Annals of Nutrition and Metabolism

Human Nutrition: Research Article

Ann Nutr Metab
DOI: 10.1159/000542000

Received: July 8, 2024
Accepted: October 11, 2024
Published online: October 14, 2024

Associations between Cooking Methods and Socio-Demographic, Dietary, and Anthropometric Factors: Results from the Cross-Sectional Swiss National Nutrition Survey

Ana-Lucia Mayén[a] Pedro Marques-Vidal[b]

[a]Independent Researcher, Paris, France; [b]Department of Medicine, Internal Medicine, Lausanne University Hospital (CHUV) and University of Lausanne, Lausanne, Switzerland

Keywords
Cross-sectional study · Cooking methods · Socio-economic status · Cardiac risk · 24-h dietary recalls

Abstract
Introduction: Appropriate cooking methods can improve food safety, decrease contaminants, and increase nutrient bioavailability. Few studies assessed the sociodemographic characterization of their use in European populations. We aimed to characterize the socio-demographic, lifestyle, and anthropometric predictors of cooking methods in the Swiss population. ***Methods:*** Adults aged 18–75 years (n = 2,050) participating in the cross-sectional national nutrition survey in Switzerland (*menuCH)* (2014–2015), representing the 7 main regions in the country. We used logistic regressions to assess the probability of the presence or absence of boiled, roasted, microwaved, oven-cooked, gratinated, fried, steamed, and grilled foods by sociodemographic variables. ***Results:*** Among all participants, the most frequently used cooking methods were boiling (46%), stove-cooking (19%), and steaming (8%). Single participants had a higher probability of consuming grilled or fried foods (68%) than their married counterparts and participants with obesity had a higher probability of consuming grilled or fried foods (67% or 135%) compared to those with normal weight. Divorced or separated participants had a 55% lower probability of consuming roasted foods than married participants. Those following a diet had a 57% lower probability of consuming grilled foods compared to those not on a diet. ***Conclusion:*** We found differences in the distribution of cooking methods in the Swiss population by sociodemographic variables. Further studies should examine the link between cooking methods and disease risk.

Introduction

Treating foods with heat is a practice that started approximately 700,000 years ago [1], and aims to modify and preserve foods organoleptic and nutritional properties. Nowadays, it is a common process and can occur through a variety of methods such as boiling, frying, steaming, baking, stewing and roasting [2]. These methods have both beneficial and undesired aspects for human health. Benefits include food safety through the inactivation of natural toxins and enzymes [3, 4], a decreased concentration of contaminants [5, 6], a prolongation of shelf-life, and improved digestibility and bioavailability of nutrients [3, 4], while undesired aspects include the loss of nutritional value [7].

Literature characterizing cooking methods in epidemiology is scarce due to the difficulty of compiling such

karger@karger.com
www.karger.com/anm

Correspondence to:
Pedro Marques-Vidal, pedro-manuel.marques-vidal@chuv.ch

information in large cohorts. Cooking methods are usually not included in the routinely used dietary intake collection methods (i.e., food frequency questionnaires) or if included in 24-h dietary recalls, usually not exploited. Up to date, studies describing cooking methods highlight their role in food composition and sensory attributes [8–10], their impact on the environment [11], or the formation of mutagenic or proinflammatory molecules in foods [3]. For instance, foods cooked at high temperatures for long periods of time using dry heat (i.e., baking, roasting, and grilling), promote the formation of advanced glycation end products (AGEs) which have been considered pro-inflammatory and pro-oxidative compounds [12].

Few studies assessed the role of cooking methods on health, including case-control and large cohort studies evaluating associations between meat cooking methods and the risk of developing chronic diseases. Previous studies have shown a positive association between roasting, stewing, grilling meat and bladder cancer [13] and no significant associations between barbecuing, grilling, pan-frying, broiling, or microwaving meat and prostate cancer [14]. Other studies have shown that mutagens formed in meats cooked at high temperatures such as heterocyclic amines, MelQx (2-amino-3,8-dimethylimidazo[4,5-f] quinoxaline), DiMelQx (2-amino-3,4,8-trimethylimidazo [4,5-f] quinoxaline), and PhIP (2-amino-1-methyl-6-phenylimidazo[4,5-b]pyridine) are the potential causes of higher colorectal cancer risk. As for other chronic diseases [15, 16], previous literature has shown a positive association between broiling, barbecuing, and roasting meat with diabetes [17], and between grilling, stewing and oven-cooking foods with obesity [17]. However, evidence remains scarce. Two studies have described the frequency of cooking methods used in the Spanish population using a large case-control study [18, 19] but did not present the use of cooking methods by sociodemographic, lifestyle and anthropometric groups. Previous studies have described the dietary characterization in Switzerland by region. However, the results did not show information about cooking methods [20]. In this study, we aimed to characterize the prevalence and socio-demographic, lifestyle, and anthropometric correlates of cooking methods used in the diet of the Swiss population.

Materials and Methods

Study Population

The Swiss National Nutrition Survey (menuCH; https://menuch.iumsp.ch) is a cross-sectional survey conducted among non-institutionalized residents of Switzerland aged 18–75 years from January 2014 to February 2015 [20]. Data collection procedures have been previously described [20, 21]. Briefly, Swiss residents were drawn from a stratified random sample provided by the Federal Statistical Office, being representative of the seven main regions of Switzerland (Lemanic, Ticino, Mittelland, Central, East, Northwest, and Zurich) [22] and lived in the cantons of Aargau, Basel-Land, Basel-Stadt, Bern, Lucerne, St. Gallen, and Zurich (German-speaking region); Geneva, Jura, Neuchatel, and Vaud (French-speaking region); and Ticino (Italian-speaking region).

Exclusion Criteria

Institutionalized people those with insufficient mobility to access a study centre or those with insufficient oral and written language skills were excluded.

