Research Article

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Fruit and vegetable consumption: Study involving Portuguese and French consumers

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Abstract: The regular consumption of vegetables and fruits has been indicated as part of a healthy diet. They are considered healthy foods because they are sources of vitamins, minerals, and fibre. Adequate intake of these foods can reduce the risk of certain chronic diseases, like cardiovascular disease, diabetes, obesity, and various types of cancer. The objective of the present study was to determine the consumption habits of vegetables and fruits in two different countries, Portugal and France. For this descriptive study, it was used a questionnaire survey, applied to individuals over 18 years old and carried out through the internet, being disseminated on social networks and by email. The sample was constituted by 640 participants (257 from Portugal and 383 from France). Statistical tools were used for the treatment of data, like the *T*-Test and chi-square test utilised to compare the results between Portuguese and French consumers. The results showed that the Portuguese eat out more often than the French. Portuguese and French like vegetables equally but the French eat more vegetables and fruit per week on average than the Portuguese. The French like soup as much as the Portuguese but the Portuguese eat soup more regularly than the French and prefer soup with cut pieces, unlike the French which prefer soup with grounded vegetables. The global consumption of vegetables and fruits is low in both countries and should be increased, most especially in Portugal, where the consumption is lower. In conclusion, despite some differences found across consumers according to country, the consumption of these foods is still below the recommendations of the World Health Organisation, and therefore, some more actions are necessary to incentivise a higher consumption of fruits and vegetables as part of a healthy lifestyle.

Keywords: consumer attitudes, healthy diet, fruits consumption, vegetable consumption, survey

1 Introduction

According to the World Health Organisation, adults should eat at least five portions or 400 g of fruits and vegetables per day to have a complete and healthy nutritional diet [1]. In addition to this recommendation, the Dietary Guidelines for Americans (DGA) encouraged, since 2005, the population to practice a varied consumption of fruits and vegetables, especially legumes, dark green, orange, and starchy vegetables, among others [2]. The portion consumption recommendations differ depending on the fruit and vegetable type. Presently, the DGA advises an individual, on a 2,000-kcal diet, to eat five and a half cups of red and orange vegetables, five cups of starchy vegetables, one and a half cups of dark green vegetables and legumes, and four cups of other vegetables per week [2]. Vegetables and fruits represent, respectively, the second and third larger groups of foods in the Mediterranean Food Wheel, being recommended to consume two–three portions from each of these groups. The Mediterranean Food Wheel is a graphic representation extended from the Portuguese Food Wheel and aims to emphasise the characteristics of the Mediterranean dietary pattern, evidencing not only the dietary component but also the elements inherent to this lifestyle. It is round shaped, like a plate intended to reflect the dish and the Mediterranean conviviality around the table [3]. This dietary

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pattern has the food groups of vegetables and fruits as one of its pillars for its relevance for good nutrition.

However, and despite the many different recommendations that incentivise the consumption of fruits and vegetables, it is observed that the actual consumption of these foods is very low in a significant number of countries compared to the recommendations [4]. Based on global statistics, 77.6% of men and 78.4% of women from 52 low and middle-income countries consume less than the recommended five portions of fruits and vegetables [5]. This decrease in fruit and vegetable consumption can be linked to the general decline in cooking practices. Indeed, fresh fruits and vegetables have been neglected due to unhealthy eating habits with an overreliance on processed and ultra-processed foods high in salt, fat, and sugar, even when they are of plant origin [6]. Nevertheless, this decrease is not without consequences. The World Health Organisation (WHO) and other organisations like the World Cancer Research Fund proved that the consumption of fruits and vegetables is indispensable for the prevention of cancer, cardiovascular and heart diseases, diabetes, and obesity and for maintaining good health [7].

Because of their high water, dietary fibre content, and low energy, fruits and vegetables are low-density foods. Therefore, they benefit health as they represent a rich source of dietary minerals like potassium, magnesium, folate, phytochemicals like flavonoids, and vitamins A, C, E, and K [4]. Vitamins are fundamental elements involved in diverse metabolic and biological processes in the human body. Vitamins A, C, and E are particularly important in the human diet and are also present in fruits and vegetables. Vitamin A is considered a fundamental micronutrient because it is part of several metabolic functions like preservation of immune defence and antioxidant functions [8]. Fruits are also highly rich in bioactive compounds, like for example phenolic compounds, which have proven to have high antioxidant capacity and exert a protective effect on the human body [9–11].

