

To Bio or not to Bio? Organic Food Consumption in Switzerland

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Abstract

Background: Our study aimed to gain from a comprehensive understanding of organic food consumption in Switzerland. **Methods:** Data from the Swiss National Nutrition Survey menuCH (2014–2015, n = 2057, 18 to 75 years old) and a cross-sectional, population-based survey were used. Dietary information was collected using two non-consecutive 24-hour dietary recalls (24HDRs). Organic foods were classified using information about food descriptors and labels. Participants were classified as organic food consumers if they had consumed organic foods in at least one 24HDR. Binomial logistic regression models were used to identify factors associated with organic food consumption. **Results:** This study determined that 27.8% of the Swiss population consumed organic food. However, only 3.6% of all food consumed within this group of organic food consumers was organic. Food products of plant origin tended to be consumed more frequently as organic than were those of animal origin, except for eggs and dairy products. Organic food consumption was positively associated with female sex (odds ratio (OR) = 2.18, 95% confidence interval (CI) 1.69, 2.80), high educational degree (OR = 1.28, 95% CI 1.02, 1.61), and high alternate healthy eating index (OR = 5.45, 95% CI 3.70, 8.02), and negatively associated with young age (OR = 0.56, 95% CI 0.40, 0.78), French-speaking living area (OR = 0.73, 95% CI 0.56, 0.93), non-Swiss nationality (OR = 0.74, 95% CI 0.56, 0.98), large household size (OR = 0.59 95% CI 0.38, 0.89), and obesity (OR = 0.53, 95% CI 0.36, 0.77). **Conclusion:** The present study provides a better understanding of the distribution of organic food consumption within the Swiss population and which subgroups consume particularly little organically produced food. **Clinical Trial Registration:** Clinical Trial Registration: ISRCTN 16778734; <https://www.isrctn.com/search?q=menuch>.

Keywords: organic; organic food consumption; dietary intake; nutrition survey; 24-hour dietary recall; sustainable food; sustainable nutrition

1. Introduction

In recent years, the supply and consumption of organic foods, especially in developed countries, have steadily increased [1,2]. A key reason for the increase in demand is the perception that organic food is healthier, more sustainable, and more environmentally friendly than conventionally produced food [3,4]. Key principles of organic farming and food production include a near prohibition of chemical pesticides and synthetic fertilizers, restricted use of antibiotics in animals, bans on genetically modified organisms, and a focus on crop rotation, as opposed to conventional farming and food production [5].

In several observational studies, increased consumption of organic food has been associated with lower risks of obesity, metabolic syndrome, type 2 diabetes, and some cancers [6–10]. Its positive effect on health could be related to increased intake of secondary plant metabolites and lower exposure to synthetic pesticide residues as compared to conventionally grown food products [11–14]. The International Agency for Research on Cancer (IARC) has classified various pesticides commonly used in conventional

food production as possibly or probably carcinogenic in humans [15,16]. A recent study of a 40-day organic food treatment in Greek primary-school children showed that organic food intake reduced metal exposure and oxidative damage of biomarkers, such as urinary lead concentration, over time [17,18]. However, the mechanisms underlying these results have not been extensively studied; to complicate matters, organic food consumption is highly correlated with several other health-related indicators of a healthy lifestyle [19]. Currently, there are not enough long-term clinical intervention studies to determine whether an organic diet is healthier than a diet based on conventionally grown foods [6,14,20].

Increased consumption of organic foods offers multiple environmental benefits in addition to potential human health benefits. It may reduce the environmental impact of agricultural practices and preserve biodiversity [21]. Organic food consumption could also increase diet sustainability by encouraging the purchase of local and seasonal products [22].

These are all compelling reasons for public health authorities to consider integrating the promotion of organic



food consumption into their nutrition strategies. However, targeted and efficient strategies only emerge when we can understand specific consumption patterns and identify vulnerable population subgroups. Efforts to better understand these consumption patterns have recently been made in several countries. In France, Denmark, Germany, and the US, studies have shown that individuals with higher educational levels, higher incomes, healthier lifestyles, better overall diet quality, and more in-depth nutritional knowledge show higher consumption of organic food products [23–27]. Evidence from the Swiss context shows an increase in consumer purchasing of organic food products in recent decades [28,29]. The Biobarometer, a representative online survey conducted every two years since 2018, provides information on organic food consumption behaviour in the French- and German-speaking parts of Switzerland [30,31]. It has shown that the proportion of respondents with a high level of organic food consumption (i.e., several times a week to daily) almost doubled from 2018 to 2020 and has remained stable at a high level since then (2018: 24%, 2020: 47%, 2022: 49%). This substantial increase is probably related to the COVID-19 pandemic and to a growing social awareness of sustainable food production [31].

In addition to motives for and barriers to organic food purchasing, the Biobarometer asks about the estimated frequency of current and future consumption of organic food (excluding consumption in restaurants, canteens, and take-aways). However, the respondents do not disclose any information about the amount of food consumed, which is also a weakness of other studies. Moreover, the survey only estimates consumption frequency, without providing detailed information on the individual foods consumed. This is relevant because organic food consumption is known to be often overestimated due to a discrepancy between what people consider to be organic food and what is actually organically produced according to guidelines [31]. The first national nutrition survey, menuCH, lends itself to analysis of organic food consumption in Switzerland, as it collected detailed individual and nationally representative dietary data, as well as information on food brands and bio-labels. All foods, including those consumed away from home, were covered. Furthermore, the menuCH survey also included the Italian-speaking part of Switzerland, which allows comparisons between the country's three main language regions. By examining the consumption of organic food in Switzerland using this comprehensive dietary data, this study aims to provide new information on this topic. Our objective was to gain a comprehensive understanding of organic food consumption in Switzerland and to identify associated sociodemographic, anthropometric, and lifestyle factors and related underlying dietary patterns. Data of the menuCH survey will allow for quantifying the amount of organic food consumption.

