



Original article

Barriers to healthy eating in Switzerland: A nationwide study

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SUMMARY

Background & aims: Several barriers can hinder healthy eating in the population. We aimed to assess the prevalence of self-reported barriers to healthy eating in Switzerland and examine their socioeconomic and demographic determinants.

Methods: Using representative cross-sectional data from the Swiss Health Survey 2012, we assessed, separately by gender, the prevalence of ten barriers and their association with demographic and socioeconomic determinants; we used age- and multivariable-adjusted logistic regression and report the odds ratio for likelihood to identify each barrier according to each demographic and socioeconomic determinant.

Results: The most prevalent barriers were “price” (43.2% in women, 35.8% in men), “daily habits, constraints” (39.8%, 37.5%), “fondness of good food” (38.8%, 51.0%), “time constraint” (34.8%, 29.0%) and “lack of willpower” (22.0%, 21.2%). Prevalence of most barriers decreased with age, increased for “fondness of good food” and remained constant for “price.” After multivariable adjustment, obese participants were more likely to report “fondness of good food” [Odds ratio (95% confidence interval) for obese vs. normal weight women and men, respectively: 1.63 (1.38–1.91), 2.02 (1.72–2.38)]. Participants with lower education were more likely to report “fondness of good food” [mandatory vs. tertiary women and men, respectively: 1.93 (1.62–2.39), 1.51 (1.26–1.81)], but less likely to report “lack of willpower” [0.45 (0.38–0.55), 0.40 (0.33–0.49)] and “time constraint” [0.61 (0.51–0.73), 0.78 (0.63–0.96)]. Participants with lower income were more likely to report “price” [lowest vs. highest quartile for women and men, respectively, 1.65 (1.43–1.90), 1.47 (1.26–1.71)] but less likely to report “lack of willpower” [0.71 (0.61–0.82), 0.40 (0.33–0.49)]. Smoking, living situation, nationality and living area showed little or no association.

Conclusion: Several barriers to healthy eating were highly prevalent regardless of gender; the most important determinants were age, obesity, education, and income, with different effects per barrier. This requires multifaceted interventions to tackle several barriers simultaneously.

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1. Introduction

Healthy eating is associated with lower risk of developing many chronic noncommunicable diseases such as obesity, diabetes, hypertension, myocardial infarction, stroke and many forms of cancer

[1,2], all of which disproportionately affect people of lower socioeconomic status (SES) [3,4]. Indeed, healthy eating—any diet high in fruits, vegetables, whole grains, nuts and seeds, and low in sugar, salt, red meat and processed foods—tends to be more common in women, older people, those with normal BMI and higher SES [5,6].

The demographic and socioeconomic inequalities in healthy eating are likely driven by the conditions in which people live and work, and by the distribution of and access to resources and money in their communities—the social determinants of health [7]. The evidence points to access barriers such as food price and availability of healthy foods in stores [8–12]; external barriers such as time and work constraints [8,9,13]; individual barriers such as food taste preference [8,11,12] and willpower [8]; and social barriers such as lack of social support [14]. Thus, despite widespread dietary

Abbreviations: CVD, cardiovascular disease; SES, socioeconomic status; SHS, Swiss Health Survey.

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guidelines in most high-income countries aiming to provide sufficient nutrition knowledge, people face several barriers that prevent compliance to healthy eating recommendations. In clinical nutrition, these barriers may hinder preventive measures and adversely affect outcomes.

In Switzerland, compliance to dietary guidelines is low, with men, obese people, and those with low education being less likely to comply [15]. The Swiss population enjoys a high quality of life, low unemployment and poverty, universal and mandatory healthcare, and one of the longest life expectancies worldwide [16]. Compared to bordering France or Germany, Switzerland has low cardiovascular disease (CVD) mortality and relatively low CVD risk factors [17]. A recent study in a Swiss city showed that people with high education, older age and living in couple were more likely to follow a healthy diet [18]. However, no study has investigated potential barriers to healthy eating in Switzerland. Thus, using a nationally representative sample of the Swiss adult population, we aimed to assess, separately by gender, the prevalence of barriers to healthy eating and their demographic and socioeconomic determinants.

2. Methods

2.1. Database and sampling

Data from the Swiss Health Survey (SHS) of 2012 was analyzed. The SHS is a cross-sectional, nationwide, population-based study conducted every five years since 1992 by the Swiss Federal Statistical Office under a mandate of the Swiss Government. The SHS is considered representative of the Swiss adult population, does not require consent from an Ethics Committee, and the data are anonymized before use.

Selection of participants is based on a stratified random sampling applied to a database of all private Swiss households with landline telephones (over 90% of the population). The first sampling stratum consists of the seven main administrative regions (Leman, Mittelland, Northwest, Zurich, Northeast, Central and South). The second stratum consists of the cantons, the number of households drawn being proportional to each cantonal population. In some cantons, oversampling of the households was made to obtain accurate cantonal estimates, and extra strata were used for the cantons of Zurich and Bern. Overall, 29 strata were used. The third stratum is the household. For each household, one member aged ≥ 15 years was randomly selected; an invitation letter to participate in the survey was sent, and phone contacts were made if no response to the letter was obtained. Participants aged < 75 years were interviewed by phone using computer-assisted telephone interview software, while participants aged ≥ 75 years received face-to-face interviews at home. All participants were invited to fill out an additional written questionnaire sent by mail. The interviews were conducted in German, French or Italian—individuals unable to speak any were excluded, as were those with asylum-seeker status or with very poor health. The telephone survey and the written survey had participations rates of 53% and 45%, respectively. SHS 2012 details are available at http://www.bfs.admin.ch/bfs/portal/fr/index/infothek/erhebungen_quellen/blank/blank/ess/04.html.

2.2. Barriers to healthy eating

Barriers to healthy eating were assessed by the written questionnaire, completed by 85% of participants in the telephone survey. To the main question “Many people, maybe including yourself, place importance in following a healthy diet. Please identify which of the following obstacles prevent you from having a healthy diet,”

participants answered “yes” or “no” from a 10-item list (Supplementary Table 1). To facilitate the discussion from a social determinants of health perspective, the barriers were further categorized into four domains: a) access to healthy foods (items 2, 3 and 4); b) social support (items 5 and 6); c) external constraints (items 1 and 9) and d) individual factors (items 7, 8 and 10). The questions assessing barriers were set by a multidisciplinary group of experts before the first Swiss Health Survey took place in 1992, and no reference to any previously validated instrument could be found. However, the barriers assessed are similar to those in the pan-European survey and previous research that investigated barriers to healthy eating [8,10–12,19]. Hence, in the absence of a standard, validated instrument, the current questionnaire is the best and only option for the Swiss population.

