secondary	16.2	12.8	20.9	20.3	
Occupation					<0.0001
Non-manual	31.1	26.2	37.6	36.7	
Manual	18.0	19.1	18.0	15.9	
Housewife	11.0	10.9	11.5	10.8	
Retired	35.2	38.8	29.1	31.9	
Student	1.8	1.9	1.7	1.6	
Unemployed	2.9	3.1	2.1	3.1	
Marital status					<0.0001
Married/in couple	75.1	75.3	75.3	74.5	
Single	14.6	13.9	15.9	15.4	
Separated/divorced	3.2	2.5	3.5	4.5	
Widowed	7.1	8.3	5.3	5.6	
Smoking habit					<0.0001
No	59.7	56.2	59.7	66.8	
Yes	15.9	17.9	15.2	12.4	
Former	22.4	23.9	23.3	18.6	
Occasional	2.0	2.0	1.8	2.2	
Sport activity					<0.0001
No	81.6	84.3	78.8	77.8	
Yes	18.4	15.7	21.2	22.2	
Body mass index					0.0015
Normal weight	48.1	46.5	48.1	51.4	
Overweight	38.3	39.1	38.6	36.6	
Obese	13.6	14.4	13.3	12.0	
Cardiovascular disease	3.2	3.9	2.0	2.7	0.0002
Cancer	3.4	3.4	3.1	3.7	0.66
Hypertension	31.8	33.2	28.4	31.2	0.0023
Diabetes	7.6	7.3	7.2	8.4	0.22
Hypercholesterolemia	21.9	21.6	21.4	22.7	0.49
MedDietScore ^a	28.7 (3.6)	28.8 (3.5)	28.9 (3.5)	28.5 (3.9)	0.0046

Values are reported as percentages.

^a MedDietScore (not including whole grain foods) is reported as means with standard deviations.

related stress (OR = 0.55; 0.40–0.76), and higher family-related stress (OR = 0.59; 0.40–0.87; [Table 5](#), Model 2).

Children/adolescents

Among children/adolescents (5–19 years), 21.9% reported a regular consumption (≥1times/week) of WG products ([Table 3](#)).

In this sample, female gender and Southern Italy geographical area were major determinants of regular WG intake ([Table 3](#)).

In agreement with what observed for adults, the major food source was represented by WG bread (42.3%), followed by WG biscuits (20.2%), WG breakfast cereals (15.7%) and WG pasta (15.8%) whereas WG soups contributed to 6.0% of the total WG intake ([Supplementary Figure 1A](#)).

Table 2 Demographic and socioeconomic factors associated with whole grain food consumption in the adult population (20–97 years).