Given that one of the major causes of death in Western countries is cancer, consuming fruits and vegetables could reduce the risk of developing cancer, especially the oropharynx, esophagus, lung, stomach, and colorectal cancers [12]. Low fruit and vegetable consumption is in the top five risk factors for poor health, with more than 2 million deaths and 65 million Disability-Adjusted Life Years (DALYs) related to low intake of fruits and 1.5 million deaths and 34 million DALYs related to low intake of vegetables worldwide each year [1]. It is estimated that 35% of adults, representing 1.5 billion people, are overweight, and over 200 million men and almost 300 million women are obese [13]. Moreover, overweight and obese people are more likely to have chronic diseases associated with excessively high body mass index (BMI), waist circumference, blood glucose, and blood lipids. Dietary changes such as increased fruit and vegetable consumption have been associated with improvements in BMI, blood glucose, and lipids [14].

Mediterranean Diet has (MD) been suggested as a healthy dietary pattern practiced for centuries in the Southern countries of Europe and those around the Mediterranean Sea [15–17]. The MD is particularly prevalent in some Mediterranean countries like Greece, Spain, Portugal, Italy, France, and northern Africa. The seven countries initially applying for the recognition of UNESCO as Intangible Heritage of Mankind, which was approved in 2013, were as follows: Cyprus, Croatia, Spain, Greece, Italy, Morocco, and Portugal [18,19]. The MD comprises a traditional dietary pattern characterised by a low intake of saturated fat and a high intake of vegetable oils, and particularly olive oil. It also includes a high consumption of plant-based foods, while reducing significantly the consumption of sweet desserts, processed and red meats. In counterpart includes moderate intakes of fish and poultry, red wine, and dairy products [20]. Some studies have been conducted to study the adherence to MD in different countries and their relation with some health conditions [21–24]; however, very few specific studies are found in the scientific literature focusing on the consumption of vegetables and fruits in particular, either in Portugal or in France, and even these focus on different perspectives, like for example the association of consumption with specific health outcomes [25–28]. Hence, the main objective of this work was to determine the consumption habits of vegetables and fruits in a sample of Portuguese and French Participants and to evaluate how these aspects differ among participants from both countries.

2 Materials and methods

2.1 Research design and data collection

This work is a descriptive study, which was aimed at individuals over 18 years of age, of both sexes, and that was carried out through the internet, being disseminated on social networks and by email. The research and data collection was carried out between September 2020 and May 2021.

This research was conducted on a convenience sample, owing to the facility of recruitment based on joint research between teams in both countries. It is known that there are some disadvantages when using convenience samples, but it is also pointed out that these are generally recognised as most useful for conducting research of an exploratory nature [29–31]. When using conventional samples, it is

not mandatory to include a formal calculation of the sample size. Nevertheless, this could be seen as a useful indicator even in these cases [32]. Therefore, an indicative sample size was obtained for both countries. For this, it was considered a 90% confidence for a convenience sample recruitment, corresponding to a z score of 1.65, and a standard error of 10% (α = 0.01) [33,34]. Based on the global population of both countries, an assumption that 80% were adults was considered, and we targeted half of the adult population (50% of adults). Based on these principles, and considering the population in the year 2019 in Portugal and France to be, respectively, 10.29 and 67.39 million people [35], the minimum sample sizes in both countries would be 69. The final samples obtained in both countries were higher than that estimated value (n = 257 in Portugal and n = 383 in France).

The questionnaire that was used to collect information consisted of five parts. In the first part, sociodemographic characteristics were addressed (gender, age, education, marital status, profession, and size of household). In the second part, the participants were asked about anthropometric and behavioural characteristics (weight, height, practice of physical exercise, and classification of health status). The third part made it possible to assess the lifestyle and consumption habits related to vegetables and fruits, namely the frequency and quantity consumed in a week. Data related to health problems were collected in the fourth part, directed to individuals who have some diseases such as diabetes, obesity, cardiovascular disease, high cholesterol, constipation, or cancer. The last part of the questionnaire aimed to assess the knowledge of the people surveyed about the benefits and composition of vegetables and fruits, and in these questions, the participants expressed their agreement on various topics on a scale from 1 “totally disagree” to 5 “totally agree.”