2.3. Demographic and socioeconomic variables

All data was self-reported. Age was categorized into 18–35, 36–50, 51–65 and > 65 groups. Weight and height were collected; body mass index (BMI) was calculated and categorized as normal or underweight ($\text{BMI} < 25 \text{ kg/m}^2$), overweight ($25 \leq \text{BMI} < 30 \text{ kg/m}^2$), and obese ($\text{BMI} \geq 30 \text{ kg/m}^2$). Smoking status was categorized as never, former, or current. Living situation was categorized as alone (i.e., living alone or as single parent) or with someone (i.e., living with couple or adult family). Nationality was categorized as Swiss and non-Swiss. Living area was categorized as urban or rural. Education was categorized as mandatory, secondary, or tertiary. Income was categorized into quartiles: < 2857 ; 2857–3999; 4000–5332 and ≥ 5333 CHF (1 CHF = 0.92 € or 1.01US\$, as of 25.11.2015). Occupation was categorized as upper/middle management work, office/non-manual/small independent work, or manual work.

2.4. Statistical analysis

Statistical analyses were performed using Stata 13 (Stata Corp. College Station, TX, USA) and were stratified by gender. Results were expressed as number of participants (percentage) for qualitative data or as average \pm standard deviation for quantitative data. Bivariate analyses were conducted using chi-square test for qualitative variables and student's t-test for quantitative variables. Multivariable analyses were conducted using logistic regression. Two models were applied: 1) adjusting for age only and 2) adjusting for all demographic and socioeconomic variables. As a large proportion (20%) of the sample could not be categorized regarding their occupation, occupation was used for sensitivity analyses only. A second sensitivity analysis included the same procedure but with weighted data. To reduce the likelihood of type I error due to the high number of tests performed, statistical significance was considered for two-sided tests with $p < 0.001$.

3. Results

3.1. Sample selection and characteristics

Of the initial 21,597 participants, 6803 (31.5%) were excluded because they were below age 18 or had missing information on demographic or socioeconomic determinants or on barriers to healthy eating (Supplementary Fig. 1). The characteristics of included and excluded participants are summarized in Supplementary Table 2. Excluded participants were less frequently aged 36 to 65, overweight or obese, never smokers or of Swiss nationality than included participants; excluded participants also had lower educational and income levels than included participants.

The characteristics of the included participants according to gender are summarized in [Table 1](#). Men were more frequently overweight or obese, smokers, and living in couple, and had higher educational and income levels than women.

3.2. Prevalence of barriers to healthy eating

The overall prevalence of barriers to healthy eating and according to different demographic and socioeconomic determinants is summarized in [Table 2](#) (women) and [Table 3](#) (men). The top five barriers were similar in both genders, albeit with different prevalence, and were in the individual, external, and access domains. The most frequently reported barrier among women was “price,” followed by “daily habits, constraints,” “fondness of good food,” “time constraint,” and “lack of willpower.” Conversely, the most frequently reported barrier among men was “fondness of good food,” followed by “daily habits, constraints,” “price,” “time constraint” and “lack of willpower.”

3.3. Demographic and socioeconomic determinants of barriers to healthy eating

In women, the prevalence of most barriers decreased gradually with age; “fondness of good food,” however, increased with age, and “price” remained constant. Overweight and obese women were more likely to report “fondness of good food” and “lack of willpower.” Smoking showed no association. Women living in couple were more likely to report “daily habits, constraints” and “lack of willpower” ([Table 2](#)). After adjusting for age ([Supplementary Table 3](#)) or all covariates ([Table 4](#)), obese women remained more likely to report the above barriers, but also “no social support,” “daily habits, constraints” and “fondness of abundant food;” women living in couple were more likely to report “no social support” and “fondness of good food,” but also less likely to report “price.”

The socioeconomic determinants were associated with the most prevalent barriers. Women with lower income were more likely to report “price” and “fondness of good food;” those with higher income were more likely to report “time constraint,” “daily habits, constraints” and “limited options in restaurants.” Women with lower education were more likely to report “fondness of good food;” those with higher education were more likely to report “time constraints,” “daily habits, constraints,” “lack of willpower” and “limited options in restaurants” ([Table 2](#)). Most associations remained after adjustment, except between “daily habits, constraints” and education, and between “fondness of good food” and income ([Supplementary Table 3, Table 4](#)).

In men, age was associated with barriers the same way as in women. BMI category, however, showed slightly different associations ([Table 3](#)). After adjusting for age ([Supplementary Table 4](#)) or all covariates ([Table 5](#)), overweight and obese men were more likely to report “fondness of good food” and “fondness of abundant food.” Smoking was associated with some barriers, though in no clear pattern. Neither living situation nor nationality showed any association with barriers after adjustment. The socioeconomic determinants were associated with the most prevalent barriers in the same way as in women, with the following additions after adjustment: men with higher education were more likely to report “daily habits, constraints,” and men with the higher income were more likely to report “fondness of good food” ([Table 5, Supplementary Table 4](#)).

The associations indicated above did not change when occupation was included in the model ([Supplementary Tables 5 and 6](#)). In the sensitivity analysis with weighted data, the results were similar to the unweighted analysis ([Supplementary Tables 7–10](#)).

4. Discussion

This is one of the few studies assessing prevalence and determinants of multiple barriers to healthy eating, and the first

Table 1
Characteristics of included participants, total and by sex.

	Total	Men	Women	p-value
N	14,794	7083	7711	
Age (mean ± SD)	48.5 (17.1)	48.7 (17.3)	48.3 (17.0)	0.09
Age groups (N, %)				0.27
18–35	3715 (25.1)	1741 (24.6)	1974 (25.6)	
36–50	4567 (30.9)	2167 (30.6)	2400 (31.1)	
51–65	3744 (25.3)	1821 (25.7)	1923 (24.9)	
Above 65	2768 (18.7)	1354 (19.1)	1414 (18.3)	
BMI				<0.001
Under/normal weight	8516 (57.6)	3297 (46.6)	5219 (67.7)	
Overweight	4719 (31.9)	2955 (41.7)	1764 (22.9)	
Obese	1559 (10.5)	831 (11.7)	728 (9.4)	
Smoking				<0.001
Never smoked	7259 (49.1)	3005 (42.4)	4254 (55.2)	
Ex-smoker	3508 (23.7)	1941 (27.4)	1567 (20.3)	
Current smoker	4027 (27.2)	2137 (30.2)	1890 (24.5)	
Living alone	3319 (22.4)	1290 (18.2)	2029 (26.3)	<0.001
Swiss national	12,567 (85.0)	5883 (83.1)	6684 (86.7)	<0.001
Urban area	10,556 (71.4)	5040 (71.2)	5516 (71.5)	0.61
Education				<0.001
Mandatory	1744 (11.8)	727 (10.3)	1017 (13.2)	
Secondary	8396 (56.8)	3601 (50.8)	4795 (62.2)	
Tertiary	4654 (31.5)	2755 (38.9)	1899 (24.6)	
Income (quartiles)				<0.001
First (<2857 CHF)	3137 (21.2)	1341 (18.9)	1796 (23.3)	
Second (2857–3999 CHF)	3442 (23.3)	1538 (21.7)	1904 (24.7)	
Third (4000–5332 CHF)	3921 (26.5)	1863 (26.3)	2058 (26.7)	
Fourth (≥5333 CHF)	4294 (29.0)	2341 (33.1)	1953 (25.3)	

BMI, body mass index; CHF, Swiss Franc. Results are expressed as number of participants (percentage) for qualitative data or as average ± standard deviation for quantitative data. Bivariate analyses were conducted using chi-square test for qualitative variables and student's t-test for quantitative variables.