2. Materials and Methods

To report the findings of the present study, the “Strengthening the Reporting of Observational Studies in Epidemiology–Nutritional Epidemiology (STROBE-nut)” checklist was used [32].

2.1 Study Design and Setting

The Swiss National Nutrition Survey menuCH was conducted between January 2014 and February 2015 in 10 study centres across Switzerland. As a cross-sectional and population-based survey, Swiss residents aged 18 to 75 years were drawn from a stratified random sample provided by the Federal Statistical Office. The sample covers the German-, French-, and Italian-speaking regions of Switzerland and is representative of the following 35 strata (7×5): the seven administrative regions of Switzerland (Lake Geneva Region, Espace Mittelland, Zurich, and Northwestern, Eastern, Central, and Southern Switzerland) and five age groups (18–29, 30–39, 40–49, 50–64, and 65–75 years) [33].

Out of 13,606 individuals in the initial sample, 5496 were successfully contacted by either mail or phone and 2086 agreed to participate in the study, resulting in a net participation rate of 38%. The present study ultimately included 2057 participants who underwent a complete dietary assessment, consisting of two 24-hour dietary recalls (24HDRs). Further information about the recruitment procedure for the menuCH survey and a complete flow diagram of study participation has been published elsewhere [33].

All participants provided written informed consent, and all procedures performed in the survey followed the ethical standards of the Declaration of Helsinki. The survey protocol was approved by the Ethics Committee of the city of Lausanne (Protocol 26/13) and by the relevant regional ethics committees. The survey was entered at the ISRCTN registry under the number 16778734 [34].

2.2 Dietary Assessment

Dietary assessment for menuCH was performed by trained dietitians [33]. The initial 24HDR was carried out through face-to-face interviews, while the second 24HDR was conducted by phone between two and six weeks later. Throughout the survey period, interviews took place across all seasons and days of the week [33]. No detailed information was recorded regarding the use of dietary supplements.

Using the trilingual Swiss version (0.2014.02.27) of the GloboDiet® software (formerly EPIC-Soft®, IARC, Lyon, France [35,36]) — adapted to Switzerland by the Federal Food Safety and Veterinary Office (FSVO) in Bern, Switzerland — food consumption by menuCH participants was recorded in a standardized and automated manner. A photo book illustrating portion sizes and common household measurements was utilized during the 24HDR to support the quantification of food consumption [37]. To estimate macronutrient and micronutrient intake, each recorded

food was then linked to the most suitable item in the Swiss Food Composition Database [38] using the matching tool FoodCASE (Premotec GmbH, Winterthur, Switzerland). Dietary assessment data were cleaned and screened for inconsistency in the primary study of menuCH data. Detailed information about the quality control of dietary data has been previously published elsewhere [33].

2.3 Assessment of Organic Foods

Organic foods were classified using information about food descriptors and labels. The identification of the organic food labels was done through an internet search based on an existing overview [39]. A listing of the different labels and brands of organic food products can be found in the supplementary materials (**Supplementary Table 1**). Participants were classified as organic food consumers if they reported consuming organic foods in at least one 24HDR. In addition, the number and quantity of organic food consumed were calculated based on mean values from the two 24HDR.

2.4 Assessment of Diet Quality

The diet quality of the menuCH participants was assessed using the 2010 version of the Alternate Healthy Eating Index (AHEI) [40]. The AHEI includes the following components: vegetables, fruits, whole grains, sugar-sweetened beverages and fruit juices, nuts and legumes, red and processed meats, trans fat, fish, polyunsaturated fatty acids, sodium, and alcohol. The AHEI value range from 0 to 110 points, with 0 points indicating low and 110 points indicating high diet quality. Quintiles of AHEI were used for the statistical analysis. Detailed information about the calculation of the AHEI of the menuCH participants has been previously published elsewhere [41].

2.5 Assessment of Sociodemographic, Anthropometric, and Lifestyle Factors

Information about sociodemographic and lifestyle factors was obtained from a separate questionnaire filled out by the participants at home and checked for completeness and clarity by the dietitians on the day of the first 24HDR. Anthropometric data for body weight and body height were measured by trained personnel in the study centres and were used to calculate the body mass index (BMI) [33,41]. The following variables were considered in the present study: sex (male, female); age (18–29, 30–44, 45–59, 60–75 years); language region (German-, French-, Italian-speaking regions); nationality (Swiss, binational, non-Swiss); education (primary or no degree, secondary, tertiary); household size (1–2, 3–4, 5–6 people); gross household income (<6000, 6000–13,000, >13,000 Swiss francs/month; equivalent to <6382, 6382–13,828, >13,828 Euro/month); BMI (underweight [$\text{BMI} < 18.5 \text{ kg/m}^2$], normal weight [$18.5 \text{ kg/m}^2 \leq \text{BMI} < 25.0 \text{ kg/m}^2$], overweight [$25.0 \text{ kg/m}^2 \leq \text{BMI} < 30.0 \text{ kg/m}^2$], obese [$\text{BMI} \geq 30.0 \text{ kg/m}^2$]) [41,42]; self-reported physical activity (low, mod-

erate, high); smoking status (current, former, non-smoker); and self-reported health (very bad to medium, good to very good).

2.6 Weighting Strategy

To ensure the study's representativeness to the Swiss population and to account its sampling design and response, weighting factors were applied using the menuCH weighting strategy [43]. The weighted sample of 2057 participants is representative of a total population of 4,627,878 individuals. In the present study, all results were weighted for sex, age, marital status, major region of Switzerland, nationality, and household size. Furthermore, analyses that focused on food consumption were additionally weighted for the season and weekday of data collection.