The study was evaluated and approved by the Ethics Committee of the Instituto Politécnico de Viseu with reference No. 10/SUB/2020. The questionnaire was disseminated on social networks and by email and the anonymisation of the participants’ data was guaranteed, as well as other ethical issues to obey international standards for studies with human participants. The questionnaire was translated into Portuguese and French, to be disseminated among participants from these two countries. The sample consisted of 640 participants, of which 383 were French and 257 were Portuguese.

2.2 Data analysis

The data were analysed using basic descriptive statistics such as frequency, mean, and standard deviation. The independent samples T-test was used to compare means across groups of participants, such as country. Contingency tables and the chi-square test were also used to analyse differences in qualitative variables among groups. The use of the Chi-square tests associated with the contingency tables allowed to establish a direct comparison between the results obtained for Portugal and France, at a significant level. In this way, it was possible to identify if country differences were significant or not significant for each of the variables tested.

The software used for data analysis was SPSS (Version 28) from IBM Inc., and the level of significance considered was 5% ($p < 0.05$).

3 Results and discussion

3.1 Sociodemographic characteristics of the participants in the study

The age of the participants varied from a minimum of 18 years to a maximum of 83 and was on average 28.55 ± 13.90 years (Table 1). For the Portuguese participants, the age varied between 18 and 83 years, and the mean was 26.55 ± 10.81 years, while for the French participants, the range was from 18 to 81 years, and the mean was higher than for the Portuguese sample (29.88 ± 15.51 years). Note that one

Table 1: Age of the participants

Variable	Sample	*N*	Minimum	Maximum	Mean ± SD[1]	*T*-Test[2] (statistic, significance)
Age (Years)	Global	639	18	83	28.55 ± 13.90	$t = -3.196$, $p = 0.001$
	Portugal	257	18	83	26.55 ± 10.81	
	France	382	18	81	29.88 ± 15.51	

[1]SD = Standard deviation.

[2]Comparison between Portuguese and French samples. Level of significance of 5%; results are deemed significant if $p < 0.05$.

of the French participants did not indicate the age. According to the independent samples T-test, the age was significantly different in the two groups of participants, i.e. the French and the Portuguese (t = −3.196, p = 0.001).

The age distribution of the participants was classified according to three categories, young adults (aged between 18 and 25 years), adults (aged between 26 and 55 years), and senior adults (with 56 years or over). Most participants were young adults (64.9% of the global sample), with a lower representativeness of senior adults (8.65; Table 2). However, significant differences were found between the samples from both counties (Chi-square test: χ^2 = 10.236, p = 0.006), with a lower percentage of young adults in the French sample (64.9%) and a higher percentage of senior adults (11.5%).

The distribution of the participants according to sex was 440 females and 199 males, corresponding to 68.9% of female participants in the global sample (Table 2). Again, significant differences were found between the distribution of the participants by sex in the two participating countries (Chi-square test: χ^2 = 22.068, p < 0.001). While in Portugal the percentage of female participants was lower, 58.4%, in France the discrepancy between female and male participants was bigger (75.9% females).

The level of education of the participants was generally high, with only 0.2% having a lower school level (primary school), 2.2% having middle school instruction, 21.3% having completed high school (either conventional or technological), and 76.4% with university studies (Table 2). Regarding this variable, no significant differences were found between the two sets of participants (Chi-square test: χ^2 = 0.843, p = 0.839). The distributions were similar in Portugal (0.0% primary, 1.9% middle, 21.8% high school, and 76.3% university) and in France (0.3% primary, 2.49% middle, 20.9.8% high school, and 76.4% university).

With respect to the marital status (Table 2), most of the participants were single (79.3%), with 16.3% married, 3.9% divorced, and 0.5% widowed. Significant differences were encountered in this case between countries (Chi-square test: χ^2 = 8.454, p = 0.038). The percentage of single participants was higher in the Portuguese (84.8% single, 11.3% married, 3.5% divorced, and 0.4% widowed) when compared with that of French participants (75.7% single, 19.6% married, 4.2% divorced, and 0.5% widowed).