Table 2

Prevalence and socio-demographic determinants of barriers to healthy eating among women, Swiss Health survey 2012, unweighted data.

	Access			Social		External		Individual		
	Price	Limited options in restaurants	Limited options at market	No social support	Social group opposition	Time constraint	Daily habits, constraints	Fondness of good food	Fondness of abundant food	Lack of willpower
Overall	43.2 (42.1–44.3)	19.5 (18.6–20.4)	5.9 (5.4–6.5)	7.8 (7.2–8.4)	3.0 (2.6–3.4)	34.8 (33.7–35.9)	39.8 (38.7–40.9)	38.8 (37.7–39.8)	11.0 (10.3–11.8)	22.0 (21.1–22.9)
Age groups										
18–35	43.2 (41.0–45.4)	21.6 (19.8–23.5)	7.3 (6.2–8.5)	10.9 (9.6–12.3)	4.5 (3.6–5.5)	40.5 (38.3–42.7)	51.1 (48.9–53.3)	35.4 (33.3–37.6)	17.5 (15.8–19.2)	29.8 (27.8–31.9)
36–50	43.8 (41.8–45.8)	21.1 (19.5–22.8)	6.1 (5.2–7.2)	7.5 (6.4–8.6)	2.9 (2.2–3.6)	36.0 (34.1–38.0)	47.1 (45.1–49.1)	32.8 (31.0–34.8)	10.6 (9.4–11.9)	23.4 (21.7–25.2)
51–65	42.3 (40.1–44.6)	21.4 (19.6–23.3)	5.3 (4.3–6.3)	6.8 (5.7–8.0)	2.7 (2–3.5)	32.1 (30.1–34.3)	36.1 (33.9–38.3)	38.7 (36.5–40.9)	9.2 (7.9–10.6)	18.7 (17.0–20.5)
Above 65	43.5 (40.9–46.1)	11.4 (9.8–13.2)	4.6 (3.6–5.8)	5.2 (4.1–6.4)	1.6 (1.0–2.4)	28.4 (26.1–30.9)	16.5 (14.6–18.5)	53.5 (50.9–56.2)	5.3 (4.2–6.6)	13.0 (11.3–14.9)
<i>p-value</i>	0.82	<0.001	<0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
BMI category										
Under/normal weight	43.4 (42.0–44.8)	20.7 (19.6–21.8)	6.3 (5.6–7.0)	7.5 (6.8–8.2)	3.1 (2.7–3.6)	36.0 (34.7–37.3)	41.1 (39.8–42.4)	34.5 (33.2–35.8)	10.7 (9.9–11.6)	21.7 (20.6–22.8)
Overweight	43.2 (40.9–45.5)	17.2 (15.4–19.0)	4.7 (3.8–5.8)	7.7 (6.5–9.0)	2.7 (2.0–3.5)	33.1 (30.9–35.4)	37.0 (34.7–39.3)	46.8 (44.5–49.2)	10.7 (9.3–12.3)	20.5 (18.7–22.5)
Obese	41.9 (38.3–45.6)	16.6 (14.0–19.5)	6.5 (4.8–8.5)	10.0 (7.9–12.4)	3.0 (1.9–4.5)	30.4 (27.0–33.8)	37.1 (33.6–40.7)	49.6 (45.9–53.3)	14.2 (11.7–16.9)	27.8 (24.5–31.2)
<i>p-value</i>	0.75	0.001	0.05	0.05	0.62	<0.01	<0.01	<0.001	0.02	<0.001
Smoking										
Never smoked	43.0 (41.5–44.5)	19.1 (18–20.3)	5.6 (5.0–6.4)	8.0 (7.2–8.9)	3.3 (2.8–3.8)	34.7 (33.2–36.1)	39.6 (38.1–41.1)	38.1 (36.6–39.5)	10.5 (9.6–11.5)	22.4 (21.2–23.7)
Ex-smoker	46.3 (43.8–48.8)	22.1 (20–24.2)	5.4 (4.4–6.7)	7.9 (6.6–9.3)	2.9 (2.1–3.8)	34.9 (32.5–37.3)	38.0 (35.6–40.5)	37.3 (34.9–39.8)	11.4 (9.9–13.1)	22.2 (20.2–24.3)
Current smoker	41.1 (38.8–43.3)	18.2 (16.5–20)	7.0 (5.9–8.2)	7.0 (5.9–8.3)	2.5 (1.9–3.4)	35.0 (32.8–37.2)	41.6 (39.4–43.8)	41.5 (39.2–43.7)	11.9 (10.5–13.5)	20.9 (19.0–22.7)
<i>p-value</i>	<0.01	0.01	0.08	0.39	0.29	0.97	0.10	0.02	0.23	0.39
Living situation										
Alone	45.9 (43.7–48.1)	19.6 (17.9–21.4)	6.1 (5.1–7.2)	5.4 (4.4–6.4)	2.7 (2.0–3.5)	35.1 (32.0–36.2)	34.8 (32.7–36.9)	39.6 (37.4–41.7)	9.8 (8.5–11.1)	18.0 (16.3–19.7)
In couple	42.2 (40.9–43.5)	19.5 (18.4–20.5)	5.9 (5.3–6.5)	8.6 (7.9–9.4)	3.1 (2.7–3.6)	34.1 (33.8–36.3)	41.6 (40.3–42.8)	38.5 (37.2–39.7)	11.5 (10.7–12.4)	23.4 (22.3–24.5)
<i>p-value</i>	<0.01	0.88	0.68	<0.001	0.36	0.4	<0.001	0.37	0.03	<0.001
Nationality										
Swiss	43.3 (42.1–44.5)	19.5 (18.6–20.5)	5.4 (4.9–6.0)	7.8 (7.1–8.4)	3.1 (2.7–3.5)	35.3 (34.1–36.5)	39.3 (38.5–40.9)	38.8 (37.7–40.0)	11.2 (10.4–11.9)	22.4 (21.4–23.4)
Non-Swiss	42.9 (39.9–46.0)	19.5 (17.1–22.0)	9.4 (7.6–11.3)	7.7 (6.1–9.5)	2.5 (1.7–3.7)	31.6 (28.7–34.5)	40.4 (37.4–43.5)	38.2 (35.2–41.2)	10.3 (8.5–12.3)	19.5 (17.1–22.0)
<i>p-value</i>	0.85	0.98	<0.001	0.94	0.34	0.02	0.66	0.68	0.43	0.04
Area										
Urban	44.0 (42.6–45.3)	19.8 (18.7–20.9)	6.1 (5.5–6.8)	7.5 (6.9–8.3)	3.0 (2.5–3.5)	35.0 (33.8–36.3)	39.3 (38.0–40.6)	38.4 (37.1–39.7)	11.1 (10.3–12.0)	20.9 (19.9–22.0)
Rural	41.3 (39.3–43.4)	18.8 (17.2–20.5)	5.5 (4.6–6.6)	8.3 (7.2–9.5)	3.1 (2.4–3.9)	34.2 (32.2–36.2)	40.9 (38.8–43.0)	39.7 (37.6–41.8)	10.8 (9.6–12.2)	24.6 (22.8–26.5)
<i>p-value</i>	0.04	0.34	0.33	0.27	0.77	0.50	0.22	0.29	0.73	<0.001
Education										
Mandatory	42.2 (39.1–45.3)	10.6 (8.8–12.7)	5.8 (4.4–7.4)	6.8 (5.3–8.5)	3.0 (2.0–4.2)	26.7 (24.0–29.5)	23.8 (21.2–26.5)	51.8 (48.7–54.9)	9.1 (7.4–11.1)	17.3 (15.0–19.8)
Secondary	43.5 (42.1–44.9)	18.8 (17.7–19.9)	5.5 (4.9–6.2)	8.0 (7.3–8.8)	3.0 (2.5–3.5)	33.7 (32.4–35.1)	38.7 (37.3–40.1)	39.8 (38.4–41.2)	10.9 (10.0–11.8)	22.5 (21.3–23.7)
Tertiary	43.1 (40.8–45.3)	26.1 (24.2–28.2)	7.1 (6.0–8.4)	7.6 (6.4–8.9)	3.2 (2.4–4.0)	41.9 (39.6–44.1)	51.1 (48.9–53.4)	29.2 (27.2–31.3)	12.5 (11.0–14.1)	23.2 (21.3–25.2)
<i>p-value</i>	0.74	<0.001	0.04	0.38	0.91	<0.001	<0.001	<0.001	0.02	<0.001
Income (quartiles)										
1st (<2857 CHF)	47.6 (45.2–49.9)	13.1 (11.6–14.7)	6.5 (5.4–7.8)	7.9 (6.7–9.3)	3.2 (2.5–4.2)	30.6 (28.5–32.8)	31.4 (29.2–33.5)	43.4 (41.1–45.8)	9.7 (8.4–11.2)	19.0 (17.3–20.9)
2nd (2857–3999 CHF)	45.4 (43.1–47.6)	17.7 (16.0–19.4)	5.8 (4.8–6.9)	7.6 (6.5–8.9)	2.9 (2.2–3.8)	33.0 (30.9–35.2)	38.5 (36.3–40.7)	40.3 (38.1–42.5)	10.9 (9.6–12.4)	22.5 (20.7–24.5)
3rd (4000–5332 CHF)	42.9 (40.7–45.0)	21.7 (20.0–23.6)	5.8 (4.8–6.9)	7.6 (6.5–8.9)	3.2 (2.4–4.0)	36.9 (34.8–39.0)	41.6 (39.5–43.8)	37.4 (35.3–39.5)	11.1 (9.8–12.5)	22.8 (21.0–24.7)
4th (≥5333 CHF)	37.5 (35.3–39.7)	24.9 (23.0–26.9)	5.7 (4.7–6.8)	7.9 (6.7–9.2)	2.7 (2–3.5)	38.2 (36.0–40.3)	46.8 (44.6–49.0)	34.4 (32.3–36.6)	12.3 (10.9–13.8)	23.3 (21.4–25.2)
<i>p-value</i>	<0.001	<0.001	0.67	0.98	0.78	<0.001	<0.001	<0.001	0.10	<0.01