Assessment of Cooking Methods

Cooking methods for foods were included in the two non-consecutive computer-assisted 24-h dietary recalls, collected by trained dietitians during interviews with participants (first dietary recall) and by phone 2–6 weeks later (second dietary recall). Dieticians used the computer-directed interview program GloboDiet® (GD, formerly EPIC-Soft®, version CH-2016.4.10, International Agency for Research on Cancer (IARC), Lyon, France) and recalls were conducted on all weekdays and seasons. The procedure was split into three parts: (i) collection of general information about the participant; (ii) quick list of food consumption occasions and items; and (iii) detailed description and quantification of all the consumed foods and beverages, including cooking and preservation methods, brand name, and portion size [23]. Food items were then linked to the best match in an extended research version of the 2015 Swiss Food Composition Database using FoodCASE (Premotec GmbH, Winterthur, Switzerland) [24]. The dietary recalls included eight different cooking methods (boiled, roasted, microwaved, oven-cooked, gratinated, fried, steamed, and grilled), described in Supplementary Table 1 (for all online suppl. material, see https://doi.org/10.1159/000542000). We created a binary variable that equalled zero if the cooking method was not used (absent) or 1 if it was used (present) for the foods reported in the 24-h dietary recalls.

Predictors of Cooking Methods Use

Participants provided information on sociodemographic characteristics on the day of the first dietary recall interview, including age (18–34, 35–44, 45–64, and 65+ years), sex (male, female), region (German,

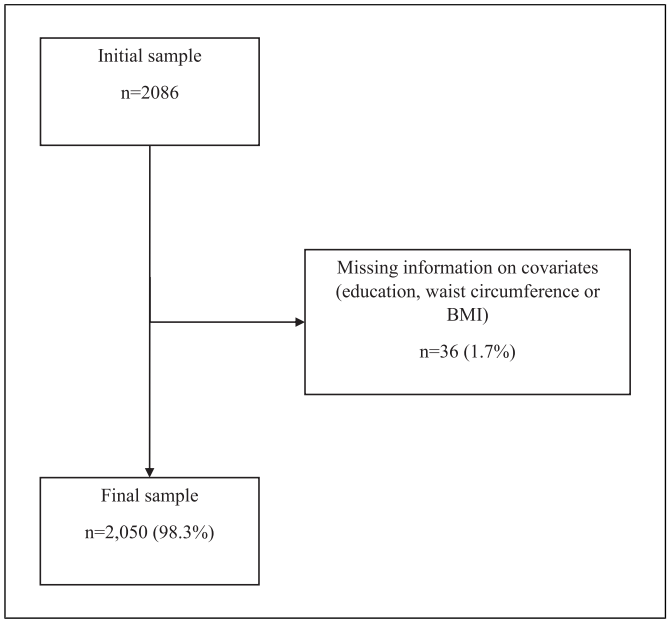

Fig. 1. Flowchart of included participants in the study.

French, and Italian speaking), gross household income (between 4,500 and 5,999, between 6,000 and 8,999, between 9,000 and 12,999, and over 13,000 Swiss Francs/month, 1 Swiss Franc = 1.19 USD or 1.06 EUR as of September 30, 2024), and education (originally in 19 categories; grouped into primary, secondary, and tertiary education).

Body weight, height and waist circumference were measured during the interview using international standard protocols [25] and body mass index (BMI) was computed. For pregnant and lactating women, self-reported values of weight before pregnancy were used. This was also the case when measurements were impossible for non-pregnant or male participants [26]. Waist circumference was measured 3 times, and the mean between the second and third measurements was used as the final measure. A cardiac risk score was created according to the British Heart Federation using waist circumference, whereas a low risk was defined by a circumference <94 in men and <80 in women, a medium risk by a circumference between 94 and 102 cm in men and 80 and 88 cm in women, and a high risk by a circumference >102 cm in men and >88 cm in women [27].

Statistical Analyses

Baseline characteristics of study participants were described by cooking method with a number of participants (column percentage) for categorical variables and as mean ± standard deviation for continuous variables. Comparison between socio-demographic, lifestyle, and anthropometric variables by sex were described using a chi-square test. We compared values between participants reporting the cooking method versus not reporting it in any foods for each method separately (boiled, roasted, microwaved, oven-cooked, gratinated, fried, steamed, and grilled) and we focused on one single cooking method per food item. Multivariable analyses of the associations between cooking methods and socioeconomic and demographic variables were performed using a weighted multivariable logistic regression model: adjusting for age, sex, region, civil status, if currently on a diet, BMI, and education. We tested for interaction between BMI categories and (1) educational level; (2) income categories. As over 95% of the interaction terms were not significant, it was decided not to include them in the models. Weights represent the probability of participating in the sample survey based on 7 major regions in Switzerland and 5 age categories. Weighted multivariable analyses using income instead of education and including cardiac risk are shown in online supplementary Tables 2 and 3. Results were expressed as odds ratios and (95% confidence intervals) and p values <0.05 were considered statistically significant. We excluded missing values on education, waist circumference, or BMI, leaving us with a sample size of 2,050 participants for analyses. An additional category of missing values was added to the variable income (n = 341). As a sizable number of participants did not provide information on income, a sensitivity analysis was performed after excluding them (online suppl. Table 4). All statistical analyses were performed using STATA software, version 14 (Stata Corporation, College Station, TX, USA).

Results

Characteristics of Participants

Of the initial 2,086 participants included in the study, 10 (1.7%) were excluded due to missing data regarding covariates (Fig. 1). Baseline characteristics of participants according to gender are described in Table 1. Most participants were aged between 18 and 55 years old, had a normal weight, were married, on a diet, lived in the German-speaking region, have a monthly income <13,000 CHF, and had secondary or tertiary education. There was a higher percentage of married than unmarried men while women were more frequently divorced; women also reported more frequently being on a diet.