Table 2: Distribution of the participants by the different classes considered for the sociodemographic variables

Variable	Groups	Global sample (%)	Portuguese sample (%)	French sample (%)	Chi-square test (statistic, significance[1])
Age	Young adults (18–25 years)	67.1	70.4	64.9	χ^2 = 10.236, p = 0.006
	Adults (26–55 years)	24.3	25.3	23.6	
	Senior adults (56+ years)	8.6	4.3	11.5	
Sex	Women	68.9	58.4	75.9	χ^2 = 22.068, p < 0.001
	Men	31.1	41.6	24.1	
Education level	Primary school	0.2	0.0	0.3	χ^2 = 0.843, p = 0.839
	Middle school	2.2	1.9	2.4	
	High school	21.3	21.8	20.9	
	University	76.4	76.3	76.4	
Marital status	Single	79.3	84.8	75.7	χ^2 = 8.454, p = 0.038
	Married	16.3	11.3	19.6	
	Divorced	3.9	3.5	4.2	
	Widowed	0.5	0.4	0.5	
Professional status	Students	64.9	70.8	61.0	χ^2 = 61.843, p < 0.001
	Unemployed	1.9	1.9	1.8	
	Public employee	2.7	6.6	0.0	
	Employed	21.0	13.6	25.9	
	Entrepreneur	3.1	5.4	1.6	
	Other	6.4	1.6	9.7	
Household	1–2 Persons	44.0	23.7	57.6	χ^2 = 123.853, p < 0.001
	3–5 Persons	42.3	46.3	39.5	
	6–9 Persons	11.3	24.1	2.6	
	10 Or plus persons	2.5	5.8	0.3	

[1]Level of significance of 5%; results are deemed significant if p < 0.05.

The professional activity of the participants was also investigated as shown in Table 2. A high percentage of the participants in this study were students, 64.9%, while only 1.9% were unemployed, 21.0% were employed, and 2.7% were working in governmental bodies. A small percentage, 3.1%, were entrepreneurs and 6.4% had other occupations. Results of the Chi-square test revealed significant differences between the samples from Portugal and France (χ^2 = 610.843, p < 0.001). Higher discrepancies were observed for the percentage of students (70.8% in Portuguese and 61.0% in French participants) and those employed (13.6% in Portuguese and 25.9% in French participants).

The dimension of the household was found to be mostly one or two persons (44.0% of the participants) or from three to five persons (42.3%; Table 2). Households consisting of six to nine persons represented 11.3% and those with a higher number of members represented 2.5%. Significant differences were found between the Portuguese and the French groups of participants (Chi-square test: χ^2 = 123.853, p < 0.001). In Portugal, there were significantly larger families (23.7% for one–two members, 46.3% for three–five members, 24.1% for six–nine members, 5.8% for 10 or plus members) than in France (57.6% for one–two members, 39.5% for three–five members, 2.6% for six–nine members, and 0.3% for 10 or plus members).

3.2 Anthropometric and behavioural variables

Table 3 shows the values of weight, height, and BMI of the participants in the study. Concerning the weight, it varied between 34.00 and 164.00 kg, with a mean of 62.18 ± 14.46 kg for the global sample. The mean value for weight was higher for the French sample (64.64 ± 13.12 kg) when compared to the Portuguese (58.40 ± 15.59 kg), and these differences were significant (T-test for independent samples: t = 5.357, p < 0.001). For the global sample, the height varied between 1.20 and 1.95 m, with a mean value of 1.65 ± 0.10 m. The height was higher for French participants than for the Portuguese (1.68 ± 0.09 and 1.62 ± 0.10 m, respectively), with a significant difference (T-test: t = 7.384, p < 0.001). The BMI varied from a minimum of 12.64 to a maximum of 61.72 kg/m^2, being on average 22.64 ± 4.48 kg/m^2 for the global sample. Once again the difference between the Portuguese and the French participants was significant (T-test: t = 2.140, p = 0.033), with a higher mean value for French participants (22.95 ± 3.85 kg/m^2).

For the global sample, 63.2% of the participants are satisfied with their body weight against 36.8% who are not. However, these percentages were significantly variable according to country (Chi-square test: χ^2 = 10.661, p = 0.001), with higher satisfaction with body weight among the Portuguese participants (70.8%) in relation to the French (58.1%). Among the participants who replied that they were not satisfied with their weight, 37.6% were considered to be underweight, 52.0% considered to be overweight, and 10.3% admitted being obese. Also in this case significant differences were found between countries (Chi-square test: χ^2 = 47.279, p < 0.001), with differences for all reasons of bodyweight dissatisfaction: 52.9% of low weight, 32.3% of overweight, and 14.8% of obesity for the Portuguese, and 23.2% of low weight, 70.7% of overweight, and 6.1% of obesity for the French.