Results are expressed as unweighted percentage (95% confidence interval). Bivariable statistical analyses performed using chi-square. Significant ($p < 0.001$) findings are indicated in bold.

Table 3

Prevalence and socio-demographic determinants of barriers to healthy eating among men, Swiss Health survey 2012, unweighted data.

	Access			Social		External		Individual		
	Price	Limited options in restaurants	Limited options at market	No social support	Social group opposition	Time constraint	Daily habits, constraints	Fondness of good food	Fondness of abundant food	Lack of willpower
Overall	35.8 (34.7–36.9)	17.1 (16.2–18.0)	6.1 (5.6–6.7)	6.1 (5.5–6.6)	1.8 (1.5–2.2)	29.0 (27.9–30.1)	37.5 (36.4–38.6)	51.0 (49.8–52.2)	16.4 (15.5–17.3)	21.2 (20.2–22.1)
Age groups										
18–35	37.6 (35.3–39.9)	16.1 (14.4–18.0)	6.9 (5.7–8.2)	7.5 (6.3–8.9)	2.9 (2.2–3.8)	38.5 (36.2–40.9)	44.1 (41.7–46.4)	45.0 (42.7–47.4)	24.2 (22.2–26.3)	26.3 (24.3–28.4)
36–50	36.8 (34.8–38.9)	20.8 (19.1–22.5)	7.4 (6.3–8.6)	6.4 (5.4–7.5)	1.8 (1.3–2.5)	29.7 (27.8–31.6)	46.5 (44.4–48.6)	44.8 (42.7–46.9)	16.8 (15.3–18.5)	21.1 (19.4–22.9)
51–65	33.7 (31.5–35.9)	17.2 (15.5–19.1)	5.4 (4.4–6.6)	5.9 (4.9–7.1)	1.2 (0.8–1.8)	23.9 (22.0–26.0)	34.1 (31.9–36.3)	54.0 (51.7–56.3)	13.0 (11.5–14.6)	20.9 (19.1–22.9)
Above 65	34.8 (32.2–37.4)	12.3 (10.6–14.2)	4.0 (3.0–5.2)	3.8 (2.8–4.9)	1.3 (0.8–2.1)	22.4 (20.2–24.7)	19.2 (17.1–21.4)	64.5 (61.9–67.0)	10.2 (8.6–11.9)	15.0 (13.1–17)
<i>p</i> -value	0.06	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
BMI category										
Under/normal weight	37.3 (35.7–39.0)	18.1 (16.7–19.4)	6.8 (5.9–7.7)	6.3 (5.5–7.2)	1.9 (1.4–2.4)	31.2 (29.6–32.8)	40.2 (38.5–41.9)	43.6 (41.9–45.3)	15.7 (14.5–17.0)	22.2 (20.8–23.7)
Overweight	33.8 (32.1–35.6)	16.4 (15.1–17.8)	5.5 (4.7–6.3)	5.5 (4.7–6.4)	1.9 (1.4–2.4)	27.7 (26.1–29.4)	35.2 (33.5–36.9)	55.8 (54.0–57.6)	16.6 (15.2–17.9)	20.0 (18.6–21.5)
Obese	36.8 (33.5–40.2)	16.0 (13.6–18.7)	5.9 (4.4–7.7)	7.1 (5.4–9.1)	1.7 (0.9–2.8)	24.9 (22.0–28.0)	35.0 (31.8–38.4)	62.9 (59.6–66.2)	18.4 (15.8–21.2)	20.9 (18.2–23.9)
<i>p</i> -value	<0.02	0.15	0.16	0.09	0.94	<0.001	<0.001	<0.001	0.16	0.10
Smoking										
Never smoked	36.2 (34.5–38.0)	18.1 (16.7–19.5)	6.5 (5.7–7.5)	7.0 (6.1–7.9)	2.0 (1.5–2.6)	32.1 (30.4–33.8)	39.6 (37.9–41.4)	48.4 (46.6–50.2)	18.0 (16.6–19.4)	22.5 (21.0–24.1)
Ex-smoker	35.0 (32.9–37.2)	16.7 (15.1–18.5)	5.8 (4.8–7.0)	5.2 (4.3–6.3)	1.8 (1.2–2.4)	24.9 (23.0–26.9)	33.4 (31.3–35.6)	55.0 (52.7–57.2)	12.4 (11.0–14.0)	19.1 (17.3–20.9)
Current smoker	35.9 (33.9–38.0)	16.1 (14.5–17.7)	5.8 (4.8–6.9)	5.6 (4.6–6.6)	1.7 (1.2–2.3)	28.3 (26.4–30.2)	38.2 (36.1–40.3)	51.1 (48.9–53.2)	17.7 (16.1–19.4)	21.2 (19.4–22.9)
<i>p</i> -value	0.69	0.14	0.02	0.47	0.68	<0.001	<0.001	<0.001	<0.001	0.02