	Occasional consumers (n = 1475) vs non-consumers (n = 4656)		Regular consumers (n = 2290) vs non-consumers (n = 4656)	
	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)
Age groups (y)				
20–34	-1-	-1-	-1-	-1-
35–49	1.28 (1.06–1.54)	1.44 (1.13–1.84)	1.34 (1.08–1.66)	1.70 (1.29–2.23)
50–64	1.24 (1.03–1.50)	1.59 (1.23–2.05)	1.28 (1.03–1.58)	1.84 (1.38–2.45)
65–74	0.89 (0.73–1.08)	1.32 (0.99–1.77)	1.07 (0.85–1.34)	1.75 (1.26–2.44)
≥75	0.70 (0.56–0.87)	1.21 (0.88–1.66)	1.03 (0.80–1.32)	1.91 (1.34–2.72)
Sex				
Women	-1-	-1-	-1-	-1-
Men	0.60 (0.55–0.65)	0.58 (0.51–0.63)	0.63 (0.57–0.70)	0.63 (0.56–0.70)
Geographical area				
Northern	-1-	-1-	-1-	-1-
Central	1.05 (0.92–1.19)	1.01 (0.88–1.14)	0.80 (0.70–0.93)	0.78 (0.68–0.90)
Southern	0.87 (0.79–0.96)	0.92 (0.84–1.02)	0.80 (0.72–0.89)	0.85 (0.76–0.95)
Educational level				
Up to primary	-1-	-1-	-1-	-1-
Lower secondary	1.32 (1.14–1.53)	1.33 (1.15–1.55)	1.25 (1.05–1.47)	1.25 (1.06–1.49)
Upper secondary	1.69 (1.46–1.95)	1.50 (1.29–1.74)	1.53 (1.30–1.80)	1.40 (1.18–1.66)
Post-secondary	2.36 (1.99–2.80)	1.90 (1.58–2.27)	1.93 (1.60–2.32)	1.59 (1.30–1.95)
Occupation				
Non-manual	-1-	-1-	-1-	-1-
Manual	0.65 (0.57–0.74)	0.78 (0.68–0.90)	0.69 (0.60–0.80)	0.81 (0.69–0.94)
Housewife	0.57 (0.48–0.67)	0.70 (0.59–0.83)	0.60 (0.50–0.72)	0.71 (0.59–0.86)
Retired	0.68 (0.58–0.79)	0.80 (0.69–0.94)	0.71 (0.60–0.85)	0.83 (0.69–0.98)
Student	0.75 (0.51–1.10)	0.80 (0.54–1.19)	0.94 (0.60–1.46)	0.97 (0.61–1.54)
Unemployed	0.63 (0.48–0.82)	0.74 (0.56–0.98)	0.90 (0.67–1.21)	1.07 (0.79–1.45)
Marital status				
Married/in couple	-1-	-1-	-1-	-1-
Single	1.19 (1.03–1.39)	1.14 (0.98–1.33)	1.19 (1.01–1.40)	1.14 (0.97–1.35)
Separated/divorced	1.47 (1.15–1.88)	1.43 (1.11–1.85)	1.48 (1.15–1.91)	1.46 (1.13–1.89)
Widowed	0.68 (0.56–0.83)	0.70 (0.58–0.85)	0.68 (0.55–0.85)	0.68 (0.55–0.85)
Smoking habit				
No	-1-	-1-	-1-	-1-
Yes	0.65 (0.58–0.74)	0.66 (0.58–0.76)	0.62 (0.53–0.72)	0.62 (0.53–0.72)
Former	0.90 (0.80–1.00)	0.90 (0.80–1.01)	0.76 (0.66–0.86)	0.75 (0.66–0.86)
Occasional	0.90 (0.66–1.23)	0.85 (0.62–1.17)	0.99 (0.71–1.40)	0.93 (0.66–1.32)
Sport activity				
No	-1-	-1-	-1-	-1-
Yes	1.48 (1.32–1.66)	1.34 (1.19–1.51)	1.41 (1.25–1.60)	1.32 (1.16–1.49)
Body mass index				
Normal weight	-1-	-1-	-1-	-1-
Overweight	1.01 (0.91–1.11)	1.08 (0.98–1.20)	0.94 (0.84–1.05)	1.00 (0.90–1.12)
Obese	0.87 (0.76–0.99)	0.99 (0.86–1.14)	0.81 (0.69–0.94)	0.90 (0.76–1.05)
MedDietScore				
Poor (5–27)	-1-	-1-	-1-	-1-
Average (28–30)	0.87 (0.78–0.97)	0.85 (0.76–0.95)	0.81 (0.71–0.91)	0.80 (0.71–0.91)
Good (31–44)	1.00 (0.90–1.11)	0.97 (0.87–1.08)	0.86 (0.76–0.96)	0.86 (0.76–0.97)

Model 1 = Odds ratio (OR) with 95% confidence intervals (95%CI) obtained from a model adjusted for age groups and sex.

Model 2 = as in model 1, further controlled for geographical area, educational level, occupation, marital status, smoking habit, sport activity, BMI, CVD, hypertension and adherence to Mediterranean diet (not including whole grains).

Table 3 reports the association of demographic and socioeconomic factors with WG consumption among younger subjects, with WG food intake. Boys were less likely to consume WG as compared to girls (OR = 0.59; 0.41–0.86 and OR = 0.65; 0.43–1.01, for occasional and regular consumption, respectively, Table 3; Model 2).

Younger consumers spending >2 h/d using PC were less likely to be occasional (OR = 0.53; 0.36–0.80) or regular consumers (OR = 0.56; 0.36–0.87) (Table 4; Model 2).

Determinants of consumers' food choice

Supplementary Figure 2 shows the main reasons people choose to consume WG products. A great proportion of WG consumers believe WG food is healthy food (47.7%) or more natural than regular products (26.2%).

Reasons for non-consumption of WG are depicted in Supplementary Figure 3 and ranged from dislike (38.8%) to an actual lack of knowledge on WG products (45.3%), while about 12.9% believes WG food is 'hard to cook'.