Concerning the practice of physical exercise, 21.1% of the participants replied they never do it, 36.5% do it once a week, 29.7% do it two or three times per week, and only 12.7% practice physical exercise more than three times per week. In this regard, no significant differences were found between the Portuguese and the French participants (Chi-square test: χ^2 = 7.453, p = 0.059). For the Portuguese

Table 3: Anthropometric characteristics of the participants

Variable	Sample	*N*	Minimum	Maximum	Mean ± SD[1]	*T*-Test[2] (statistic, significance)
Weight (kg)	Global	616	34.00	164.00	62.18 ± 14.46	t = 5.357, p < 0.001
	Portugal	243	34.00	164.00	58.40 ± 15.59	
	France	373	42.00	130.00	64.64 ± 13.12	
Height (m)	Global	626	1.20	1.95	1.65 ± 0.10	t = 7.384, p < 0.001
	Portugal	243	1.20	1.90	1.62 ± 0.10	
	France	373	1.45	1.95	1.68 ± 0.09	
BMI[2] (Kg/m^2)	Global	616	12.64	61.72	22.64 ± 4.48	t = 2.140, p = 0.033
	Portugal	243	12.64	61.72	21.49 ± 5.28	
	France	373	16.71	46.06	22.95 ± 3.85	

[1]SD = Standard deviation; [2]BMI = Body Mass Index (= weight/height^2).

[2]Comparison between Portuguese and French samples. Level of significance of 5%; results are deemed significant if p < 0.05.

participants, the weekly frequency was 17.1% never, 35.4% once, 35.0% 2–3 times, and 12.5% more than three times, and for the French participants, the weekly frequency was 23.8% never, 37.2% once, 26.2% 2–3 times, and 12.8% more than 3 times.

The perception of a varied diet was also investigated, with a high percentage of participants indicating that they do it sometimes (39.9%) or several times per week (33.2%), with only 2.5% assuming they never have a varied diet and 24.4% indicating they always have a varied food consumption. To this matter, significant differences were encountered between the participants of the two countries (Chi-square test: $\chi^2 = 19.753$, $p < 0.001$), with the French practicing a varied diet more frequently than the Portuguese. The responses of the Portuguese were 1.6% never, 49.8% sometimes, 25.7% several times, and 23.0% always, while those of the French were 3.1% never, 33.2% sometimes, 38.2% several times, and 25.4% always.

The great majority of the participants considered that they had a good health status (54.8%), with 8.6% considering it excellent, 25.0% considering it sufficient, and 3.1% considering it not satisfactory. Still, 5.9% replied they did not know about their health status and 2.5% would not want to reply to the question. Also, to this matter, significant differences were observed between the groups according to country (Chi-square test: $\chi^2 = 14.173$, $p = 0.015$). In general terms, a better health status was reported by the French (11.0% excellent, 53.4% god, and 24.9% satisfactory) in comparison to the Portuguese (5.1% excellent, 56.8% god, and 25.3% satisfactory).

3.3 Consumption habits

The results in Table 4 refer to the eating out patterns and the preferences towards food in the categories of fruits and vegetables, for the global sample, and separated by country. It was observed that a high percentage of participants eat out of home between two and four times per month (38.5% of the total participants, 34.2% of the Portuguese, and 41.4% of the French). There is also an expressive percentage who eat out less than once per month (34.3% of the total participants, 31.9% of the Portuguese, and 35.9% of the French), so, in general, the frequency of eating out is low for both samples. Nevertheless, significant differences were found between the Portuguese and the French participants ($p < 0.001$). With respect to the type of food consumed outside of the home,