Table 1. Baseline characteristics of the study population by sex, Swiss National Nutrition Survey 2014-2015

	All (n = 2,050)	Men (n = 1,043)	Women (n = 1,007)	p value
Age groups				0.986
18–34 years	540 (26)	275 (26)	265 (26)	
35–44 years	369 (18)	189 (18)	180 (18)	
45–54 years	436 (22)	218 (21)	218 (22)	
55–64 years	349 (17)	176 (17)	173 (17)	
65+ years	356 (17)	185 (18)	171 (17)	
BMI categories				0.723
Normal	1,144 (56)	573 (55)	571 (57)	
Overweight	605 (29)	314 (30)	291 (29)	
Obese	301 (15)	156 (15)	145 (14)	
Civil status				0.011
Single	630 (31)	313 (30)	317 (31)	
Married	1,126 (54)	599 (57)	527 (52)	
Divorced	218 (11)	90 (9)	128 (14)	
Other	76 (4)	41 (4)	35 (3)	
On a diet				0.017
No	1,944 (95)	1,001 (96)	943 (94)	
Yes	106 (5)	42 (4)	64 (6)	
Region				0.548
German	1,343 (65)	677 (65)	666 (66)	
French	505 (25)	267 (25)	238 (24)	
Italian	202 (10)	99 (10)	103 (10)	
Monthly income (CHF)				0.989
<4,500	221 (11)	109 (10)	112 (11)	
4,500–5,999	139 (7)	70 (7)	69 (7)	
6,000–8,999	446 (22)	230 (22)	216 (21)	
9,000–12,999	413 (20)	213 (20)	200 (20)	
13,000+	272 (13)	135 (14)	137 (14)	
Missing	559 (27)	286 (27)	273 (27)	
Education				0.520
Primary	114 (6)	59 (6)	55 (6)	
Secondary	955 (46)	473 (45)	482 (48)	
Tertiary	981 (48)	511 (49)	470 (46)	

Results are expressed as number of participants and (column percentage). Statistical analysis using chi-square to compare differences between men and women. BMI, body mass index; CHF, Swiss Franc.

Distribution of and Factors Associated with Cooking Methods

Among all participants, 46% of Swiss participants reported boiling their foods, while 19% reported stove-cooking and 8% reported steaming (Fig. 2). Participant's characteristics according to the absence/presence of each cooking method are shown in Table 2. Most sociodemographic variables followed the same pattern irrespective of the presence or absence of the cooking method. However, some differences appeared: married individuals consumed boiled foods more frequently; individuals from the German-speaking region consumed oven-cooked or roasted foods more frequently, and fried foods less frequently; younger individuals consumed fried foods more frequently.

Multivariable analyses of the associations between BMI, education, and cooking methods using weighted multivariable logistic regressions are described in Table 3. When using weighted multivariable logistic regression models to model associations, single participants had a higher probability of consuming grilled or fried foods (68%) than their married counterparts and participants with obesity had a higher probability of consuming grilled or fried foods (67% and

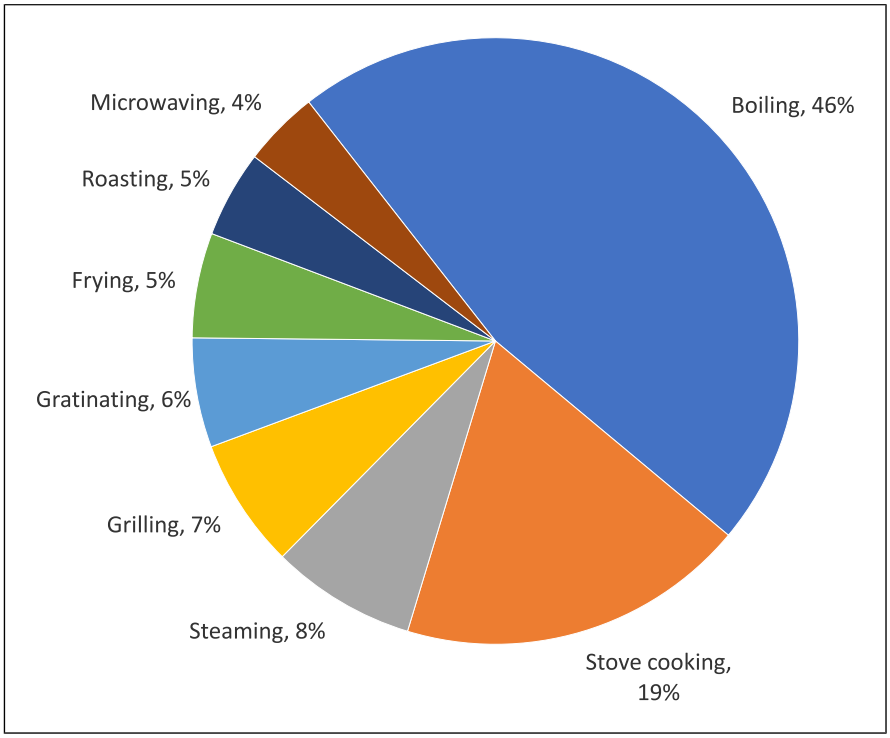

Fig. 2. Distribution of cooking methods in the Swiss population, National Nutrition Survey 2014-2015.

135%, respectively) compared to those with normal weight. Divorced or separated participants had a 55% lower probability of consuming roasted foods than married participants. Those following a diet had a 57% lower probability of consuming grilled foods compared to those not on a diet. Participants aged 35–44, 45–54, or 65+ years had a 56%, 54% and 86% lower probability of consuming fried foods than the youngest participants (aged 18–34 years). French-speaking participants had a 70% higher probability of consuming fried foods but 69% lower probability of consuming roasted foods than their German-speaking counterparts. Models using other covariates (online suppl. Tables 2, 3) yielded similar estimates.

Discussion

This is the first study evaluating the prevalence of and the factors associated with different cooking methods in Switzerland. The most frequently used cooking methods were boiling, oven-cooking, and steaming. Using weighted models, single or participants with obesity consumed more grilled or fried foods than their married or normal weight counterparts. Divorced participants had a lower probability of consuming roasted foods than married participants, and participants following a diet had a lower probability of consuming grilled foods than those not currently on a diet. Older participants had a lower probability of consuming fried foods than the youngest participants, and participants in the French-speaking region had a higher probability of consuming fried foods and less roasted foods than their German-speaking region counterparts.

A previous study has shown that married individuals prepare their foods and eat at home more frequently than single individuals [28]. Another study reported women's level of cooking skills were higher when they were married than when they were not [29], potentially suggesting single individuals might prefer quicker and easier cooking methods. This is in line with our findings whereas single individuals preferred fried and grilled foods, which might be quicker and less elaborate than other preparation methods.