Table 3 Characteristics of children/adolescents (5–19 years) according to intake of whole grain foods and demographic and socioeconomic determinants of consumption.

	Whole grain intake				Unadjusted <i>p</i> value	Occasional consumers (n = 87) vs non-consumers (n = 351)		Regular consumers (n = 123) vs non-consumers (n = 351)	
	Whole sample	Non- consumers	Occasional consumers (<1 time/week)	Regular consumers (≥ 1 time/week)		Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)
N (%)	561	351 (62.6)	87 (15.5)	123 (21.9)	–	–	–	–	–
Sex					0.0041				
Girls	49.6	44.2	57.5	59.4		-1-	-1-	-1-	-1-
Boys	50.4	55.8	42.5	40.6		0.56 (0.39–0.80)	0.59 (0.41–0.86)	0.63 (0.41–0.96)	0.65 (0.43–1.01)
Geographical area					0.0040				
Northern	20.1	23.9	12.6	14.6		-1-	-1-	-1-	-1-
Central	7.7	8.0	12.7	3.3		1.93 (0.85–4.38)	1.96 (0.86–4.47)	0.59 (0.18–1.92)	0.60 (0.18–1.98)
Southern	72.2	68.1	74.7	82.1		1.23 (0.74–2.05)	1.29 (0.77–2.15)	1.07 (0.55–2.05)	1.12 (0.58–2.18)
Sport activity					0.93				
No	34.4	34.2	33.3	35.8		–	–	–	–
Yes	65.6	65.8	66.7	64.2		–	–	–	–
Body mass index					0.12				
Normal weight	82.5	80.3	82.8	88.6		-1-	-1-	-1-	-1-
Overweight/Obese	17.5	19.7	17.2	11.4		0.75 (0.45–1.25)	0.73 (0.43–1.21)	0.59 (0.32–1.11)	0.59 (0.31–1.11)
KIDMED index ^a	4.3 (1.4)	4.3 (1.3)	4.5 (1.7)	4.2 (1.4)	0.39	-	-	-	-

Values are reported as percentages.

Model 1 = Odds ratio (OR) with 95% confidence interval (95%CI) obtained from a model adjusted for age and sex.

Model 2 = as in model 1, further controlled for place of residence and BMI.

^a KIDMED index is reported as means with standard deviations.

Table 4 Association of meal patterns and eating-related behaviours with whole grain food intake in adults (20–97 y) and among children/adolescents (5–19 y) from the INHES study cohort.