Living situation										
Alone	34.1 (31.5–36.8)	18.6 (16.5–20.8)	6.5 (5.2–8.0)	6.4 (5.1–7.8)	1.8 (1.1–2.7)	28.1 (30.5–35.7)	39.1 (36.4–41.8)	48.5 (45.8–51.3)	16.1 (14.1–18.2)	21.6 (19.4–24.0)
In couple	36.2 (34.9–37.4)	16.8 (15.8–17.8)	6.0 (5.4–6.7)	6.0 (5.4–6.6)	1.9 (1.5–2.2)	33.0 (26.9–29.3)	37.2 (35.9–38.4)	51.5 (50.2–52.8)	16.5 (15.5–17.4)	21.1 (20.0–22.1)
<i>p</i> -value	0.16	0.12	0.62	0.51	0.88	<0.001	0.20	0.05	0.72	0.65
Nationality										
Swiss	35.2 (33.9–36.4)	17.2 (16.2–18.2)	5.8 (5.2–6.4)	6.0 (5.4–6.7)	1.7 (1.4–2.1)	29.1 (27.9–30.3)	37.7 (36.4–38.9)	51.7 (50.5–53.0)	16.8 (15.9–17.8)	22.1 (21.0–23.1)
Non-Swiss	38.9 (36.1–41.7)	16.8 (14.8–19.1)	7.6 (6.1–9.2)	6.2 (4.9–7.7)	2.5 (1.7–3.5)	28.5 (26.0–31.1)	37.0 (34.3–39.8)	47.3 (44.4–50.1)	14.2 (12.2–16.3)	16.8 (14.8–19.1)
<i>p</i> -value	<0.02	0.78	0.86	0.02	0.06	0.39	0.70	<0.01	0.02	<0.001
Area										
Urban	37.0 (35.7–38.4)	18.5 (17.4–19.6)	6.6 (5.9–7.3)	6.3 (5.7–7.0)	1.9 (1.6–2.4)	29.3 (28.0–30.6)	37.7 (36.3–39)	50.4 (49.0–51.8)	16.2 (15.2–17.3)	20.5 (19.4–21.6)
Rural	32.8 (30.7–34.8)	13.8 (12.3–15.4)	4.9 (4.0–6.0)	5.4 (4.5–6.5)	1.6 (1.1–2.2)	28.2 (26.3–30.2)	37.1 (35–39.2)	52.4 (50.2–54.6)	16.8 (15.2–18.5)	22.8 (21.0–24.7)
<i>p</i> -value	<0.001	<0.001	0.16	<0.01	0.28	0.38	0.66	0.14	0.55	0.03
Education										
Mandatory	36.3 (32.8–39.9)	8.7 (6.7–11.0)	5.1 (3.6–6.9)	6.2 (4.6–8.2)	2.1 (1.2–3.4)	24.5 (21.4–27.8)	23.9 (20.9–27.2)	56.0 (52.3–59.6)	16.6 (14.0–19.6)	16.6 (14.0–19.6)
Secondary	36.9 (35.3–38.5)	15.2 (14.0–16.4)	5.7 (4.9–6.5)	6.1 (5.3–6.9)	1.7 (1.3–2.1)	29.1 (27.6–30.6)	32.6 (31.0–34.1)	53.4 (51.8–55.1)	15.5 (14.4–16.7)	20.5 (19.2–21.9)
Tertiary	34.3 (32.5–36.1)	21.9 (20.3–23.4)	7.0 (6.0–8.0)	6.0 (5.1–6.9)	2.0 (1.5–2.6)	30.1 (28.3–31.8)	47.5 (45.6–49.4)	46.5 (44.6–48.3)	17.4 (16.0–18.9)	23.2 (21.6–24.8)
<i>p</i> -value	0.09	<0.001	0.96	<0.05	0.56	0.01	<0.001	<0.001	0.13	<0.001
Income (quartiles)										
1st (<2857 CHF)	39.9 (37.3–42.6)	12.2 (10.5–14.1)	5.7 (4.6–7.1)	6.8 (5.5–8.3)	2.2 (1.5–3.1)	27.4 (25.0–29.8)	29.3 (26.9–31.8)	52.2 (49.5–54.9)	17.0 (15–19.1)	20.0 (17.9–22.2)
2nd (2857–3999 CHF)	37.6 (35.2–40.1)	14.2 (12.5–16.0)	5.3 (4.3–6.6)	5.8 (4.7–7.1)	1.6 (1.0–2.3)	27.0 (24.8–29.3)	34.7 (32.3–37.1)	50.8 (48.2–53.3)	15.1 (13.3–17)	20.0 (18.0–22.0)
3rd (4000–5332 CHF)	36.3 (34.1–38.5)	16.9 (15.2–18.7)	6.6 (5.5–7.8)	6.0 (5.0–7.2)	1.8 (1.2–2.5)	29.2 (27.1–31.3)	38.0 (35.8–40.3)	51.1 (48.8–53.4)	16.2 (14.5–17.9)	21.2 (19.3–23.1)
4th (≥5333 CHF)	31.9 (30.0–33.8)	22.0 (20.3–23.7)	6.5 (5.5–7.5)	5.9 (4.9–6.9)	1.9 (1.4–2.5)	31.1 (29.2–33.0)	43.7 (41.6–45.7)	50.3 (48.3–52.4)	17.0 (15.5–18.6)	22.6 (21.0–24.4)
<i>p</i> -value	<0.001	<0.001	0.65	0.36	0.68	0.02	<0.001	0.74	0.38	0.14

