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Perceived barriers to healthy eating and adherence to dietary guidelines: nationwide study

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1 **Abstract**

2 **Background:** People report many barriers that prevent them from achieving a healthy diet.

3 Whether perceived barriers are associated with dietary behavior remains unclear.

4 **Objective:** To assess the association between barriers to healthy eating and adherence to the

5 Swiss dietary guidelines.

6 **Methods:** Cross-sectional data from the Swiss Health Survey 2012 (N=15,450; 53% women).

7 Barriers included price, daily habits, taste, gluttony, lack of time, lack of willpower, limited

8 options in restaurants, in supermarkets, no social support, and social opposition. The

9 associations between barriers and adherence to Swiss dietary guidelines were assessed using

10 multivariable logistic regression.

11 **Results:** Daily habits (odds ratio; 95% confidence interval: 0.91; 0.85-0.98) and taste (0.85;

12 0.79-0.91) were associated with lower adherence to the guidelines for fruits, while price

13 (1.13; 1.06-1.21) and limited options in restaurants (1.33; 1.23-1.45) and in supermarkets

14 (1.18; 1.03-1.35) were associated with higher adherence. Taste was associated with lower

15 adherence to the guidelines for vegetables (0.72; 0.66-0.78), while price (1.20; 1.11-1.30),

16 gluttony (1.17; 1.04-1.31), social group opposition (1.48; 1.18-1.85) and limited options in

17 restaurants (1.56; 1.42-1.72) and in supermarkets (1.25; 1.07-1.47) were associated with

18 higher adherence. Daily habits (0.82; 0.75-0.90), time (0.86; 0.78-0.94), lack of willpower

19 (0.78; 0.70-0.87), and gluttony (0.86; 0.76-0.98) were associated with lower adherence to the

20 guidelines for fish, whereas price (1.09; 1.01-1.19), and limited options in restaurants (1.26;

21 1.14-1.39) and supermarkets (1.40; 1.20-1.63) were associated with higher adherence. Daily

22 habits (0.89; 0.82-0.97), taste (0.66; 0.61-0.72), lack of willpower (0.84; 0.76-0.92) and

23 gluttony (0.66; 0.58-0.75) were associated with lower adherence to the guidelines for meat.

24 Time (0.88; 0.78-0.99) was associated with lower adherence to the guidelines for dairy, while
25 gluttony (1.26; 1.09-1.46) was associated with higher adherence. Daily habits was associated
26 with lower adherence (0.91; 0.85-0.97) to the guidelines for liquids, while limited options in
27 restaurants was associated with higher adherence (1.12; 1.03-1.22).

28 **Conclusion:** In the Swiss adult population, several self-reported barriers to healthy eating
29 appear to hinder adherence to the dietary guidelines, while other commonly reported barriers
30 are linked to higher adherence.

31 **Keywords:** barriers to healthy eating; dietary guidelines; national health survey; epidemiology;
32 nutrition

33 **Introduction**

34 Healthy eating is a powerful tool to prevent the development of chronic diseases such
35 as obesity, diabetes, hypertension, cardiovascular disease, and cancer (1, 2). Extensive evidence
36 indicates that healthy eating can be defined as any diet characterized by high intakes of
37 vegetables, fruits, whole grains, legumes, nuts and seeds, and by low or no intakes of foods
38 with added sugar, processed meats, and sugar-sweetened beverages (1-3). However, healthy
39 eating is hard to achieve for the majority of the population; consistent evidence indicates that
40 only a small proportion of the population adhere to the recommended dietary guidelines (4-6).

41 This low adherence represents a critical challenge as the burden of chronic diseases in
42 the population continues to increase (7-11). Structural, environmental, social, and individual
43 factors interact to influence an individual's dietary behavior (12, 13). Despite the existence of
44 an abundant and diverse food supply and widespread general knowledge on healthy eating,
45 individuals report several barriers that prevent them from achieving and maintaining a healthy
46 diet (13, 14). For instance, individuals consistently report time constraints, taste preferences,
47 high cost of foods, and low availability of healthy foods as important barriers to healthy eating
48 (14). We previously reported that between 20% and 50% of the Swiss adult population
49 perceived time constraints, taste preference, high cost of healthy foods and daily habits as the
50 main barriers to healthy eating over a 15-year period (15), and that reporting of these barriers
51 was demographically and socioeconomically patterned (16). However, only few reports have
52 explored whether perceived barriers to healthy eating are in fact associated with an unhealthy
53 dietary behavior (17, 18), and findings have been inconsistent. In the largest study to date (N =
54 8319), McMorro et al. found that among 13 perceived barriers to healthy eating, only a few
55 were associated with lower consumption of fruits and vegetables among adults in Scotland (17).
56 In another study (N = 5900), Pinho et al. found that reporting any barrier to healthy eating was

57 associated with unfavorable dietary intake among adults living in five European urban areas
58 (18).