	Adults (n = 8421)				Children/Adolescents (n = 561)			
	Occasional consumers (n = 1475) vs non-consumers (n = 4656)		Regular consumers (n = 2290) vs non-consumers (n = 4656)		Occasional consumers (n = 87) vs non-consumers (n = 351)		Regular consumers (n = 123) vs non-consumers (n = 351)	
	Model 1a OR (95%CI)	Model 2b OR (95%CI)	Model 1a OR (95%CI)	Model 2b OR (95%CI)	Model 1c OR (95%CI)	Model 2d OR (95%CI)	Model 1c OR (95%CI)	Model 2d OR (95%CI)
Having breakfast								
Never/rarely	-1-	-1-	-1-	-1-	-1-	-1-	-1-	-1-
Always	1.64 (1.13–2.37)	1.38 (0.95–1.99)	1.45 (0.94–2.22)	1.31 (0.86–2.00)	0.64 (0.34–1.19)	0.61 (0.32–1.14)	0.65 (0.34–1.24)	0.63 (0.33–1.21)
Only with coffee	0.73 (0.49–1.09)	0.70 (0.47–1.04)	0.47 (0.29–0.76)	0.48 (0.30–0.78)	0.60 (0.16–2.28)	0.52 (0.14–1.99)	0.74 (0.19–2.93)	0.79 (0.20–3.14)
Breakfast (place)								
Home	-1-	-1-	-1-	-1-	-1-	-1-	-1-	-1-
Out	0.57 (0.44–0.73)	0.59 (0.46–0.76)	0.41 (0.29–0.57)	0.43 (0.31–0.60)	0.28 (0.09–0.86)	0.27 (0.09–0.83)	0.44 (0.12–1.58)	0.41 (0.11–1.47)
Late morning snack								
Never/rarely	-1-	-1-	-1-	-1-	-1-	-1-	-1-	-1-
Always	0.93 (0.84–1.02)	0.92 (0.83–1.01)	0.93 (0.83–1.03)	0.92 (0.83–1.03)	1.21 (0.81–1.82)	1.23 (0.82–1.84)	1.02 (0.65–1.61)	1.04 (0.66–1.64)
Lunch (place)								
Home	-1-	-1-	-1-	-1-	-1-	-1-	-1-	-1-
Out	0.98 (0.85–1.14)	0.86 (0.74–1.00)	0.94 (0.80–1.11)	0.84 (0.70–0.99)	2.20 (0.84–5.75)	2.60 (0.97–6.98)	3.80 (1.20–12.05)	3.25 (1.00–10.53)
Late afternoon break								
Never/rarely	-1-	-1-	-1-	-1-	-1-	-1-	-1-	-1-
Always	0.90 (0.82–1.00)	0.92 (0.83–1.02)	1.03 (0.92–1.15)	1.04 (0.93–1.17)	0.99 (0.68–1.45)	0.97 (0.66–1.42)	0.73 (0.48–1.12)	0.78 (0.50–1.20)
Dinner (place)								
Home	-1-	-1-	-1-	-1-	-1-	-1-	–	–
Out	0.82 (0.50–1.33)	0.93 (0.57–1.50)	0.75 (0.43–1.34)	0.81 (0.46–1.41)	0.72 (0.06–8.74)	0.85 (0.07–10.31)	–	–
Time spent watching TV								
≤ 2 h/day	-1-	-1-	-1-	-1-	-1-	-1-	-1-	-1-
>2 h/day	0.91 (0.83–0.99)	0.98 (0.89–1.08)	1.13 (1.01–1.25)	1.22 (1.09–1.36)	0.79 (0.55–1.15)	0.76 (0.52–1.11)	0.73 (0.47–1.12)	0.73 (0.47–1.13)
Time spent using PC								
≤ 2 h/day	-1-	-1-	-1-	-1-	-1-	-1-	-1-	-1-
>2 h/day	1.42 (1.28–1.58)	1.19 (1.07–1.33)	1.47 (1.31–1.64)	1.26 (1.12–1.42)	0.53 (0.36–0.80)	0.53 (0.36–0.80)	0.57 (0.36–0.89)	0.56 (0.36–0.87)
Having meals while watching TV								
Never	-1-	-1-	-1-	-1-	-1-	-1-	-1-	-1-
Sometimes/Yes	0.84 (0.70–0.99)	0.85 (0.71–1.01)	0.77 (0.63–0.93)	0.77 (0.63–0.94)	0.63 (0.32–1.25)	0.64 (0.32–1.27)	0.97 (0.45–2.07)	1.01 (0.47–2.15)
Having meals while using PC								
Never	-1-	-1-	-1-	-1-	-1-	-1-	–	–
Sometimes/Yes	0.91 (0.59–1.40)	0.82 (0.53–1.27)	0.93 (0.58–1.52)	0.94 (0.58–1.52)	0.22 (0.05–1.01)	0.24 (0.05–1.06)	–	–

Model 1a = Odds ratio (OR) with 95% confidence interval (95%CI) obtained from a model adjusted for age groups and sex.

Model 2b = as in model 1, further controlled for place of residence, educational level, occupation, marital status, smoking habit, sport activity, BMI, CVD, hypertension and adherence to Mediterranean diet (excluding whole grains).

Model 1c = Odds ratio (OR) with 95% confidence interval (95%CI) obtained from a model adjusted for sex and age.

Model 2d = as in model 1, further controlled for place of residence and BMI.

Table 5 Psychosocial factors associated with whole grain intake in adults (20–97 years).