Results are expressed as unweighted percentage (95% confidence interval). Bivariable statistical analyses performed using chi-square. Significant ($p < 0.001$) findings are indicated in bold.

Table 4

Multivariable analysis of the associations between socio-demographic factors and barriers to healthy eating in women, Swiss Health survey 2012, unweighted data.

	Access			Social		External		Individual		
	Price	Limited options in restaurants	Limited options at markets	No social support	Social group opposition	Time constraint	Daily habits, constraints	Fondness of good food	Fondness of abundant food	Lack of willpower
BMI category										
Under/normal weight	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Overweight	0.98 (0.88–1.10)	0.79 (0.61–1.02)	0.93 (0.80–1.07)	1.17 (0.95–1.45)	0.99 (0.71–1.39)	1.01 (0.90–1.13)	1.13 (0.98–1.30)	1.46 (1.30–1.64)	1.27 (1.06–1.53)	1.15 (1.02–1.30)
Obese	0.91 (0.77–1.06)	1.12 (0.81–1.55)	0.92 (0.74–1.14)	1.62 (1.24–2.13)	1.13 (0.71–1.79)	0.92 (0.78–1.09)	1.78 (1.48–2.13)	1.63 (1.38–1.91)	1.86 (1.47–2.36)	1.25 (1.05–1.48)
<i>p</i> -value for trend	0.23	0.49	0.43	<0.001	0.62	0.35	<0.001	<0.001	<0.001	0.01
Living situation										
In couple	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Alone	1.15 (1.03–1.28)	1.07 (0.86–1.34)	1.2 (1.05–1.37)	0.68 (0.55–0.85)	1.03 (0.75–1.42)	1.05 (0.94–1.17)	0.88 (0.77–1.01)	0.87 (0.78–0.97)	1.02 (0.85–1.22)	1.01 (0.90–1.13)
Nationality										
Swiss	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Non-Swiss	0.96 (0.84–1.11)	1.67 (1.31–2.13)	0.97 (0.81–1.15)	0.91 (0.70–1.17)	0.71 (0.47–1.09)	0.78 (0.67–0.90)	0.75 (0.63–0.89)	1.03 (0.90–1.19)	0.76 (0.61–0.95)	0.87 (0.75–1.00)
Area										
Urban	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Rural	0.87 (0.79–0.96)	0.95 (0.76–1.18)	1.01 (0.88–1.15)	1.03 (0.85–1.24)	0.97 (0.72–1.30)	0.98 (0.88–1.10)	1.16 (1.03–1.31)	1.03 (0.92–1.14)	0.93 (0.79–1.09)	1.06 (0.95–1.18)
Education										
Tertiary	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Secondary	0.94 (0.84–1.05)	0.80 (0.63–1.00)	0.77 (0.68–0.88)	1.08 (0.87–1.33)	0.96 (0.69–1.33)	0.75 (0.67–0.84)	1.02 (0.89–1.17)	1.37 (1.22–1.55)	0.93 (0.78–1.11)	0.72 (0.64–0.81)
Mandatory	0.83 (0.70–0.98)	0.77 (0.54–1.09)	0.49 (0.39–0.62)	0.96 (0.69–1.33)	1.06 (0.65–1.73)	0.61 (0.51–0.73)	0.88 (0.71–1.09)	1.93 (1.62–2.29)	0.91 (0.69–1.20)	0.45 (0.38–0.55)
<i>p</i> -value for trend	0.03	0.14	<0.001	0.79	0.81	<0.001	0.24	<0.001	0.51	<0.001
Income (CHF)										
Highest	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
3rd quartile	1.29 (1.13–1.46)	1.09 (0.83–1.44)	0.93 (0.80–1.08)	0.99 (0.78–1.25)	1.22 (0.84–1.77)	1.02 (0.90–1.16)	0.99 (0.85–1.15)	0.99 (0.87–1.14)	0.92 (0.76–1.12)	0.92 (0.80–1.05)
2nd quartile	1.47 (1.29–1.68)	1.12 (0.84–1.48)	0.76 (0.65–0.90)	0.96 (0.75–1.22)	1.13 (0.76–1.69)	0.89 (0.78–1.03)	0.95 (0.81–1.11)	1.05 (0.91–1.21)	0.90 (0.73–1.11)	0.83 (0.72–0.95)
Lowest quartile	1.65 (1.43–1.90)	1.30 (0.97–1.75)	0.60 (0.50–0.72)	1.07 (0.82–1.38)	1.33 (0.88–2.00)	0.86 (0.74–1.00)	0.82 (0.69–0.98)	1.04 (0.90–1.20)	0.84 (0.67–1.06)	0.71 (0.61–0.82)
<i>p</i> -value for trend	<0.001	0.09	<0.001	0.69	0.24	0.16	0.02	0.47	0.15	<0.001

BMI, body mass index; CHF, Swiss Franc. Statistical analysis by logistic regression adjusting for all variables in the table, plus age. Results are expressed as odds ratio and (95% confidence interval). Significant ($p < 0.001$) findings are indicated in bold.

conducted in Switzerland. Our results show that the most frequent barriers, regardless of gender, relate to access (“price”), external factors (“time constraint” and “daily habits, constraints”) and the individual (“fondness of good food” and “lack of willpower”).