2.7 Statistical Methods

Descriptive statistics were used to characterise the survey's participants overall consumption and organic food consumption. Proportions of organic food consumption (amount and number of organic food) overall and by food group were calculated across the total population and within the group of organic food consumers. The number of organic foods consumed was considered in addition to the amount because the intrinsic weights of the different foods vary greatly. Thus, foods with a high liquid content (e.g., beverages or fruits) would have a greater impact when considering the amount than foods with a low liquid content (e.g., cereals or nuts and seeds). Univariate and multivariate binomial logistic regression models were used to investigate the association of organic food consumption with different sociodemographic, anthropometric, and lifestyle factors. In addition to potential sociodemographic, anthropometric, and lifestyle factors, multivariate analyses were further adjusted for mean energy intake as well as the season and weekday of the dietary assessment.

To increase the number of participants with complete information about sociodemographic, anthropometric, and lifestyle factors, multivariate imputation by chained equations (MICE, $m = 25$) was performed [44].

The analyses were conducted using R software (version 4.2.2. for Windows, R Foundation for Statistical Computing, Vienna, Austria). Multivariate imputation by chained equations was performed with the package *mice* [44]. Additionally, the package *survey* was used to perform the weighted statistical analyses [45]. For all analyses, the statistical significance was set at $p < 0.05$.

3. Results

3.1 Characteristics of Participants

The characteristics of the study population overall and by organic food consumption are shown in Table 1 (Ref. [42]). Of the 2057 study participants, 575 individuals were classified as organic food consumers (27.8%). This proportion was 35.6% among women and 20.0% among men.

Table 1. Characteristics of the menuCH participants overall and by organic food consumption ^{ab}.

	Overall	Non-organic food consumers	Organic food consumers
Number of participants	2057	1482	575
Weighted	4,627,878	3,341,767	1,286,111
Weighted (%)	100.0	72.2	27.8
Sex (%)			
Males	49.8	55.2	35.9
Females	50.2	44.8	64.1
Age group (%) ^c			
18–29 years	18.8	20.8	13.4
30–44 years	29.9	28.5	33.4
45–59 years	29.8	29.0	31.9
60–75 years	21.6	21.6	21.3
Language region (%) ^d			
German-speaking region	69.2	67.9	72.8
French-speaking region	25.2	26.2	22.7
Italian-speaking region	5.6	6.0	4.5
Nationality (%)			
Swiss only	61.4	60.9	63.0
Swiss binational	13.8	14.0	13.2
Non-Swiss	24.8	25.2	23.8
Education, highest degree (%)			
Primary/no degree	4.7	4.8	4.3
Secondary	42.6	45.2	35.7
Tertiary	52.6	49.7	60.0
Household size (%)			
1–2 people	56.0	54.1	61.0
3–4 people	34.9	35.8	32.6
5–6 people	9.0	9.9	6.5
Gross household income (%)			
<6000 (CHF/month; 6382 Euro)	17.7	18.3	16.1
6000–13,000 (CHF/month; 6382–13,828 Euro)	39.8	40.1	39.1
>13,000 (CHF/month; 13,828 Euro)	14.9	14.1	16.8
Did not answer	27.6	27.5	28.0
BMI categories (%) ^e			
Underweight	2.4	2.0	3.6
Normal weight	54.1	50.5	63.5
Overweight	30.6	32.8	24.9
Obese	12.9	14.8	7.9
Self-reported physical activity (%)			
Low	11.3	11.8	10.2
Moderate	24.2	22.9	27.5
High	40.3	41.2	38.0
Did not answer	24.2	24.1	24.3
Smoking status (%)			
Never	42.9	41.6	46.4
Former	33.6	33.1	35.0
Current	23.3	25.1	18.6
Self-reported health (%)			
Very bad to medium	12.7	13.6	10.4
Good to very good	87.1	86.1	89.6
Nutrition score AHEI (%)			
Q1 (13.7–34.5 points)	20.8	25.5	8.8

Table 1. Continued.

	Overall	Non-organic food consumers	Organic food consumers
Q2 (>34.5–41.6 points)	19.4	21.2	14.7
Q3 (>41.6–48.2 points)	20.2	21.1	17.9
Q4 (>48.2–55.7 points)	19.8	17.2	26.3
Q5 (>55.7–91.4 points)	19.8	15.0	32.3
Vegetarian diet (%)			
High meat consumption	16.0	17.2	12.7
Medium meat consumption	65.1	68.8	55.4
Low meat consumption	14.2	11.6	21.0
No meat consumption	4.7	2.3	10.9

CHF, Swiss francs; BMI, Body Mass Index; AHEI, Alternate Healthy Eating Index.

^a All results were weighted for sex, age, marital status, major area of Switzerland, nationality, and household size.

^b The percentage of individuals with missing values <0.5% is not shown.

^c Age groups are based on self-reported age on the day that the sociodemographic and lifestyle questionnaire was filled out.

^d German-speaking region: Aargau, Basel-Land, Basel-Stadt, Bern, Lucerne, St. Gallen, Zurich cantons; French-speaking region: Geneva, Jura, Neuchatel, Vaud cantons; Italian-speaking region: Ticino canton.

^e BMI was obtained from measured weight and height, with self-reported weight or height used when measurements were impossible; for pregnant and lactating women, self-reported weight before pregnancy was used. BMI categories were defined according to standards of the World Health Organization (underweight: BMI <18.5 kg/m²; normal weight: 18.5 kg/m² ≤ BMI < 25.0 kg/m²; overweight: 25.0 kg/m² ≤ BMI < 30.0 kg/m²; obese: BMI ≥30.0 kg/m² [42]).

Most participants lived in the German-speaking region, were of Swiss nationality, and lived in households with 1 to 2 people. In addition, most participants had normal body weight, had never smoked, and reported having good to very good health. In the group of organic food consumers, a higher proportion were female. Moreover, organic food consumers were more likely to have a higher educational level, less likely to be overweight or obese, and more likely to have a better diet quality compared to non-organic food consumers. In addition, we found that in the group of organic food consumers, a higher proportion followed a vegetarian diet than in the group of non-organic food consumers.