59 Therefore, we aimed to assess the association between perceived barriers to healthy
60 eating and adherence to the Swiss dietary guidelines in a representative sample of the Swiss
61 adult population. We hypothesized that perceived barriers to healthy eating would preclude
62 participants from adhering to the dietary recommendations.

63 **Methods**

64 We used data from the Swiss Health Survey (SHS) from 2012, which sampled 21,597
65 participants aged 16 years and older. The SHS is a cross-sectional, nationwide, population-
66 based study with a sample considered representative of the Swiss adult population. Details of
67 the SHS methodology have been described elsewhere (16).

68 *Exposures*

69 In a written questionnaire, participants answered the question “Please identify which of
70 the following obstacles prevent you from having a healthy diet” by selecting from a list of ten
71 predetermined barriers: time constraint, limited options in restaurants, limited options in food
72 markets, price, lack of social support, social opposition, taste, gluttony, daily habits, and
73 willpower. A multidisciplinary team of experts set the different items, which reflected those
74 listed in a Pan-European survey (19) and other similar research (14). **Supplementary table 1**
75 lists the barriers as presented in the questionnaire.

76 *Outcomes*

77 We focused on six Swiss dietary guidelines for which adherence data were available in
78 the SHS. The frequency of consumption of each food group was reported by participants in the

79 questionnaire, which were dichotomized to reflect adherence to the Swiss dietary guidelines as
80 follows: fruits (≥ 2 servings/day), vegetables (≥ 3 servings/day), dairy foods (≥ 3 servings/day),
81 fish (≥ 2 servings/week), meat (≤ 2 servings/week), and non-alcoholic, non-sweetened beverages
82 (≥ 2 liters/day; therein referred to as liquids).

83 *Covariates*

84 We included the following covariates in our analysis: sex, age (categorized into 18-35,
85 36-50, 51-65, and >65 age groups), body mass index (BMI, kg/m^2) (categorized into three
86 groups: $18.5 \leq \text{BMI} < 25$; $25 \leq \text{BMI} < 30$ and $\text{BMI} \geq 30$), education (categorized as mandatory/lower
87 secondary school, secondary, and tertiary), household composition was defined as the number
88 of people living with the participant (categorized as 1, 2, 3, or ≥ 4), smoking status
89 (dichotomized as current smoker or not), and language (categorized according to the three major
90 official language regions of Switzerland: German, French, and Italian).

91 *Eligibility and exclusion criteria*

92 Eligible participants included those with information on barriers to healthy eating and
93 food intake. From these, we excluded participants who lacked data on sex, age (and those
94 younger than 18 y), smoking, BMI (and participants with $\text{BMI} < 18.5$), education, household
95 composition, and smoking status.

96 *Statistical analysis*

97 We present descriptive results as average \pm standard deviation (SD) for continuous data
98 and as number of participants (percentage) for categorical data. We used chi-square test to test
99 for difference between categorical variables, and student t-test for continuous variables. To test
100 for the association between perceived barriers to healthy eating and adherence to the dietary

101 guidelines, we used logistic regression models to generate odds ratios (OR) and 95% confidence
102 intervals, first adjusted for age and sex only, and then additionally adjusted for BMI, smoking,
103 education, household composition, and language. We also tested for interaction between the
104 different covariates and each barrier to healthy eating; when an interaction was significant
105 ($p < 0.05$), we reran the above models stratifying for the corresponding covariate to assess
106 potential differential associations. Finally, we computed dietary patterns (20) from weekly food
107 consumption frequencies using principal components analysis as performed previously (21),
108 and compliance patterns using factor analysis. As compliance variables are binary (yes/no), we
109 used a polychoric correlation matrix instead of the usual Pearson's correlation matrix. For each
110 participant, scores were computed for each principal component and then compared between
111 barriers to healthy eating. Statistical analyses were performed using Stata 15.1 (Stata Corp,
112 College Station, Texas, USA). All tests were two-tailed and statistical significance was
113 considered for $p < 0.05$.