	Occasional consumers (n = 1475) vs non-consumers (n = 4656)		Regular consumers (n = 2290) vs non-consumers (n = 4656)	
	Model 1 OR (95%CI)	Model 2 OR (95%CI)	Model 1 OR (95%CI)	Model 2 OR (95%CI)
Self-reported health status				
Very good	-1-	-1-	-1-	-1-
Bad	0.47 (0.41–0.54)	0.51 (0.45–0.59)	0.41 (0.36–0.46)	0.44 (0.38–0.51)
Type of distress				
Adverse life events				
None	-1-	-1-	-1-	-1-
At least one	0.92 (0.80–1.06)	0.92 (0.80–1.07)	1.00 (0.86–1.17)	0.93 (0.79–1.09)
Occupation-related				
Never	-1-	-1-	-1-	-1-
Sometimes/most of the times	1.03 (0.76–1.38)	0.94 (0.69–1.29)	0.83 (0.60–1.13)	0.70 (0.50–0.97)
Often/Always	0.88 (0.62–1.24)	0.78 (0.54–1.12)	0.80 (0.55–1.15)	0.68 (0.46–1.00)
Not working/unascertained	0.76 (0.56–1.02)	0.79 (0.57–1.08)	0.65 (0.47–0.90)	0.61 (0.43–0.85)
Family-related				
Never	-1-	-1-	-1-	-1-
Sometimes	1.21 (0.93–1.57)	1.13 (0.87–1.48)	0.94 (0.71–1.24)	0.87 (0.66–1.15)
Most of the times	0.78 (0.60–1.02)	0.77 (0.59–1.00)	0.69 (0.52–0.92)	0.69 (0.52–0.91)
Often/Always	0.71 (0.50–1.01)	0.71 (0.49–1.01)	0.60 (0.40–0.88)	0.59 (0.40–0.87)
Job control				
None/little	-1-	-1-	-1-	-1-
Moderate -good	0.86 (0.70–1.05)	0.82 (0.66–1.01)	0.80 (0.64–1.01)	0.77 (0.61–0.98)
Fairly good	1.26 (1.01–1.57)	1.18 (0.94–1.47)	1.22 (0.96–1.55)	1.16 (0.91–1.48)
Not working/unascertained	0.93 (0.78–1.12)	0.98 (0.81–1.19)	0.98 (0.80–1.20)	1.02 (0.83–1.27)
Financial circumstances-related				
None/little	-1-	-1-	-1-	-1-
Moderate	0.80 (0.60–1.08)	0.73 (0.54–0.99)	0.65 (0.49–0.89)	0.55 (0.40–0.76)
A lot	0.94 (0.70–1.28)	0.96 (0.71–1.31)	0.93 (0.67–1.27)	0.88 (0.63–1.21)
Not working/unascertained	0.50 (0.34–0.73)	0.58 (0.39–0.86)	0.55 (0.36–0.83)	0.58 (0.38–0.89)

Model 1 = Odds ratio (OR) with 95% confidence interval (95%CI) obtained from a model adjusted for age groups and sex.

Model 2 = as in model 1, further controlled for place of residence, educational level, occupation, marital status, smoking habit, sport activity, BMI, CVD, hypertension and adherence to Mediterranean diet (excluding whole grains).

Discussion

The present study provides an updated evaluation of WG food consumption and its major demographic, socio-economic, psychosocial and behavioural factors in a large sample of Italian adults, children and adolescents.

Findings showed that WG food is consumed on a regular basis (≥ 1 time/week) by 26.9% of the whole study sample, with WG bread being the major food source of total WG food for both age groups, up to half of the total WG intake.

These data are in accordance with prior data from the INRAN-SCAI 2005–06 survey [15] showing that WG bread represents the principal food source of total WG intake in adults (46%) while children were more likely to report a prevalent intake of WG breakfast cereals (32%) that in our young population contributed to 15.7% of the total WG intake. Similarly, INHES adults showed low consumption of breakfast cereals (4.8%) in line with the INRAN-SCAI adults (7%), although reporting greater WG pasta intake over the total WG consumption (13.1% vs 2%, respectively). Our results are also in line with data from a cohort of 1400 French adults [23] indicating that the highest contribution to total WG intake derived from WG bread (and toast) intake, although breakfast cereals contributed much more as compared to our Italian adult sample (24%).

Previous population surveys reveal cultural differences in WG food consumption which is typically higher in Scandinavian countries [21] than in many other European countries.

In detail, the percentage of adult consumers (27.2%) resulting from our study is lower than that documented by surveys conducted in USA [12] or UK [22] all reporting consumption above 50 percent, while it is similar to that reported in France (around 30%) [23].

The relatively low consumption of WG foods observed in our Italian sample, which is fairly similar to that reported by the INRAN-SCAI national survey [15], appears to be in contrast with the fact that our population is supposed to be close to a traditional Mediterranean diet which definitely encourages higher intake of unrefined cereals.