3.2 Mean Amount and Number of Organic Foods Consumed

Total food consumption per person per day was 3465 g, with an average consumption of 34 g of organically produced food, corresponding to about 1.0% of total consumption (Table 2A, **Supplementary Table 2**). Organic food consumers as a group consumed a total of around 125 g of organically produced food (Table 2B), or about 3.6% of their total consumption. Since the different food groups have very different weights, we also analysed the number of foods consumed in addition to the amount consumed. Overall, an average of 29 foods were consumed per person per day. Of these, 1.3% were produced organically (Table 2A). Among organic food consumers, an average of 31 foods were consumed per person per day, with a share of organically produced foods of 4.3% (Table 2B).

3.3 Organic Food Consumption by Food Groups

Among consumers of organic foods, the proportion of organic food consumption within the individual food groups was similar, regardless of how the consumption was measured (amount in g or number of foods) (Table 2B). The categories “Eggs and egg products” (19.2% of the amount of foods consumed and 13.5% of the number of foods consumed) and “Legumes” (17.7% and 9.0%) showed above-average organic shares. Furthermore, the organic share was above-average in the categories “Milk and dairy products” (10.5% and 6.0%), “Fats and oils” (9.8% and 6.1%), “Fruits, nuts and seeds” (9.0% and 11.3%), and “Sugar and chocolate” (7.8% and 5.1%). The organic share was comparatively low in the category “Meat and meat products” (1.5% and 2.2%) and lowest in the category “Fish and seafood” (0.2% and 0.2%), although the latter food group is not widely consumed in Switzerland.

Regardless of how the consumption of organic food was measured, the food groups “Non-alcoholic beverages” (37.9% of the amount of foods consumed and 13.6% of the number of foods consumed), “Milk and dairy products” (22.3% and 16.8%), and “Fruits, nuts and seeds” (15.7% and 22.5%) contributed the most to the total amount and number of organic foods consumed (Fig. 1, **Supplementary Table 3**). The food groups “Vegetables” (7.8% and 9.9%) and “Cereals” (6.1% and 9.5%) were also relevant food groups for overall organic food consumption.

Table 2A. Mean amount and number of organic and non-organic foods consumed, by food groups (n = 2057) ^{abc}.

	Mean amount of food intake (g/day)				Mean number of foods consumed			
	Overall ^d	Non-organic ^d	Organic ^d	Organic (%) ^e	Overall ^d	Non-organic ^d	Organic ^d	Organic (%) ^e
Overall	3465.616	3431.265	34.352	1.0%	29.053	28.682	0.371	1.3%
Non-alcoholic beverages	2031.952	2018.935	13.017	0.6%	6.644	6.594	0.051	0.8%
Alcoholic beverages	198.240	198.121	0.119	0.1%	0.725	0.724	0.000	0.0%
Cakes and pies	37.448	37.346	0.102	0.3%	0.588	0.584	0.003	0.5%
Miscellaneous foods	3.097	3.097	-	-	0.152	0.152	-	-
Eggs and egg products	12.989	12.321	0.668	5.1%	0.316	0.303	0.013	4.1%
Fats and oils	19.905	19.333	0.573	2.9%	1.994	1.959	0.035	1.8%
Fish and seafood	21.008	20.996	0.012	0.1%	0.262	0.262	0.000	0.0%
Meat and meat products	105.878	105.544	0.334	0.3%	1.342	1.335	0.007	0.5%
Fruits, nuts, and seeds	178.591	173.196	5.396	3.0%	1.874	1.790	0.083	4.4%
Vegetables	173.395	170.730	2.665	1.5%	3.314	3.278	0.037	1.1%
Cereals	236.509	234.413	2.096	0.9%	2.814	2.779	0.035	1.2%
Legumes	4.728	4.364	0.363	7.7%	0.056	0.054	0.002	4.0%
Potatoes and other starchy foods	50.737	50.659	0.078	0.2%	0.354	0.353	0.001	0.3%
Milk and dairy products	249.496	241.830	7.666	3.1%	3.336	3.274	0.062	1.9%
Savoury snacks	9.792	9.773	0.019	0.2%	0.173	0.173	0.001	0.4%
Soups and bouillons	46.485	46.274	0.211	0.5%	0.212	0.211	0.001	0.5%
Sauces and seasonings	49.305	49.031	0.274	0.6%	3.011	2.998	0.013	0.4%
Sugar and chocolate	36.060	35.302	0.757	2.1%	1.889	1.861	0.027	1.4%

^a All results were weighted for sex, age, marital status, major region of Switzerland, nationality, household size, season, and weekday of the data collection.

^b The mean amount and number of foods consumed were derived from the average value of the two 24-hour dietary recalls (24HDRs).

^c A detailed description of the foods included in various food groups can be found in the supplementary materials (**Supplementary Table 2**).

^d The absolute values are given to 3 decimal places because some of the quantities are very small and would result in 0.0 if rounded.

^e Percentages represent the share of organic foods within the single food groups.