Table 4: Eating out and preferences towards fruits and vegetables

Question	Answering options	Global sample (%)	Portuguese sample (%)	French sample (%)	Chi-square test (statistic, significance[1])
How many times do you have lunch or dinner out?	≤1 time/month	34.3	31.9	35.9	$\chi^2 = 17.119$, $p < 0.001$
	2–4 times/month	38.5	34.2	41.4	
	2–3 times/week	19.4	21.0	18.3	
	≥4 times/week	7.8	12.8	4.5	
What type of food do you consume when eating out?*	Regular food	83.4	91.4	78.1	
	Vegetarian food	8.0	10.1	6.5	
	Detox food	1.6	1.9	1.3	
	Others	8.4	1.2	13.3	
Do you like to eat vegetable foods?	Yes	93.6	94.9	92.4	$\chi^2 = 1.320$, $p = 0.251$
	No	6.4	5.1	7.3	
Do you like to eat soup?	Yes	83.7	84.4	83.2	$\chi^2 = 0.160$, $p = 0.690$
	No	16.3	15.6	16.8	
Which type of soup do you prefer?	Chicken soup	13.4	12.1	14.3	$\chi^2 = 13.158$, $p = 0.004$
	Soup with cut vegetable pieces	54.4	60.3	50.2	
	Soup with grounded vegetables	29.8	27.6	31.5	
	Others	2.4	0.0	4.0	
In which forms do you prefer consuming the fruits?	In fresh/natural	87.2	88.7	86.2	$\chi^2 = 8.324$, $p = 0.040$
	Natural juice	8.5	9.8	7.7	
	Smoothie	1.7	0.8	2.4	
	Others	2.5	0.8	3.7	

*Participants could select more than one option.

[1]Level of significance of 5%; results are deemed significant if $p < 0.05$.

there is a prevalence of regular food (83.4% for the global sample, 91.4% for the Portuguese, and 78.1% for the French). Only small niches consume vegetarian (8.0% for the global sample, 10.1% for the Portuguese, and 6.5% for the French) or detox foods (1.6% for the global sample, 1.9% for the Portuguese, and 1.3% for the French).

Table 4 also shows the participants' preferences regarding consumption of vegetables and fruits. Practically all participants like vegetables, 93.6%, and no significant differences were found ($p > 0.05$) between the Portuguese and the French, with percentages of 94.9 and 92.4, respectively. Also, very similar results were observed for the liking of soup, so 83.7% of the participants liked the soup, being 84.4% for the Portuguese and 83.2% for the French, with no significant differences between countries ($p > 0.05$). When it comes to the preferences for soup, those with cut vegetable pieces were preferred by 54.4% of the participants, and more by Portuguese than French (60.3 and 50.2%, respectively), with significant differences between countries ($p = 0.004$). In what concerns the consumption

Table 5: Consumption patterns towards vegetables and fruits

Question	Answering options	Global sample (%)	Portuguese sample (%)	French Sample (%)	Chi-square test (statistic, significance[1])
Weekly frequency of consumption of vegetables	Never	0.9	0.8	1.1	$\chi^2 = 11.205$, $p = 0.024$
	1–2 times/week	28.6	34.0	25.0	
	3–5 times/week	34.7	28.9	38.7	
	6–7 times/week	12.1	10.2	13.4	
	Every day	23.6	26.2	21.8	
Weekly frequency of consumption of soup	Never	20.1	15.5	23.2	$\chi^2 = 16.896$, $p = 0.002$
	1 time/week	44.6	40.2	47.6	
	2–3 times/week	24.8	30.7	20.8	
	4–7 times/week	6.4	7.6	5.7	
	Every day	4.0	6.0	2.7	
Preferred form of consumption of vegetables	Raw	26.1	40.7	16.3	$\chi^2 = 48.356$, $p < 0.001$
	Cooked	36.1	31.6	39.2	
	Both	37.7	27.7	44.5	
Most consumed vegetables*	Pees/beans	56.7	47.1	63.2	
	Tomato	76.6	67.3	82.2	
	Pepper	41.6	30.4	49.1	
	Eggplant	26.3	31.9	22.5	
	Artichoke	9.5	9.3	9.7	
	Cauliflower	28.7	34.6	24.8	
	Carrot	65.3	61.1	68.1	
	Beetroot	24.8	15.6	31.1	
	Lettuce	62.8	69.6	58.2	
	Broccoli	42.0	52.5	35.0	
	Cabbage	22.8	38.1	12.5	
	Watercress	19.2	40.1	5.2	
	Spinach	42.3	36.6	46.2	
Average consumption of vegetables (doses)	None	0.2	0.5	0.0	$\chi^2 = 22.622$, $p < 0.001$
	1–7/week	71.0	82.0	64.3	
	8–14/week	21.7	14.1	26.3	
	15 or more/week	7.1	3.4	9.4	
Average consumption of fruits (pieces/doses)	None	7.2	9.3	5.8	$\chi^2 = 14.467$, $p = 0.002$
	1–3/week	43.2	49.8	38.7	
	4–7/week	35.2	27.6	40.3	
	1–2/day or more	14.4	13.2	15.3	
Average consumption of natural fruit juices or smoothies (doses)	None	79.1	66.1	87.2	$\chi^2 = 2.746$, $p < 0.001$
	1–4/week	12.3	21.4	6.3	
	5–7/week	5.5	7.4	4.2	
	8 or more/week	3.4	5.1	2.3	

*Participants could select more than one option.