4.1. Prevalence of barriers to healthy eating

The most frequently reported barriers differed slightly by gender. While 51% of men reported “fondness of good food,” only 39% of women did so; and while 43% of women reported “price,” only 36% of men did so. The pan-EU study yielded similar findings [8]. This difference is possibly due to women's higher likelihood to take charge of food shopping [20], rendering them more aware of price differences between healthy and unhealthy foods. Interestingly, the prevalence of “price” as a barrier irrespective of gender was considerably higher in Switzerland than in France (19%), Austria (19%), Germany (9%) and Italy (7%) [8], although the Swiss actually dedicate a similar portion of their budget (9%) to foods compared to Austrians (10%) and Germans (11%), and less than the French and Italians (14%) [21]. People in Switzerland may identify healthy eating differently than their European counterparts, namely regarding the consumption of organic products; Switzerland has the world's highest per capita organic products consumption, well above its neighboring countries [22]. The much

higher costs of organic products may account for this higher perception of “price” as a barrier to healthy eating.

Additionally, women seemed to be more affected by “time constraint” than men (35% vs 29%), probably due to difficulties in balancing household duties with professional life, as previously reported [13]. Conversely, both genders reported similar prevalence for “daily habits, constraints” and “lack of willpower,” the latter being similar to the prevalence reported in Austria (24%) and France (21%), but higher than in Germany and Italy (10%) [8].

4.2. Demographic and socioeconomic determinants of barriers to healthy eating

In both genders, the prevalence of most barriers followed an age gradient; “price,” however, remained a constant access barrier in all age groups. As an individual barrier, “fondness of good food” solely increased with age, as previously reported [23,24]. The decreasing prevalence of external barriers may be due to seniority or better life and work time management as one ages, and to more available time in retirement. It could also indicate a cohort effect: older people may belong to a generation more used to preparing their own meals and less reliant on ready-to-eat foods. Future studies should explore whether these barriers are age- or cohort-dependant. Obese women were more likely to report “daily

Table 5

Multivariable analysis of the associations between socio-demographic factors and barriers to healthy eating in men, Swiss Health survey 2012, unweighted data.

	Access			Social		External		Individual		
	Price	Limited options in restaurants	Limited options at markets	No social support	Social group opposition	Time constraint	Daily habits, constraints	Fondness of good food	Fondness of abundant food	Lack of willpower
BMI category										
Under/normal weight	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Overweight	0.87 (0.79–0.97)	0.85 (0.68–1.05)	0.92 (0.80–1.05)	0.95 (0.76–1.18)	1.21 (0.83–1.78)	0.98 (0.88–1.10)	0.96 (0.85–1.09)	1.55 (1.40–1.72)	1.31 (1.14–1.51)	0.91 (0.81–1.01)
Obese	1.00 (0.85–1.17)	0.95 (0.69–1.32)	0.94 (0.76–1.17)	1.29 (0.94–1.75)	1.17 (0.64–2.13)	0.90 (0.75–1.08)	1.06 (0.88–1.29)	2.02 (1.72–2.38)	1.64 (1.33–2.02)	1.00 (0.84–1.18)
<i>p</i> -value for trend	0.95	0.77	0.59	0.11	0.62	0.27	0.52	<0.001	<0.001	0.97
Living situation										
In couple	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Alone	0.90 (0.79–1.02)	1.05 (0.82–1.35)	1.12 (0.96–1.32)	1.04 (0.81–1.34)	0.92 (0.58–1.46)	1.23 (1.08–1.40)	1.04 (0.89–1.21)	0.89 (0.78–1.00)	0.95 (0.80–1.12)	1.11 (0.97–1.26)
Nationality										
Swiss	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Non-Swiss	1.12 (0.98–1.28)	1.24 (0.97–1.59)	0.99 (0.83–1.18)	0.94 (0.72–1.22)	1.32 (0.86–2.03)	0.94 (0.82–1.09)	0.71 (0.60–0.84)	0.88 (0.77–1.00)	0.73 (0.60–0.87)	0.93 (0.81–1.07)
Area										
Urban	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Rural	0.80 (0.72–0.89)	0.76 (0.60–0.96)	0.75 (0.65–0.87)	0.81 (0.65–1.02)	0.81 (0.54–1.22)	0.96 (0.85–1.08)	1.12 (0.99–1.27)	1.05 (0.95–1.17)	0.99 (0.86–1.14)	1.02 (0.91–1.14)
Education										
Tertiary	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Secondary	1.07 (0.95–1.19)	0.85 (0.69–1.06)	0.75 (0.65–0.86)	1.03 (0.83–1.29)	0.82 (0.55–1.21)	0.98 (0.87–1.10)	0.84 (0.74–0.96)	1.29 (1.16–1.44)	0.84 (0.73–0.97)	0.57 (0.51–0.64)
Mandatory	0.93 (0.77–1.12)	0.73 (0.49–1.08)	0.44 (0.33–0.59)	1.00 (0.69–1.45)	0.87 (0.46–1.63)	0.78 (0.63–0.96)	0.69 (0.55–0.87)	1.51 (1.26–1.81)	0.94 (0.74–1.19)	0.40 (0.33–0.49)
<i>p</i> -value for trend	0.46	0.11	<0.001	0.99	0.65	0.02	<0.01	<0.001	0.60	<0.001
Income (CHF)										
Highest	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
3rd quartile	1.24 (1.08–1.41)	1.14 (0.88–1.46)	0.83 (0.71–0.98)	1.07 (0.82–1.40)	1.01 (0.63–1.61)	0.95 (0.83–1.09)	0.98 (0.84–1.14)	0.90 (0.79–1.02)	0.99 (0.83–1.17)	0.97 (0.85–1.11)
2nd quartile	1.30 (1.13–1.50)	0.91 (0.68–1.22)	0.71 (0.59–0.85)	1.03 (0.77–1.37)	0.87 (0.51–1.46)	0.87 (0.75–1.01)	0.93 (0.79–1.10)	0.86 (0.75–0.99)	0.89 (0.74–1.07)	0.86 (0.74–0.99)
Lowest quartile	1.47 (1.26–1.71)	1.07 (0.79–1.46)	0.68 (0.56–0.84)	1.31 (0.97–1.76)	1.28 (0.76–2.16)	0.94 (0.80–1.11)	1.04 (0.87–1.24)	0.82 (0.71–0.96)	1.14 (0.94–1.39)	0.82 (0.70–0.96)
<i>p</i> -value for trend	<0.001	0.99	<0.001	0.11	0.48	0.31	0.85	<0.01	0.37	<0.01

BMI, body mass index; CHF, Swiss Franc. Statistical analysis by logistic regression adjusting for all variables in the table, plus age. Results are expressed as odds ratio and (95% confidence interval). Significant ($p < 0.001$) findings are indicated in bold.

habits, constraints” and “no social support” than normal weight women, indicating that obese women may not find the stimulating and supportive environment needed to improve their diet, as suggested before [14].