3.4 Factors Associated with Organic Food Consumption

In univariate analyses, female sex, middle age, German-speaking living area, higher educational level, smaller household size, normal weight, non-smoking status, good self-reported health, and high diet quality were significantly associated with organic food consumption (**Supplementary Table 4**). Multivariate analyses confirmed most of these associations. Women had significantly higher odds of being organic food consumers compared to men (odds ratio [OR] = 2.18, 95% confidence interval [CI] 1.69, 2.80; Table 3, Ref. [42]). Younger (age group 18–29 years) and older (age group 60–75 years) individuals had lower chances to consume organic foods than the reference category of 30–44 years old (OR = 0.56, 95% CI 0.40, 0.78 and OR = 0.70, 95% CI 0.50, 0.98, respectively). People living in the French-speaking region of Switzerland had a lower chance of consuming organic foods compared to those living in the German-speaking region (OR = 0.73, 95% CI 0.56, 0.93). Non-Swiss people also had a lower chance of being organic food consumers compared to participants of Swiss nationality (OR = 0.74, 95% CI 0.56, 0.98). People with a tertiary educational degree had significantly higher odds of consuming organic food compared to those with a secondary degree (OR = 1.28, 95% CI 1.02,

1.61). Income showed no significant association with organic food consumption in our model. The larger the household, the lower the chance of consuming organic food (5–6 people: OR = 0.59, 95% CI 0.38, 0.89). Overweight or obese individuals had a significantly lower chance of consuming organic food compared to those of a normal weight (OR = 0.77, 95% CI 0.60, 0.99 and OR = 0.53, 95% CI 0.36, 0.77, respectively). Finally, a strong association was observed between organic food consumption and diet quality (quintiles of AHEI). The higher the quality of the diet, the higher the chance of consuming organically produced foods. Participants in the highest quintile of diet quality were more than five times as likely to consume organic food compared to those in the lowest quintile of diet quality (OR = 5.45, 95% CI 3.70, 8.02).

4. Discussion

The present study identified 27.8% of the Swiss population as consumers of organic food. The food groups “Fruits, nuts and seeds”, “Milk and dairy products”, and “Non-alcoholic beverages” contributed the most to the total consumption of organic food. Organic food consumption was significantly positively associated with female sex, middle age, German-speaking living area, Swiss national-

Table 2B. Mean amount and number of organic and non-organic foods consumed within the group of organic food consumers, by food groups (n = 575) ^{abc}.

	Mean amount of food intake (g/day)				Mean number of foods consumed			
	Overall ^d	Non-organic ^d	Organic ^d	Organic (%) ^e	Overall ^d	Non-organic ^d	Organic ^d	Organic (%) ^e
Overall	3513.199	3388.315	124.884	3.6%	31.233	29.885	1.349	4.3%
Non-alcoholic beverages	2072.325	2025.001	47.324	2.3%	6.995	6.812	0.184	2.6%
Alcoholic beverages	158.254	157.821	0.433	0.3%	0.642	0.641	0.001	0.2%
Cakes and pies	35.181	34.812	0.369	1.1%	0.627	0.616	0.011	1.8%
Miscellaneous foods	3.128	3.128	-	-	0.095	0.095	-	-
Eggs and egg products	12.631	10.202	2.429	19.2%	0.344	0.297	0.046	13.5%
Fats and oils	21.170	19.089	2.082	9.8%	2.078	1.951	0.127	6.1%
Fish and seafood	18.733	18.688	0.045	0.2%	0.254	0.253	0.000	0.2%
Meat and meat products	80.920	79.704	1.215	1.5%	1.110	1.085	0.025	2.2%
Fruits, nuts, and seeds	218.943	199.326	19.616	9.0%	2.684	2.381	0.303	11.3%
Vegetables	195.608	185.920	9.688	5.0%	3.681	3.548	0.133	3.6%
Cereals	231.612	223.993	7.620	3.3%	3.028	2.900	0.127	4.2%
Legumes	7.444	6.123	1.321	17.7%	0.091	0.083	0.008	9.0%
Potatoes and other starchy foods	49.119	48.836	0.283	0.6%	0.332	0.328	0.004	1.1%
Milk and dairy products	264.505	236.635	27.870	10.5%	3.766	3.540	0.226	6.0%
Savoury snacks	8.220	8.150	0.070	0.8%	0.170	0.167	0.002	1.3%
Soups and bouillons	51.863	51.095	0.768	1.5%	0.241	0.237	0.004	1.6%
Sauces and seasonings	48.190	47.193	0.998	2.1%	3.153	3.106	0.046	1.5%
Sugar and chocolate	35.354	32.601	2.753	7.8%	1.945	1.845	0.099	5.1%

^a All results were weighted for sex, age, marital status, major region of Switzerland, nationality, household size, season, and weekday of the data collection.

^b The mean amount and number of foods consumed were derived from the average value from of two 24HDRs.

^c A detailed description of the foods included in various food groups can be found in the supplementary materials (**Supplementary Table 2**).

^d The absolute values are given to 3 decimal places because some of the quantities are very small and would result in 0.0 if rounded.

^e Percentages represent the share of organic foods within the single food groups.

ity, higher educational degree, smaller household size, normal body weight, and higher diet quality.

Our results on the proportion of organic food consumers differ from those of other studies. Most previously published studies have reported the frequency of organic food consumption, limiting comparison with our analysis. According to results of the German National Nutrition Survey from 2005–2006, 44.9% stated that they purchased organic food [46]. In a large prospective study from the UK (only women, survey conducted 3 years after recruitment in 1996–2001), 30% reported never, 63% reported sometimes, and 7% reported usually or always consuming organic food [7]. A Danish cross-sectional study from 1999–2002 calculated an overall organic food score based on consumption frequency information: 15% of the study participants reported never consuming organic foods, 76% had a low-to-medium consumption, and 10% had a high consumption [46]. Data from the French NutriNet-Santé cohort study revealed that 34% of women and 42% of men did not consume organic foods, that 52% of women and 48% of men occasionally consumed organic foods, and that 15% of women and 11% of men regularly consumed organic foods [27].