[1]Level of significance of 5%; results are deemed significant if $p < 0.05$.

of fruits, there is a huge preference for fresh natural fruits (87.2% of the participants, with a trend for a higher percentage of Portuguese than French (88.7 and 86.2%, respectively), making these differences significant ($p = 0.040$).

Table 5 presents the results for the eating patterns regarding consumption of vegetables and fruits. Vegetables are consumed three–four times per week by 34.7% of the participants, with a higher percentage for the French (38.7%) than for the Portuguese (28.9%), being the differences between countries significant ($p = 0.024$). However, a contrary trend was observed regarding the frequency of consumption of soup, with 30.7% of the Portuguese consuming it two–three times/week against 20.8% of the French. Again, the differences in the frequency of consumption of soup between countries were significant ($p = 0.002$). With respect to the form of consumption of vegetables, about one-third prefer them raw, another third prefer them cooked and the other third like both options. Nevertheless, the differences between French and Portuguese preferences for raw or cooked vegetables were significant ($p < 0.001$), with more Portuguese preferring them in the raw form (40.7%) and more French preferring them cooked (39.2%). The most consumed vegetables include tomato, carrot, and lettuce (76.6, 65.3 and 62.8% of the whole sample, respectively).

With respect to the frequency of consumption, the results in Table 5 show that significant differences were found for the consumption of vegetables ($p < 0.001$) with a higher percentage of consumption for the French (26.3% consume them from 8 to 14 times per week) when compared to the Portuguese (only 14.1% consume vegetables 8–14 times/week). Also, significant differences were found for the consumption of fruits ($p = 0.002$) with a similar trend (40.3% of the French and 27.6% of the Portuguese consume them four–seven times per week). Considering the whole sample, most participants consume only less than one dose of vegetables per day (71.0% consume one–seven times/week) and 43.2% consume fruits only one–three times per week. Natural fruit juices or smoothies are consumed with low regularity, with 12.3% of the participants consuming them one–four times per week, a higher percentage for the Portuguese than for the French (21.4 and 6.3%, respectively), with significant differences ($p < 0.001$).

4 Discussion

Worldwide, there is a rising burden of non-communicable diseases related to high BMI. This results from inappropriate dietary habits, with energy-dense diets rich in saturated fat or salt associated with unhealthy lifestyles such as lack of physical activity [36–39]. The results obtained for this study indicated that in all cases, i.e. for the global sample and the French and Portuguese groups, the mean values of BMI fall into the category of normal weight, ($18.5 \leq \text{BMI} < 25.0\ \text{kg/m}^2$) [40]. This is a positive indicator, given that the prevalence of obesity is linked with a number of noncommunicable chronic diseases, such as cardiovascular diseases, heart diseases, diabetes, fatty liver, and kidney problems, among others, allied to lack of physical activity [41–45]. The participants in this study were, to a high extent, university students in Portugal and France. A recent study conducted on students from 31 universities in China revealed that obesity-related eating behaviours were significantly associated with chronic diseases, infectious diseases, and mental disorders [46]. Another study conducted in Peru [47] revealed a significantly higher prevalence of overweight in male than in female university students.

Adequate eating habits are an essential part of a healthy lifestyle and poor nutritional habits are pre-established risk factors for the onset of chronic diseases. The transition from adolescence to adulthood is a period often characterised by an unhealthy lifestyle, in which young people become independent and adopt enduring health behaviour patterns. Therefore, this transition period can significantly shape the type of eating habits that young adults adopt, which may have lifelong implications [48].

The Portuguese General Direction of Health and the Portuguese Nutrition Association emphasise an adequate intake of vegetables and fruits, as recommended in food education tools such as the Mediterranean Food Wheel [3]. Adequate intake of these food groups reduces the risk of some diseases, such as cardiovascular diseases, various types of cancer, obesity, eye problems, liver diseases, diseases of the gastrointestinal tract, and diabetes [49–54].