Participants with obesity consumed more grilled or fried foods than their normal-weight counterparts. Previous studies have shown an association between fried foods and obesity in adults [30] and between grilled foods and obesity in children and adolescents in rural areas [31], which is in line with our findings. The process of frying can change the nutrient composition generating more trans-fatty acids, which have been shown to be a risk factor for obesity [32]. Several studies highlighted the production of pro-inflammatory and carcinogenic compounds in grilled foods such as AGEs [33, 34], or polycyclic aromatic hydrocarbons [35], which promote the risk of chronic diseases.

Table 2. Socio-demographic, lifestyle, and anthropometric factors associated with the presence/absence cooking methods in the Swiss Population: National Nutrition Survey 2014-2015

	Boiled		Oven-cooked		Steamed		Grilled	
	absent (*n* = 326)	present (*n* = 1,724)	absent (*n* = 1,361)	present (*n* = 689)	absent (*n* = 1,764)	present (*n* = 286)	absent (*n* = 1,792)	present (*n* = 258)
Age group								
18–34 years	85 (26)	455 (26)	366 (27)	174 (25)	463 (26)	77 (27)	465 (26)	75 (29)
35–44 years	55 (17)	314 (18)	246 (18)	123 (18)	312 (18)	57 (20)	325 (18)	44 (17)
45–54 years	78 (24)	358 (22)	303 (23)	133 (19)	372 (21)	64 (22)	380 (21)	56 (22)
55–64 years	51 (16)	298 (17)	226 (16)	123 (18)	300 (17)	49 (17)	302 (17)	47 (18)
65+ years	57 (17)	299 (17)	220 (16)	136 (20)	317 (18)	39 (14)	320 (18)	36 (14)
Sex								
Women	157 (48)	850 (49)	673 (50)	334 (49)	868 (49)	139 (49)	895 (50)	112 (43)
Men	169 (52)	874 (51)	688 (50)	355 (51)	896 (51)	147 (51)	897 (50)	146 (57)
BMI category								
Normal	191 (59)	953 (55)	763 (56)	381 (55)	988 (56)	156 (54)	1,003 (56)	141 (55)
Overweight	91 (27)	514 (30)	404 (30)	201 (29)	515 (29)	90 (32)	535 (30)	70 (27)
Obese	44 (14)	257 (15)	194 (14)	107 (16)	261 (15)	40 (14)	254 (14)	47 (18)
Civil status								
Single	**117 (36)**	**513 (30)**	434 (32)	196 (28)	550 (31)	80 (28)	536 (30)	94 (36)
Married	**157 (48)**	**969 (56)**	727 (53)	399 (58)	959 (54)	167 (58)	992 (55)	134 (52)
Divorced	**41 (13)**	**177 (10)**	151 (11)	67 (10)	187 (11)	31 (11)	196 (11)	22 (9)
Other	**11 (3)**	**65 (4)**	49 (4)	27 (4)	68 (4)	8 (3)	68 (4)	8 (3)
On a diet								
No	303 (93)	1,641 (95)	1,289 (95)	655 (95)	1,678 (95)	266 (93)	1,696 (95)	248 (96)
Yes	23 (7)	83 (5)	72 (5)	34 (5)	86 (5)	20 (7)	96 (5)	10 (4)
Region								
German	204 (63)	1,139 (66)	**854 (63)**	**489 (71)**	1,169 (66)	174 (61)	1,180 (66)	163 (63)
French	87 (26)	418 (24)	**371 (27)**	**134 (19)**	426 (24)	79 (28)	439 (24)	66 (26)
Italian	35 (11)	167 (10)	**136 (10)**	**66 (10)**	169 (10)	33 (11)	173 (10)	29 (11)
Monthly income (CHF)								
<4,500	32 (10)	189 (11)	147 (11)	74 (11)	198 (12)	23 (8)	188 (11)	33 (13)
4,500–5,999	22 (7)	117 (7)	97 (7)	42 (6)	119 (7)	20 (7)	124 (7)	15 (6)
6,000–8,999	77 (24)	369 (21)	286 (21)	160 (23)	379 (21)	67 (23)	383 (22)	63 (24)
9,000–12,999	59 (17)	354 (21)	269 (20)	144 (21)	354 (20)	59 (21)	377 (21)	36 (14)
13,000+	49 (15)	223 (13)	178 (13)	94 (14)	229 (13)	43 (15)	236 (12)	36 (14)
Missing	87 (27)	472 (27)	384 (28)	175 (25)	485 (27)	74 (26)	484 (27)	75 (29)
Education								
Primary	20 (6)	94 (5)	67 (5)	47 (7)	100 (6)	14 (5)	99 (6)	15 (6)
Secondary	167 (51)	788 (46)	653 (48)	302 (44)	832 (47)	123 (43)	824 (46)	131 (51)
Tertiary	139 (43)	842 (49)	641 (47)	340 (49)	832 (47)	149 (52)	869 (48)	112 (43)

	Gratinated		Fried		Roasted		Microwaved	
	absent (*n* = 1,835)	present (*n* = 215)	absent (*n* = 1,844)	present (*n* = 206)	absent (*n* = 1,880)	present (*n* = 170)	absent (*n* = 1,899)	present (*n* = 151)
Age group								
18–34 years	484 (27)	56 (26)	**465 (25)**	**75 (36)**	501 (27)	39 (23)	501 (27)	39 (26)
35–44 years	329 (18)	40 (19)	**333 (18)**	**36 (17)**	348 (18)	21 (12)	342 (18)	27 (18)
45–54 years	391 (21)	45 (21)	**393 (21)**	**43 (21)**	392 (21)	44 (26)	398 (21)	38 (25)
55–64 years	315 (17)	34 (16)	**315 (17)**	**34 (17)**	315 (17)	34 (20)	332 (17)	17 (11)
65+ years	316 (17)	40 (19)	**338 (18)**	**18 (9)**	324 (17)	32 (18)	326 (17)	30 (20)

Table 2 (continued)