Overall, the comparability of the proportions of organic food consumers between different studies is quite limited due to methodological differences and changes over time. While most previous studies have relied on purchase data or yearly self-reported estimations, menuCH data provide an accurate measure of food consumption due to its two 24HDRs. However, our study only allows us to draw limited conclusions about the regularity or frequency of organic food consumption. We cannot rule out the possibility of underestimating organic food consumption due to the limited assessment of dietary information over only two days. On the other hand, in studies relying on self-reported estimations, lack of knowledge about bio-labels [31] and social desirability may influence self-reported dietary information, leading to an overestimation of organic food consumption [47]. Therefore, comparing our results with the above-mentioned studies remains difficult. Despite these uncertainties, the present study provides additional information on the quantity of organic food consumption and on different sociodemographic, anthropometric, and lifestyle factors associated with organic food consumption in Switzerland.

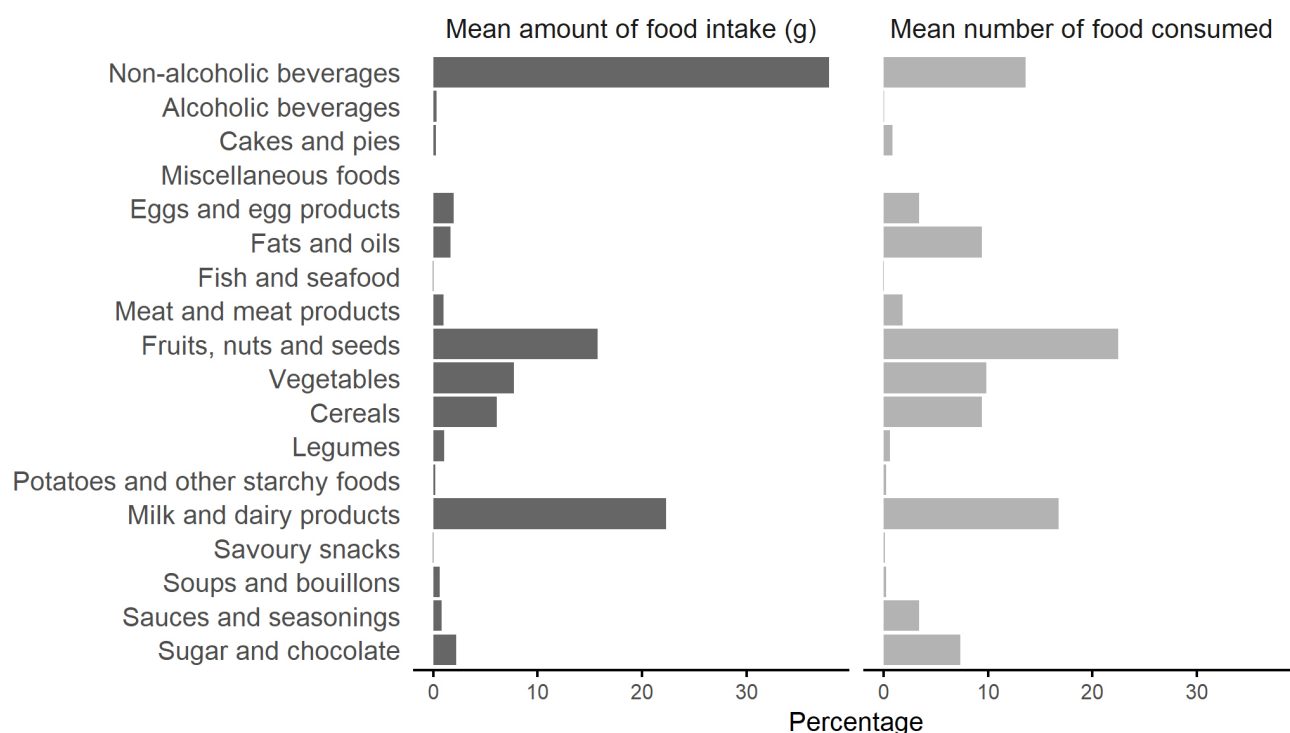


Fig. 1. Contribution of different food groups to the total consumption of organic foods (n = 575). The contribution of different food groups to the total amount (g) of organic foods consumed is shown on the left. The contribution of different food groups to the total number of organic foods consumed is shown on the right. For both, the percentage of the food groups sum up to a total consumption of 100%.

In this study, an average of about 1.0% of all foods consumed met organic standards. Within the group of organic food consumers, this proportion was 3.6%. These proportions seem comparatively low, although most of the previous studies do not provide information about percentages of organic foods consumed on the overall diet. The only somewhat comparable study, French NutriNet-Santé, reported organic food to have a share in the whole diet of 18% in men and 20% in women [23].

The food groups “Fruits, nuts and seeds”, “Milk and dairy products”, and “Non-alcoholic beverages” contributed the most to the total amount and number of organic foods consumed. “Vegetables” and “Cereals” also showed relatively high shares. Food groups such as “Meat and meat products”, “Fish and seafood”, and “Eggs and egg products” contributed little to overall organic food consumption. Our results are similar to those of the Household and Retail Panel from NielsenIQ Switzerland. The product group “Fresh vegetables and potatoes” had the largest share of total organic food sales in the Swiss retail sector, followed by “Cereals and bakery products” and “Milk and dairy products” [29]. Within the individual food groups, by far the highest organic share was observed in the group “Eggs and egg products” (19.2%). These findings are in line with the French NutriNet-Santé study’s observation that eggs were consumed as organic by 52% of women and 40% of men [23]. A Danish study showed similar results, reporting that

the food group “Egg” was always consumed organically the most (22%), whereas the food group “Meat” was always consumed organically the least (2%) [46]. Our results also agree with the findings of the Swiss Household and Retail Panel, in which the product group “Eggs” has the second highest organic sales share (28.7%) after the absolute leader, the “Baby food” product category (55.9%) [29]. In principle, our findings are in line with those of the French study [23], which states that the contribution of organic food to the diet was higher for products of plant origin than for products of animal origin. Also in line with the French study, we found exceptions in the consumption of “Eggs and egg products”, even though these contributed comparatively little to the overall diet, and the consumption of “Milk and dairy products”.