Despite the growing focus on the health benefits of vegetables and fruits, their consumption is in general below the recommended intake, leading to a drastic increase in nutrition-related health problems. According to the WHO, inadequate consumption of fruits and vegetables is among the ten risk factors that most cause death and disease worldwide. On the other hand, according to the global burden of disease project, there are 2.7 million deaths worldwide that can be attributed to insufficient consumption of vegetables and fruits. Furthermore, it has been shown that an increased intake of vegetables and fruits can reduce ischemic heart disease by 31%, cerebrovascular accidents by 19%, and stomach cancer by 19% [48].

It is known that vegetables and fruits, as part of a healthy diet low in fat, sugars, and sodium, have a protective effect on the body; therefore, the WHO suggests consuming more than 400 grams of fruits and vegetables a day

to improve general health and reduce the risk of certain noncommunicable diseases, in line with recommendations of the European Food Safety Association [55,56]. The results of this work indicated that in both countries the frequency of consumption of fruits and vegetables was low, with most participants consuming them less than once per day, making this even more problematic for vegetables than fruits. The results obtained indicated significant differences between the consumption habits and preferences for both fruits and vegetables; however, in both countries, the average consumption levels were low. A study by Estaquio et al. [28] investigated fruit and vegetable consumption on a sample of French adults and observed that the adherence to the recommendation of consumption of "5 pieces/doses per day" was highly variables according to sociodemographic characteristics of the participants, namely that adult women aged over 50 years, who are physically active, have a university education and do not consume alcohol or smoke are more prone to comply with that recommendation. In Portugal, the study by Miguel et al. [25] focused on the application of the Consumer Ethnocentric Tendencies Scale for investigating fruit and vegetable purchase and consumption among a sample of Portuguese adults. Their results identified two types of consumers, according to their degree of preference towards national food products in the categories of fruits and vegetables. Still, Portuguese consumers tend to prefer Portuguese-identified products if they are available. The consumption of local and in-season fruits and vegetables has many advantages not only for the consumer but as well as for the local producers and the environment [57].

According to the National Food and Physical Activity Survey, the Portuguese consume 418 g of vegetables and fruits per day, with children and adolescents being the two population groups with the greatest inadequacy (68.9 and 65.9%, respectively) [58]. With respect to the consumption of organic fruit, 14.7% of the population consume organic fruits on a daily basis, and 15.3% of the population indicate that they consume them two–six times a week [58]. According to data from the European Union (EU), Portugal is the second country where the highest percentage of the population eats fruit on a daily basis, also occupying the fourth place in terms of daily consumption of vegetables. According to data released by Eurostat, the EU statistics office [59], 81% of the Portuguese consumed fruit every day in 2017, being surpassed only by Italy, where this daily consumption was around 85%. When it comes to vegetables, Portugal ranks fourth with 78% of the population consuming it daily, just behind Ireland (84%), Belgium (84%), and Italy (80%). However, food consumption patterns and habits vary highly according to country, among other sociodemographic factors. In France, Bihan et al. [27] reported an average consumption of fruits and vegetables of two times per day and about 30% of the people do not consume them on a daily basis. They observed the determinants for low consumption of fruits and vegetables as being lower age, lower income, and lower education level. Another study by Estaquio et al. [28] also reported higher education levels as positively associated with increased consumption of fruits, regardless of sex.

5 Conclusions

This study allowed comparing the preferences and consumption habits regarding vegetables and fruits of two groups of people, from different countries (Portugal and France). The results showed that, although being two countries situated in Europe, the differences were significant for most investigated issues. Major differences were found for eating out, with more Portuguese participants doing it four times per week or more, 12.8% as compared with 4.5% of the French. Nevertheless, in both countries, the liking for vegetables and soup is similar, although when it comes to choosing a type of soup French prefer soup with grounded vegetables (31.5%), and Portuguese prefer soup with cut vegetable pieces (60.3%).

In what concerns the frequency of consumption, a higher consumption of vegetables and soup was observed for the Portuguese, with 26.8% consuming vegetables every day and 6.0% consuming soup also on a daily basis. The most consumed vegetables include tomato, carrot, and lettuce, with similar patterns in both countries. Finally, in what concerns the frequency of consumption, the French participants consume higher amounts of vegetables and fruits than the Portuguese (15.3% of French against 13.2% of Portuguese that consume fruits more than one time per day, and 9.4% of French against 3.4% of Portuguese that consume vegetables 15 or plus times per week).

In conclusion, these results highlight important differences in the two samples evaluated, which is relevant to help incentivise the Portuguese to higher consumption of vegetables and fruits, as part of a healthy diet aimed at preventing disease.

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