	Gratinated		Fried		Roasted		Microwaved	
	absent (n = 1,835)	present (n = 215)	absent (n = 1,844)	present (n = 206)	absent (n = 1,880)	present (n = 170)	absent (n = 1,899)	present (n = 151)
Sex								
Women	905 (49)	102 (47)	914 (50)	93 (45)	921 (49)	86 (51)	932 (49)	75 (50)
Men	930 (51)	113 (53)	930 (50)	113 (55)	959 (51)	84 (49)	967 (51)	76 (50)
BMI category								
Normal	1,035 (56)	109 (51)	1,030 (56)	114 (55)	1,054 (56)	90 (53)	1,059 (56)	85 (56)
Overweight	533 (29)	72 (33)	551 (30)	54 (26)	557 (30)	48 (28)	559 (29)	46 (30)
Obese	267 (14)	34 (16)	263 (14)	38 (18)	269 (14)	33 (19)	281 (15)	20 (13)
Civil status								
Single	563 (31)	67 (31)	550 (30)	80 (39)	581 (31)	49 (29)	579 (31)	51 (34)
Married	1,009 (55)	117 (54)	1,024 (55)	102 (50)	1,022 (54)	104 (61)	1,046 (55)	80 (53)
Divorced	198 (11)	20 (9)	200 (11)	18 (9)	206 (11)	12 (7)	205 (11)	13 (9)
Other	65 (3)	11 (5)	70 (4)	6 (3)	71 (4)	5 (3)	69 (4)	7 (5)
On a diet								
No	1,746 (95)	198 (92)	1,747 (95)	197 (95)	1,784 (95)	160 (94)	1,804 (95)	140 (93)
Yes	89 (5)	17 (8)	97 (5)	9 (5)	96 (5)	10 (6)	95 (5)	11 (7)
Region								
German	1,195 (65)	148 (69)	**1,228 (67)**	**115 (56)**	**1,213 (64)**	**130 (76)**	1,241 (65)	102 (67)
French	455 (25)	50 (23)	**435 (24)**	**70 (34)**	**478 (25)**	**27 (16)**	474 (25)	31 (21)
Italian	185 (10)	17 (8)	**181 (10)**	**21 (10)**	**189 (10)**	**13 (8)**	184 (10)	18 (12)
Monthly income(CHF)								
<4,500	203 (11)	18 (8)	207 (11)	14 (7)	204 (11)	17 (10)	210 (11)	11 (7)
4,500–5,999	125 (7)	14 (6)	128 (7)	11 (5)	126 (7)	13 (8)	124 (7)	15 (10)
6,000–8,999	389 (21)	57 (27)	402 (22)	44 (21)	409 (22)	37 (22)	407 (22)	39 (26)
9,000–12,999	366 (20)	47 (22)	367 (20)	46 (22)	379 (20)	34 (20)	387 (20)	26 (17)
13,000+	245 (13)	27 (13)	245 (13)	27 (13)	246 (13)	26 (15)	253 (13)	19 (13)
Missing	507 (28)	52 (24)	495 (27)	64 (31)	516 (27)	43 (25)	518 (27)	41 (27)
Education								
Primary	105 (6)	9 (4)	103 (6)	11 (5)	106 (6)	8 (5)	104 (5)	10 (7)
Secondary	851 (47)	104 (48)	864 (47)	91 (44)	865 (46)	90 (53)	891 (47)	64 (43)
Tertiary	879 (48)	102 (47)	877 (48)	104 (51)	909 (48)	72 (42)	904 (47)	77 (51)

Socio-demographic, lifestyle, and anthropometric factors associated with the presence/absence of cooking methods in the Swiss Population: National Nutrition Survey 2014-2015. Results are expressed as number of participants and (column percentage). Analysis conducted using chi-square. Statistically significant ($p < 0.05$) differences are indicated in bold. BMI, body mass index; CHF, Swiss Franc.

Participants aged 18–35 years had a higher probability of consuming fried foods compared to older participants. One previous study in Spain analysing two cohorts which recruited individuals aged ≥65 years reported that frequent fried-food consumption was related to younger age [36]. In one cross-sectional study conducted in the UK, participants aged 19–34 years reported being least confident with their level of cooking skills compared to older participants [2], leading them to select less time-consuming and easier cooking methods such as frying.

Participants in the French speaking-region of Switzerland had a higher probability of consuming fried foods but a lower probability of consuming roasted foods than those in the German-speaking region. Those differences might arise from culinary traditions, but no adequate explanation can be provided and further research will be needed.

Strengths and Limitations

Our study included participants recruited according to a stratified random population-based sampling of the entire Swiss population and interviewers were

Table 3. Multivariable analyses of the associations between socio-demographic, lifestyle, and anthropometric and cooking methods in the Swiss Population: National Nutrition Survey 2014-2015, weighted multivariable logistic regression models

	Boiled	Oven-cooked	Steamed	Grilled	Gratinated
Age group					
18–34 years	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
35–44 years	0.95 (0.60–1.50)	0.95 (0.67–1.35)	0.90 (0.56–1.44)	0.93 (0.56–1.53)	0.95 (0.56–1.59)
45–54 years	0.81 (0.53–1.25)	0.85 (0.59–1.23)	0.86 (0.55–1.35)	1.12 (0.70–1.79)	1.09 (0.66–1.81)
55–64 years	0.89 (0.54–1.47)	0.98 (0.69–1.41)	1.13 (0.66–1.94)	1.29 (0.78–2.11)	0.90 (0.54–1.51)
65+ years	0.86 (0.55–1.35)	1.14 (0.80–1.63)	0.84 (0.49–1.45)	0.78 (0.47–1.29)	1.24 (0.72–2.13)
Sex					
Females	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Males	0.90 (0.67–1.21)	1.13 (0.89–1.42)	0.98 (0.72–1.34)	1.33 (0.96–1.85)	1.07 (0.76–1.50)
Region					
German	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
French	0.82 (0.58–1.16)	0.76 (0.57–1.01)	1.18 (0.83–1.67)	1.08 (0.75–1.56)	1.00 (0.67–1.51)
Italian	0.88 (0.52–1.46)	1.12 (0.75–1.68)	1.40 (0.84–2.33)	1.22 (0.71–2.08)	0.74 (0.39–1.39)
Civil status					
Married	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Single	0.71 (0.49–1.01)	0.85 (0.64–1.12)	0.89 (0.61–1.32)	**1.68 (1.16–2.43)**	1.11 (0.74–1.67)
Divorced	0.81 (0.51–1.28)	0.80 (0.55–1.18)	0.95 (0.57–1.58)	0.95 (0.54–1.67)	0.73 (0.39–1.35)
Other	0.81 (0.36–1.82)	1.01 (0.55–1.84)	0.97 (0.42–2.27)	1.20 (0.53–2.70)	1.04 (0.46–2.35)
On a diet					
No	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Yes	0.60 (0.34–1.08)	1.12 (0.67–1.90)	1.38 (0.74–2.56)	**0.43 (0.20–0.91)**	1.89 (0.98–3.62)
BMI category					
Normal	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Overweight	1.12 (0.79–1.58)	1.06 (0.81–1.39)	1.04 (0.73–1.47)	1.03 (0.71–1.48)	1.26 (0.85–1.88)
Obese	1.30 (0.83–2.04)	1.07 (0.76–1.50)	0.82 (0.49–1.38)	**1.67 (1.08–2.58)**	0.93 (0.56–1.55)
Education					
Primary	1 (reference)	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Secondary	0.93 (0.52–1.64)	0.64 (0.39–1.03)	1.16 (0.56–2.39)	1.38 (0.70–2.71)	1.56 (0.71–3.40)
Tertiary	1.20 (0.67–2.16)	0.81 (0.50–1.33)	1.58 (0.76–3.27)	0.99 (0.50–1.95)	1.44 (0.66–3.18)