In our study, participants of female sex, middle age, German-speaking living area, Swiss nationality, higher educational degree, smaller household size, normal body weight, and higher diet quality had significantly higher odds of organic food consumption. In general, these results are consistent with those seen in other populations in studies reporting organic food consumption to be associated with being female, having a generally healthier lifestyle, and adopting more favourable dietary habits [24,26,46,48].

We found significantly lower organic food consumption in the French-speaking region compared to the German-speaking region of Switzerland. One explanation

Table 3. Association between organic food consumption and sociodemographic, anthropometric, and lifestyle factors (n = 2057) ^{abc}.

	Organic food consumers	
	OR	95% CI
Sex		
Males	1	
Females	2.18	[1.69; 2.80]
Age group ^d		
18–29 years	0.56	[0.40; 0.78]
30–44 years	1	
45–59 years	0.87	[0.66; 1.14]
60–75 years	0.70	[0.50; 0.98]
Language region ^e		
German-speaking region	1	
French-speaking region	0.73	[0.56; 0.93]
Italian-speaking region	0.74	[0.45; 1.20]
Nationality		
Swiss only	1	
Swiss binational	0.83	[0.61; 1.14]
Non-Swiss	0.74	[0.56; 0.98]
Education, highest degree		
Primary/no degree	1.51	[0.88; 2.58]
Secondary	1	
Tertiary	1.28	[1.02; 1.61]
Household size		
1–2 people	1	
3–4 people	0.78	[0.61; 1.00]
5–6 people	0.59	[0.38; 0.89]
Gross household income		
<6000 (CHF/month)	0.95	[0.70; 1.30]
6000–13,000 (CHF/month)	1	
>13,000 (CHF/month)	1.07	[0.78; 1.46]
BMI categories ^f		
Underweight	1.18	[0.63; 2.22]
Normal weight	1	
Overweight	0.77	[0.60; 0.99]
Obese	0.53	[0.36; 0.77]
Self-reported physical activity		
Low	1	
Moderate	1.09	[0.73; 1.63]
High	0.97	[0.67; 1.40]
Smoking status		
Never	1	
Former	1.04	[0.82; 1.32]
Current	0.89	[0.66; 1.18]
Self-reported health		
Good to very good	1	
Very bad to medium	0.99	[0.70; 1.39]

Table 3. Continued.

	Organic food consumers	
	OR	95% CI
Diet quality score AHEI		
Q1 (13.7–34.5 points)	1	
Q2 (>34.5–41.6 points)	1.89	[1.27; 2.82]
Q3 (>41.6–48.2 points)	2.36	[1.60; 3.49]
Q4 (>48.2–55.7 points)	3.99	[2.72; 5.86]
Q5 (>55.7–91.4 points)	5.45	[3.70; 8.02]

OR, odds ratio; CI, confidence interval; CHF, Swiss francs; BMI, Body Mass Index; AHEI, Alternate Healthy Eating Index.

^a OR and 95% CI were derived from binomial logistic regression models; multiple imputation by chained equations was used to address missing values.

^b OR equal to 1 represents the reference category.

^c All results were mutually adjusted for all the variables presented in this table, were additionally adjusted for mean energy intake, season, and weekday, and were weighted for sex, age, marital status, major area of Switzerland, nationality, and household size.

^d Age groups are based on self-reported age on the day that the sociodemographic and lifestyle questionnaire was filled out.

^e German-speaking region: Aargau, Basel-Land, Basel-Stadt, Bern, Lucerne, St. Gallen, Zurich cantons; French-speaking region: Geneva, Jura, Neuchatel, Vaud cantons; Italian-speaking region: Ticino canton.

^f BMI was obtained from measured weight and height, with self-reported weight or height used when measurements were impossible; for pregnant and lactating women, self-reported weight before pregnancy was used. BMI categories were defined according to standards of the World Health Organization (underweight: BMI <18.5 kg/m²; normal weight: 18.5 kg/m² ≤ BMI < 25.0 kg/m²; overweight: 25.0 kg/m² ≤ BMI < 30.0 kg/m²; obese: BMI ≥30.0 kg/m² [42]).

for this could be the culturally different dietary habits of people living in the different language regions of Switzerland [41]. However, an association between language region and organic food consumption was not observed by the Biobarometer [30]. Considering the living area, several studies have reported higher proportions of organic food consumers among people living in urban compared to rural areas [30,48]. However, some studies have found higher organic food consumption in rural areas [23]. Information about the place of residence was unfortunately not available in the menuCH data.

Surprisingly, household income was not significantly associated with organic food consumption in our study. This finding differs from other studies that have described a significant association between income and the consumption of organic food [23,27,30]. This association is plausible if we consider that access to food is often related to economic power, inequality, discrimination, and social sta-

tus [49], resulting in some people having more difficulties in accessing healthy diets than others. According to the Biobarometer 2022, the biggest barrier to buying organic food is its higher price [29,30]. Currently, in Switzerland, organic foods cost on average about 1.5 times more than conventionally produced food [50]. However, information about household income in the menuCH data is of poor quality with many missing values. Moreover, other variables in the multivariate model that are indirectly related to income showed significant results. A high educational level, which is usually positively associated with income, was associated with higher chance of organic food consumption. Furthermore, some studies have shown that organic food consumption correlates more with education level than with income [24]. In addition, larger household size, which could result in less money *per capita* being available for purchasing food, was found to be associated with lower odds of organic food consumption. The hypothesis that the larger the household, the less organic products are consumed, is further supported by the result that single persons have significantly higher organic food consumption than do married or divorced persons.