Income was associated with access, external and individual barriers: “price” and “fondness of good food” decreased with higher income, while “daily habits, constraints,” “limited options in restaurants” and “lack of willpower” increased. These findings reflect those in several countries [9,10,25], which found that access barriers were more prevalent in lower income groups. For “fondness of good food,” however, the literature remains inconclusive [12,24]. The higher prevalence of external barriers among people with higher income may due to busy work schedules—future studies should explore this hypothesis.

Education was associated with mostly external and individual barriers. For instance, the prevalence of “fondness of good food” decreased with increasing education, possibly due to incorrect beliefs among people with lower education that healthy foods taste poorly [25]. Conversely, the prevalence of “time constraint,” “daily habits, constraints” and “lack of willpower” increased with increasing education. People with higher education may experience these external barriers more often because of busy work schedules and high work stress. The higher prevalence of “lack of

willpower,” however, may be due to greater nutrition knowledge and more stringent self-imposed healthy eating standards among highly educated people, particularly women—future studies should explore this link.

4.3. Implications of findings

The high prevalence of barriers to healthy eating in the population represents a major challenge both in public health and clinical nutrition. In the general population, these barriers hinder the adherence to existing dietary guidelines for chronic disease prevention [2,26]; among people diagnosed with chronic diseases and undergoing treatment, critically, these barriers can adversely affect health outcomes. For instance, adherence to a low-protein diet is critical among people with chronic kidney disease to reduce renal death risk [27]; among overweight and obese people with high blood pressure, adherence to the DASH diet results in significant improvements in cardiometabolic markers [28]. Multifaceted interventions at the population and clinical levels are needed to tackle several barriers simultaneously; Table 6 proposes measures to tackle the most prevalent barriers. At the population level, interventions must challenge beliefs that healthy foods taste poorly, as appears to be common among people with lower

Table 6

Proposed measures to eliminate barriers to healthy eating in the population.

Barrier to healthy eating	Proposed intervention	Stakeholders	Ways to intervene
Price	1) Increase subsidies on healthy foods, and reduce or eliminate subsidies on unhealthy foods, promoting shift from meat and dairy production to fruit and vegetable production [30]; 2) Introduce or increase taxes on unhealthy foods (e.g., on sugary, salty, and fat rich products); 3) Introduce health insurance coverage of nutrition therapy to treat chronic diseases.	Government Food industry Farmers Health professionals (dietitians, nutritionists, doctors, social workers etc.) Health insurance providers	Reform price and tax legislation/subsidies; Diversify agricultural production; Provide healthier products and cheaper alternatives with similar nutritional value; Cover medical nutrition therapy as part of treatment and prevention.
Daily habits, constraints/Time constraints	1) Favor and promote flexible work schedules, and part-time work; 2) Teach how to quickly and efficiently prepare healthy foods in school curricula and elsewhere; 3) Promote and increase availability of ready-to-eat healthy meals; 4) Promote time spent preparing healthy meals as important component of healthy lifestyle.	Government Employers Food industry Health professionals	Reform work policies to introduce part-time, flexible timetables; Introduce nutrition education in school curricula; Provide healthy ready-to-eat meals; Promote time spent preparing meals; Create time slots for cooking and eating, especially for patients.
Fondness of good food	1) Promote and advertise healthy food as tasty food; 2) Ban advertisement of unhealthy foods; 3) Promote diversification of healthy food products	Restaurants, food carts, cafeterias Health promotion agencies Media Health professionals	Increase number of healthy and tasty meal options; Promote healthy foods as tasty foods; Promote cooking methods to improve taste.
Lack of willpower	1) Promote environments conducive to healthy eating in schools, at work, public spaces, and at home 2) Promote healthy eating as part of healthy and enjoyable lifestyle; 3) Challenge views of stringent diets as only way to healthy eating; 4) Promote healthy eating as easily attainable with many different foods, recipes, and flavors, and adaptable to personal preferences 5) With patients, establish collaboration between medical, nutrition, and social workers to design best course of action towards healthy eating	Government Food industry Media Health professionals	Provide counsel and advice on methods of behavior change at schools, work, and healthcare facilities; Advertise and promote different options of healthy foods and ways to eat them; Promote behavior change as part of healthier, more enjoyable lifestyle; Work closely with patients to increase self-confidence and empower them to eat healthier foods

education; simultaneously, they must challenge ideas that healthy eating is only attainable under stringent conditions, as appears to be more common among people with higher education and income. At the clinical level, given the demographic and socioeconomic patterned presence of barriers to healthy eating, multidisciplinary teams of medical, nutrition and social workers must collaborate closely to enable patients to achieve and maintain healthy eating habits.

4.4. Strengths and limitations

This study benefits from a large population-based representative sample and extends the findings from the pan-EU study conducted almost 20 years ago [8]. The questionnaire applied covers a wide range of barriers and could easily be applied in other countries for comparison, and to assess the effectiveness of healthy eating promotion campaigns. We also conducted our analysis separately for men and women, and used a p-value of <0.001 for statistical significance to reduce the likelihood of type I error due to multiple testing. However, our results are limited by the use of cross-sectional data, and the self-reported nature of all the information obtained, susceptible to recall and social desirability bias. The way participants understood the concept of healthy eating was not assessed. However, a previous study in a Swiss city found that participants had a high general level of nutrition and health

knowledge [29]. The questions assessing barriers were set by a multidisciplinary group of experts before the first Swiss Health Survey took place in 1992, and no reference to any previously validated instrument could be found. However, the barriers assessed are similar to those in the pan-European survey and previous research that investigated barriers to healthy eating [8,10–12,19]. Hence, in the absence of a standard, validated instrument, the current questionnaire is the best and only option for the Swiss population. The dichotomous nature of the answers prevented us from assessing how variations in the degree of each barrier may affect people in general and according to socioeconomic and demographic indicators. Many participants were excluded from the main analysis, and they differed significantly for those excluded in some demographic factors. This exclusion was necessary, however, as these participants had no information on barriers to healthy eating. Finally, no option was given to identify other barriers besides the ten already provided in the question; it is possible that other barriers may also affect healthy eating and be associated with socioeconomic and demographic determinants.

5. Conclusion

In Switzerland, several barriers to healthy eating have high prevalence in the population, relate to access (“price”), external (“time constraint” and “daily habits, constraints”), and individual

factors (“fondness of good food” and “lack of willpower”), and are associated with age, obesity, income and education; this requires multifaceted interventions to tackle several barriers simultaneously.

Authors' contributions

CdM and PMV conceived the paper; CdM analyzed data and wrote paper. PMV supervised the analysis, and had primary responsibility for final content. PMV and SS reviewed the manuscript and provided critical recommendations. All authors approved the final manuscript.

Conflict of interest

None.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.clnu.2016.04.004>.

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