	Fried	Roasted	Microwaved	Roasted + oven-cooked
Age group				
18–34 years	1 (reference)	1 (reference)	1 (reference)	1 (reference)
35–44 years	**0.54 (0.33–0.90)**	0.71 (0.37–1.39)	1.02 (0.56–1.87)	0.90 (0.64–1.27)
45–54 years	**0.56 (0.34–0.93)**	1.18 (0.67–2.06)	1.32 (0.70–2.49)	0.89 (0.63–1.27)
55–64 years	0.63 (0.38–1.06)	1.02 (0.58–1.80)	1.22 (0.59–2.53)	0.97 (0.68–1.38)
65+ years	**0.24 (0.13–0.44)**	1.02 (0.57–1.84)	1.33 (0.73–2.40)	1.13 (0.80–1.60)
Sex				
Females	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Males	1.17 (0.82–1.68)	0.93 (0.63–1.38)	0.90 (0.60–1.35)	1.06 (0.85–1.32)
Region				
German	1 (reference)	1 (reference)	1 (reference)	1 (reference)
French	**1.70 (1.16–2.49)**	**0.41 (0.25–0.67)**	0.87 (0.50–1.49)	0.67 (0.51–0.88)
Italian	1.19 (0.65–2.18)	0.58 (0.29–1.16)	1.62 (0.86–3.03)	1.01 (0.68–1.49)
Civil status				
Married	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Single	**1.68 (1.10–2.55)**	0.69 (0.45–1.07)	1.35 (0.82–2.23)	0.79 (0.60–1.04)
Divorced	1.02 (0.56–1.84)	**0.45 (0.22–0.89)**	0.81 (0.39–1.67)	0.72 (0.49–1.04)
Other	1.04 (0.37–2.94)	0.66 (0.23–1.87)	1.00 (0.42–2.40)	0.85 (0.48–1.52)

Table 3 (continued)

	Fried	Roasted	Microwaved	Roasted + oven-cooked
On a diet				
No	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Yes	0.49 (0.21–1.14)	1.46 (0.65–3.28)	1.47 (0.68–3.16)	1.31 (0.80–2.13)
BMI category				
Normal	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Overweight	1.27 (0.81–2.01)	0.8 (0.51–1.23)	1.17 (0.74–1.83)	1.01 (0.78–1.31)
Obese	**2.35 (1.39–3.98)**	1.29 (0.76–2.20)	0.77 (0.41–1.42)	1.10 (0.79–1.53)
Education				
Primary	1 (reference)	1 (reference)	1 (reference)	1 (reference)
Secondary	0.97 (0.44–2.13)	1.97 (0.84–4.60)	0.54 (0.24–1.20)	0.75 (0.46–1.20)
Tertiary	1.28 (0.58–2.82)	1.36 (0.57–3.23)	0.65 (0.29–1.43)	0.88 (0.55–1.42)

Multivariable analyses of the associations between socio-demographic, lifestyle, and anthropometric and cooking methods in the Swiss Population: National Nutrition Survey 2014-2015, weighted multivariable logistic regression models. Results are expressed as odds ratio and (95% confidence interval). Statistical analysis by multivariable logistic regression adjusting for the confounders are shown in the table. Statistically significant ($p < 0.05$) associations are indicated in bold. BMI, body mass index.

extensively trained for data collection to maximize standardization and quality of 24-h dietary recall in all study centres. Thus, it allows for generalizability of our results to the national level. Our study is also the first one to evaluate the sociodemographic determinants of cooking methods in the Swiss population, an under-researched field.

Our study, however, presents some limitations. First, we only focused on single cooking methods for each food item as has been reported before in the literature [37], as including different cooking techniques for each food item would lead to too many subclasses and to non-significant results due to small sample sizes. Further research should focus on specific foods (i.e., meat, vegetables) to evaluate the role of cooking methods on the nutrient composition, chemical substance formation (i.e., AGEs, acrylamides) and their role on health. Second, we used the self-reported weight for pregnant women and those for whom weight was not possible to be measured. However, according to a recent systematic review [38], there is a good agreement between measured and self-reported weight and height of participants in epidemiological studies. Third, a sizable fraction of the sample did not provide information on income, which could have biased the associations. Still, analyses excluding participants without information on income provided similar results. Finally, although pregnant and lactating women were included, they represented less than 1% of the overall sample (8 women pregnant and 11 lactating). Hence, we believe that this small percentage would not significantly change the findings.

Conclusion

Cooking methods used in the diet of the Swiss population differ by age, sex, BMI category, region, socioeconomic status, and cardiovascular risk. Further studies are required to examine the role of cooking methods on specific food items and their link with disease risk in the Swiss population.