Regarding dietary habits, we found higher organic food consumption among individuals with vegetarian diets. Furthermore, we observed a strong association between overall diet quality and organic food consumption. These findings are in line with other studies [23,24,26,48]. It should be noted that a previous analysis of menuCH data found higher scores for diet quality to correlate with female sex, older age, normal body weight, tertiary educational level, and higher physical activity [41]. Most of these variables also correlate with organic food consumption. Nevertheless, the multivariate model, which was adjusted for potential confounding factors, showed a strong association between diet quality and organic food consumption. Beyond dietary habits, our study results confirmed previous studies' findings, reporting that organic food consumption is associated with a more favourable lifestyle [46,48]. However, smoking status and physical activity level were not significantly associated with organic food consumption in our regression model.

It is not yet clear whether the consumption of organic food brings effective health benefits or whether healthy individuals are more prone to consume organic food due to their higher opportunities and resources (e.g., good education and high income). Organic food consumers appear to be making healthier food choices, thereby positively influencing their own health, and through their demand for organically produced food, they also promote organic agriculture and thus contribute to sustainable nutrition and the preservation of biodiversity [49]. Despite this, further research on the potential beneficial effects of organic diets on human health is needed. Comprehensive intervention studies should be conducted to elucidate whether a diet rich in organic foods is more favourable for health than a diet rich

in conventionally grown foods. In particular, future studies should focus on the mechanisms underlying the potential beneficial effects of organic foods consumption and on the discovery of factors potentially responsible for these protective mechanisms. Aspects such as intake of synthetic pesticides, intake of secondary plants metabolites, and plant microbiome could be considered. In addition, a differentiated analysis by food group is relevant for future studies investigating the health effects of organic foods, since health effects are likely to differ due to different cultivation or manufacturing practices (e.g., of plant versus animal foods) [46].

This study was conducted using data from the first national nutrition survey in Switzerland, menuCH, conducted between 2014 and 2015. Until now, individual consumption of organic food has never been investigated in Switzerland using detailed and comprehensive dietary data. The present analysis complements the existing data on organic food consumption in Switzerland. Among other aspects, the Biobarometer aims to identify the frequency of consumption, asking about the currently estimated frequency of organic food consumption. The menuCH data complement the Biobarometer data, providing a comprehensive assessment of organic food consumption, including detailed data on all foods consumed (including at restaurants, canteens, takeaways), information on food brands and bio-labels, as well as portion sizes. This allowed for categorizing the foods considering organic food production guidelines rather than the consumers' perception of what is considered organic foods, which are known to differ [31]. In addition, these detailed dietary data have enabled us to determine the proportions of organic food consumption in the various food groups. Besides the analysis of various food groups, the menuCH data allow for linkage to other dietary habits and the consideration of further sociodemographic, anthropometric, and lifestyle characteristics. Switzerland provides a unique setting to investigate cultural influences on organic food consumption. The three main language regions have distinct cultures and documented differences in dietary habits [33,41], which are influenced by their respective neighbouring countries. Nevertheless, they share common national health policies and a national health care system. Compared to the Biobarometer, which covers only the French-speaking and German-speaking parts of Switzerland, the menuCH survey includes the Italian-speaking part of Switzerland and therefore allows a comparison of the three main language regions.

As mentioned above, a major limitation is the uncertainty of classifying organic food consumers, potentially leading to misclassification. The menuCH survey did not systematically collect information on the organic status of food, and the limited assessment of dietary information based on only two 24HDRs may lead to an underestimation of the consumption of organically produced food. As in any observational study relying on self-reported measures for dietary assessment, recall bias and potential under- or over-

reporting cannot be ruled out. Furthermore, despite weighting strategies, selection bias cannot be excluded, as respondents to health surveys tend to have higher levels of health consciousness compared to the general population. Another limitation lies in the cross-sectional design of the menuCH survey. It is only possible to identify factors that are associated with higher organic food consumption. In addition, residual confounding in multivariate analysis could not be excluded, although important covariates were included in the analysis as adjusting factors. Finally, it should be mentioned that the menuCH survey was conducted several years ago, while the availability and consumption of organic food has been steadily increasing in recent years [28]. Therefore, the present results are comparable only to a limited extent with other more recent studies.

5. Conclusion

Our study contributes to a better understanding of organic food consumption in Switzerland. Despite its aforementioned methodological and survey limitations, its results show how organic food consumption is distributed within the Swiss population and which population groups consume particularly little organically produced food. Swiss public health authorities can use this study's results—together with the results of other studies such as the Biobarometer, which assesses the frequency of organic food consumption—to develop tailored nutritional interventions such as guidelines, information campaigns, marketing strategies, and subsidies where needed most. Improved knowledge about organic food and organic food labels within the identified subpopulations seems important in promoting organic food consumption [29]. A higher consumption of organic food products would favour organic agriculture and farming and boost diet sustainability and biodiversity in Switzerland [49]. Furthermore, in the long term, a higher consumption of organic food products might lead to a decrease in chronic disease morbidity and mortality [11,12]. Further research is needed to fully understand the potential beneficial effects of organic diets on human health, including their underlying protective mechanisms, and to determine whether the relationships are causal [14]. Future studies examining the relationship between organic food consumption and health should build on previous findings and consider that lifestyle factors strongly correlate not only with organic food consumption but also with the incidence of non-communicable diseases.

Availability of Data and Materials

The entire menuCH dataset and relevant documents (questionnaires, weighting strategy) are available upon request in the data repository: menuch.unisante.ch.

Author Contributions

Conceptualization: SR, GP, IM. Formal Analysis: IM, GP, FS. Investigation: IM and GP. Supervision: GP and SR. Writing Original Draft Preparation: IM. Writing Review and Editing: IM, GP, SR, FS. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The survey protocol of the menuCH study was approved by the ethics committee of the city of Lausanne and by the corresponding regional ethics committees (lead committee in Lausanne, Protocol 26/13, approved on 12 February 2013). All procedures performed in the survey followed the ethical standards of the Declaration of Helsinki, and all participants provided written informed consent.

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Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.31083/IJVR39946>.

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