Yet, in a global perspective, the comparison between countries needs to be interpreted with caution owing the different survey methods used to collect data on WG intake. Indeed, in our survey we used a food propensity questionnaire while others mainly relied on food intake recorded by dietary recalls [24,25]. Moreover, the differing food sources of WG (e.g. lack of ready to eat breakfast cereals in Italy) makes it difficult an actual comparison among countries.

Beyond providing an update of WG consumption in Italy, we also aimed at identifying the major determinants

of (or variables correlated with) WG food consumption by analysing the association with a number of demographic, socioeconomic, psychosocial and behavioural factors.

A clear educational gradient emerged, with subjects with highest educational attainment being more likely to be regular WG consumers as opposed to those in the lowest educational group, in line with the INRAN-SCAI 2005–06 survey [16], and with data deriving from non-Mediterranean settings [22]; we also found an association with occupation, with highest intakes reported among most advantaged social classes and smallest in the lower classes, as previously reported in a UK study [22].

The socioeconomic shape of WG food intake is in agreement with the socioeconomic gradient already observed for high quality diets, and may be accounted at least in part by the fact that higher educational level is usually associated with increased nutrition knowledge which possibly leads to healthier food choices [26].

In general, we found that regular WG consumers had a healthier lifestyle, including higher physical activity and abstention from tobacco, as already documented in other epidemiological settings [27].

Some meal patterns and eating-related behaviors were also associated with WG food intake. Individuals eating meals out of the home (i.e. breakfast or lunch) were less likely to consume WG food, thus suggesting that WG consumption is associated with a more regular eating behavior.

We also documented a relation of regular WG food intake with self-reported health status and stressful life events, in agreement with a large body of evidence indicating that diet quality is often associated with improved quality of life [28] or other indicators of mental well-being [29].

Regarding prevailing opinions on WG food, we found that about half of study participants believe WG products to be good for health, in agreement with previous results [31], and this might indicate the effectiveness of recent public campaigns to raise public awareness of the health benefits associated with WG food consumption.

On the other side, lack of knowledge on WG food is reported as being the most common obstacle by non-consumers and this may suggest that both public health strategies and food companies should direct their efforts at increasing knowledge and awareness of WG products.

As compared to estimations provided by the previous INRAN-SCAI survey in 2005–06, WG consumers in Italy experienced a relatively modest increase from 23% to 26.9% in 2013, thus leading to a serious re-thinking of public health strategies in order to increase the consumption of WG products in a more substantial manner at population level, especially in light of the numerous health benefits associated with WG intake [1–4].

Some useful suggestions come from the Danish health promotion campaign to increase WG consumption which included the following actions: increasing WG content of commercial food products; mass communication to improve consumers' knowledge about WG foods and their health benefits; and a certification logo on foods with a high WG content [30].

Of course, WG food promotion should be put within a wider context aimed to increase grain consumption globally, also in light of the fact that certain non-WG staple grain foods can be included in a healthy dietary pattern, provided that the dietary pattern maintains recommendations for calories, saturated fats, sodium and added sugars, as recently highlighted by the National Health and Nutrition Examination Survey (NHANES) suggesting that a variety of grain food groups (including enriched grains as ready-to-eat cereals) have the potential to increase consumption of shortfall nutrients [31].

Strengths and limitations of the study

This study has several strengths, including its large sample size and the large number of covariates used to accommodate at least in part confounding.

The considerable number of indicators used to assess meal patterns and the psychosocial dimension and their relation with dietary habits represents one major novelty of the present study.

Major limitations are represented by its cross-sectional and telephone-based design, the self-reported nature of data collection and lack of quantification of WG consumption.

An additional limitation is that, given that self-reported data were used, it is not possible to know whether the foods the participants described were actually WG containing.

Finally, we acknowledge that causality cannot be inferred due to the observational design of our study.

Conclusions

To the best of our knowledge, this study represents the most updated investigation on WG intake and its determinants in the Italian population.

Overall, the percentage of WG consumers emerging from our study (26.9%) is similar to that reported by the last Italian survey (23%) and appears to be still below estimations recorded in other countries of Europe, although comparisons should be made with caution.

Our study also showed that WG consumption clearly clusters with socioeconomic factors, health-related behaviors, meal patterns and with a number of psychosocial factors. Increasing knowledge on major determinants of regular WG intake may help defining more targeted public health strategies to increase the consumption of WG foods, especially in countries in which consumption is lower than recommended.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.numecd.2019.03.001>.

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