Statement of Ethics

The study protocol was reviewed and approved by the corresponding regional ethics committees (Lead Ethics Committee: CER-VD – Commission cantonale d'éthique de la recherche sur l'être humain (https://www.cer-vd.ch/) in Lausanne, Protocol 26/13, approved on February 12, 2013) [21]. The study was conducted according to the guidelines laid down in the Declaration of Helsinki and its former amendments, and each participant signed a written informed consent before entering the study. The study was registered in the Trial Registry (identification number: ISRCTN16778734, https://doi.org/10.1186/ISRCTN16778734) and the data source is the Federal Food Safety and Veterinary Office menu CH National Nutrition Survey 2014/15 (Contract Nr. FSVO 0714000510).

Conflict of Interest Statement

The authors report no conflict of interest.

Funding Sources

This study received no funding.

Author Contributions

Ana-Lucia Mayén: conceptualization, investigation, formal analysis, visualization, and writing – original draft. Pedro Marques-Vidal: conceptualization, data curation, validation, writing – review and editing, and supervision.

Data Availability Statement

The data used in this study cannot be fully shared as it was obtained via contract from the Swiss Federal Food Safety and Veterinary Office (FSVO). Data requests should be sent to the menuCH data repository, https://menuch.unisante.ch/index.php/catalog/4.

References

1 Knorr D, Augustin MA. Food processing needs, advantages and misconceptions. Trends Food Sci Technology. 2021;108:103–10. https://doi.org/10.1016/j.tifs.2020.11.026
2 Adams J, Goffe L, Adamson AJ, Halligan J, O'Brien N, Purves R, et al. Prevalence and socio-demographic correlates of cooking skills in UK adults: cross-sectional analysis of data from the UK National Diet and Nutrition Survey. Int J Behav Nutr Phys Act. 2015;12:99. https://doi.org/10.1186/s12966-015-0261-x
3 Van Boekel M, Fogliano V, Pellegrini N, Stanton C, Scholz G, Lalljie S, et al. A review on the beneficial aspects of food processing. Mol Nutr Food Res. 2010;54(9):1215–47. https://doi.org/10.1002/mnfr.200900608
4 Hoffman R, Gerber M. Food processing and the mediterranean diet. Nutrients. 2015;7(9):7925–64. https://doi.org/10.3390/nu7095371
5 Gao W, Cao D, Lv K, Wu J, Wang Y, Wang C, et al. Elimination of short-chain chlorinated paraffins in diet after Chinese traditional cooking-a cooking case study. Environ Int. 2019;122:340–5. https://doi.org/10.1016/j.envint.2018.11.025
6 Jin W, Otake M, Eguchi A, Sakurai K, Nakaoka H, Watanabe M, et al. Dietary habits and cooking methods could reduce avoidable exposure to PCBs in maternal and cord sera. Sci Rep. 2017;7(1):17357. https://doi.org/10.1038/s41598-017-17656-9
7 Bongoni R, Stieger M, Dekker M, Steenbekkers B, Verkerk R. Sensory and health properties of steamed and boiled carrots (Daucus carota ssp. sativus). Int J Food Sci Nutr. 2014;65(7):809–15. https://doi.org/10.3109/09637486.2014.931360
8 Alfaia CMM, Alves SP, Lopes AF, Fernandes MJE, Costa ASH, Fontes CMGA, et al. Effect of cooking methods on fatty acids, conjugated isomers of linoleic acid and nutritional quality of beef intramuscular fat. Meat Sci. 2010;84(4):769–77. https://doi.org/10.1016/j.meatsci.2009.11.014
9 Janiszewski P, Grześkowiak E, Lisiak D, Borys B, Borzuta K, Pospiech E, et al. The influence of thermal processing on the fatty acid profile of pork and lamb meat fed diet with increased levels of unsaturated fatty acids. Meat Sci. 2016;111:161–7. https://doi.org/10.1016/j.meatsci.2015.09.006
10 Abdel-Naeem HHS, Sallam KI, Zaki HMBA. Effect of different cooking methods of rabbit meat on topographical changes, physicochemical characteristics, fatty acids profile, microbial quality and sensory attributes. Meat Sci. 2021;181:108612. https://doi.org/10.1016/j.meatsci.2021.108612
11 Frankowska A, Rivera XS, Bridle S, Kluczkovski AMRG, Tereza da Silva J, Martins CA, et al. Impacts of home cooking methods and appliances on the GHG emissions of food. Nat Food. 2020;1(12):787–91. https://doi.org/10.1038/s43016-020-00200-w
12 Zawada A, Machowiak A, Rychter AM, Ratajczak AE, Szymczak-Tomczak A, Dobrowolska A, et al. Accumulation of advanced glycation end-products in the body and dietary habits. Nutrients. 2022;14(19):3982. https://doi.org/10.3390/nu14193982
13 Di Maso M, Turati F, Bosetti C, Montella M, Libra M, Negri E, et al. Food consumption, meat cooking methods and diet diversity and the risk of bladder cancer. Cancer Epidemiol. 2019;63:101595. https://doi.org/10.1016/j.canep.2019.101595
14 Bylsma LC, Alexander DD. A review and meta-analysis of prospective studies of red and processed meat, meat cooking methods, heme iron, heterocyclic amines and prostate cancer. Nutr J. 2015;14:125. https://doi.org/10.1186/s12937-015-0111-3
15 Cross AJ, Ferrucci LM, Risch A, Graubard BI, Ward MH, Park Y, et al. A large prospective study of meat consumption and colorectal cancer risk: an investigation of potential mechanisms underlying this association. Cancer Res. 2010;70(6):2406–14. https://doi.org/10.1158/0008-5472.CAN-09-3929
16 Chiavarini M, Bertarelli G, Minelli L, Fabiani R. Dietary intake of meat cooking-related mutagens (HCAs) and risk of colorectal adenoma and cancer: a systematic review and meta-analysis. Nutrients. 2017;9(5):514. https://doi.org/10.3390/nu9050514
17 Liu G, Zong G, Hu FB, Willett WC, Eisenberg DM, Sun Q. Cooking methods for red meats and risk of type 2 diabetes: a prospective study of U.S. Women. Diabetes Care. 2017;40(8):1041–9. https://doi.org/10.2337/dc17-0204
18 García-González Á, Achón M, Alonso-Aperte E, Varela-Moreiras G. Identifying factors related to food agency: cooking habits in the Spanish adult population—a cross-sectional study. Nutrients. 2018;10(2):217. https://doi.org/10.3390/nu10020217
19 Achón M, Serrano M, García-González Á, Alonso-Aperte E, Varela-Moreiras G. Present food shopping habits in the Spanish adult population: a cross-sectional study. Nutrients. 2017;9(5):508. https://doi.org/10.3390/nu9050508
20 Chatelan A, Beer-Borst S, Randriamiharisoa A, Pasquier J, Blanco JM, Siegenthaler S, et al. Major differences in diet across three linguistic regions of Switzerland: results from the first national nutrition survey menuCH. Nutrients. 2017;9(11):1163. https://doi.org/10.3390/nu9111163
21 Chatelan A, Marques-Vidal P, Bucher S, Siegenthaler S, Metzger N, Zuberbühler CA, et al. Lessons learnt about conducting a multilingual nutrition survey in Switzerland: results from menuCH pilot survey. Int J Vitam Nutr Res. 2017;87(1–2):25–36. https://doi.org/10.1024/0300-9831/a000429
22 Marques-Vidal P, Paccaud F. Regional differences in self-reported screening, prevalence and management of cardiovascular risk factors in Switzerland. BMC Public Health. 2012;12:246. https://doi.org/10.1186/1471-2458-12-246
23 Slimani N, Casagrande C, Nicolas G, Freisling H, Huybrechts I, Ocké MC, et al. The standardized computerized 24-h dietary recall method EPIC-Soft adapted for pan-European dietary monitoring. Eur J Clin Nutr. 2011;65(Suppl 1):S5–15. https://doi.org/10.1038/ejcn.2011.83
24 Presser K, Weber D, Norrie M. FoodCASE: a system to manage food composition, consumption and TDS data. Food Chem. 2018;238:166–72. https://doi.org/10.1016/j.foodchem.2016.09.124
25 MONICA. Manual, Part III, section 1: population survey data component. 4.6 height, weight, waist and hip measurement. Geneva, Switzerland: WHO Press; 1997.
26 Pestoni G, Krieger JP, Sych JM, Faeh D, Rohrmann S, Schader C. Cultural differences in diet and determinants of diet quality in Switzerland: results from the national nutrition survey menuCH. Nutrients. 2019;11(1):126. https://doi.org/10.3390/nu11010126
27 British Heart Foundation. Why your waist size matters [Internet]. [cited 2023 Aug 10]. Available from: https://www.bhf.org.uk/informationsupport/heart-matters-magazine/medical/measuring-your-waist#:~:text=What%20should%20your%20waist%20measurement,34.6in)%20is%20very%20high

28 Lee KW, Song WO, Cho MS. Dietary quality differs by consumption of meals prepared at home vs. outside in Korean adults. Nutr Res Pract. 2016;10(3):294–304. https://doi.org/10.4162/nrp.2016.10.3.294
29 Tani Y, Fujiwara T, Kondo K. Cooking skills related to potential benefits for dietary behaviors and weight status among older Japanese men and women: a cross-sectional study from the JAGES. Int J Behav Nutr Phys Act. 2020;17(1):82. https://doi.org/10.1186/s12966-020-00986-9
30 Qin P, Liu D, Wu X, Zeng Y, Sun X, Zhang Y, et al. Fried-food consumption and risk of overweight/obesity, type 2 diabetes mellitus, and hypertension in adults: a meta-analysis of observational studies. Crit Rev Food Sci Nutr. 2022;62(24):6809–20. https://doi.org/10.1080/10408398.2021.1906626
31 Nurwanti E, Hadi H, Chang JS, Chao JCJ, Paramashanti BA, Gittelsohn J, et al. Rural-urban differences in dietary behavior and obesity: results of the riskesdas study in 10-18-year-old Indonesian children and adolescents. Nutrients. 2019;11(11):2813. https://doi.org/10.3390/nu11112813
32 Thompson AK, Minihane AM, Williams CM. Trans fatty acids and weight gain. Int J Obes. 2011;35(3):315–24. https://doi.org/10.1038/ijo.2010.141
33 Inan-Eroglu E, Ayaz A, Buyuktuncer Z. Formation of advanced glycation end-products in foods during cooking process and underlying mechanisms: a comprehensive review of experimental studies. Nutr Res Rev. 2020;33(1):77–89. https://doi.org/10.1017/S0954422419000209
34 Uribarri J, Woodruff S, Goodman S, Cai W, Chen X, Pyzik R, et al. Advanced glycation end products in foods and a practical guide to their reduction in the diet. J Am Diet Assoc. 2010;110(6):911–6.e12. https://doi.org/10.1016/j.jada.2010.03.018
35 Ghorbani M, Najafi Saleh H, Barjasteh-Askari F, Nasseri S, Davoudi M. The effect of gas versus charcoal open flames on the induction of polycyclic aromatic hydrocarbons in cooked meat: a systematic review and meta-analysis. J Environ Health Sci Eng. 2020;18(1):345–54. https://doi.org/10.1007/s40201-020-00457-0
36 Cahill LE, Pan A, Chiuve SE, Sun Q, Willett WC, Hu FB, et al. Fried-food consumption and risk of type 2 diabetes and coronary artery disease: a prospective study in 2 cohorts of US women and men. Am J Clin Nutr. 2014;100(2):667–75. https://doi.org/10.3945/ajcn.114.084129
37 Rodríguez-Ayala M, Sandoval-Insausti H, Bayán-Bravo A, Banegas JR, Donat-Vargas C, Ortolá R, et al. Cooking methods and their relationship with anthropometrics and cardiovascular risk factors among older Spanish adults. Nutrients. 2022;14(16):3426. https://doi.org/10.3390/nu14163426
38 Fayyaz K, Bataineh MF, Ali HI, Al-Nawaiseh AM, Al-Rifai' RH, Shahbaz HM. Validity of measured vs. Self-reported weight and height and practical considerations for enhancing reliability in clinical and epidemiological studies: a systematic review. Nutrients. 2024;16(11):1704. https://doi.org/10.3390/nu16111704