114 **Results**

115 *Characteristics of included and excluded participants*

116 Of the initial 21,597 participants, 16061 (74.3%) had information on barriers to healthy
117 eating and dietary intake. After excluding those with missing data on age, sex, smoking,
118 education, and household composition, the analytical sample comprised 15,450 participants
119 (71.5% of original sample; 53% women; 48.8 ± 17.4 years). There were no major differences
120 between included and excluded participants, except that a higher proportion of included
121 participants had a tertiary education and reported slightly higher adherence to most dietary
122 guidelines (**Supplementary table 2**). The characteristics of the included participants overall
123 and according to sex are summarized in **Table 1**. Overall adherence to the dietary guidelines

124 was low (less than 40%). The highest reported adherence was for liquids intake at 39.4%,
125 followed by fruits at 38.8%, and the lowest adherence was for meat at 9.1% (**Table 1**).
126 Compared with men, women reported higher adherence to the dietary guidelines for all food
127 groups except for meat, for which there was no difference, and for liquids, for which men
128 reported higher adherence. Perceived barriers to healthy eating, namely price, daily habits, taste,
129 time, and lack of willpower showed an overall prevalence of >20% and up to 45%, with clear
130 differences between men and women.

131 *Barriers to healthy eating and adherence to dietary guidelines*

132 **Table 2** displays the result of the multivariable-adjusted logistic regression models.
133 Daily habits (odds ratio; 95% confidence interval: 0.91; 0.85-0.98) and taste (0.85; 0.79-0.91)
134 were barriers associated with lower adherence to the guidelines for fruits intake, while price
135 (1.13; 1.06-1.21) and limited options in restaurants (1.33; 1.23-1.45) and in supermarkets
136 (1.18; 1.03-1.35) were associated with higher adherence. Regarding vegetables intake, only
137 taste was associated with lower adherence (0.72; 0.66-0.78), while price (1.20; 1.11-1.30),
138 gluttony (1.17; 1.04-1.31), social group opposition (1.48; 1.18-1.85) and limited options in
139 restaurants (1.56; 1.42-1.72) and in supermarkets (1.25; 1.07-1.47) were associated with
140 higher adherence. Regarding fish intake, daily habits (0.82; 0.75-0.90), time (0.86; 0.78-0.94),
141 lack of willpower (0.78; 0.70-0.87), and gluttony (0.86; 0.76-0.98) were associated with lower
142 adherence, whereas price (1.09; 1.01-1.19) and limited options in restaurants (1.26; 1.14-1.39)
143 and in supermarkets (1.40; 1.20-1.63) were associated with higher adherence. Regarding meat
144 intake, daily habits (0.89; 0.82-0.97), taste (0.66; 0.61-0.72), lack of willpower (0.84; 0.76-
145 0.92) and gluttony (0.66; 0.58-0.75) were associated with lower adherence, while price (1.29;
146 1.20-1.40), limited options in restaurants (1.56; 1.42-1.71) and in supermarkets (1.84; 1.59-
147 2.13). Regarding dairy intake, time (0.88; 0.78-0.99) was the only barrier associated with

148 lower guidelines adherence, while gluttony (1.26; 1.09-1.46) was associated with higher
149 adherence. Regarding liquids intake, daily habits was associated with lower adherence (0.91;
150 0.85-0.97), while limited options in restaurants was associated with higher adherence (1.12;
151 1.03-1.22) (**Table 2**).

152 *Stratified analyses*

153 We found effect modification by several covariates in the above associations; hence,
154 stratified analyses were conducted for sex, age group, BMI group, education, household
155 composition, and language region (**Supplementary tables 3-8**, respectively). Within each case
156 of effect modification, the direction of the association was the same across subgroups but the
157 effect size varied slightly. For instance, in the associations between barriers to healthy eating
158 and adherence to the dietary guidelines, the effect size was stronger in men than in women
159 (**Supplementary table 3**), and in younger age groups than in older (**Supplementary table 4**).
160 Reporting taste as a barrier was associated with lower adherence to the dairy recommendation
161 only among obese participants, and the association between reporting time as a barrier and
162 adherence to the meat recommendation was stronger with higher BMI. Conversely, the
163 association between reporting limited options in restaurants and higher adherence to the meat
164 guidelines was stronger among participants with a BMI<30 (**Supplementary table 5**). The
165 association between taste and lower adherence to the fruits and meat guidelines was stronger
166 with higher education. Conversely, the association of time with lower adherence to the meat
167 guideline remained only among participants with lower education (**Supplementary table 6**).

168 Principal component analysis identified three dietary patterns explaining over two thirds
169 of the total variance (**Supplementary table 9**). The first pattern was associated with a higher
170 consumption of fruits and vegetables; dietary pattern 2 was associated with higher consumption

171 of dairy and meat, and with lower consumption of fish; dietary pattern 3 was associated with
172 higher consumption of meat and fish. Regarding adherence to the dietary guidelines, one pattern
173 was identified, characterized by adherence to the fruits and vegetables guidelines
174 (**Supplementary table 9**). The levels of the dietary and dietary guidelines adherence patterns
175 according to barriers to healthy eating are summarized in **Table 3**. Overall, the results reflected
176 those of the main analyses. For instance, reporting taste as a barrier to healthy eating was
177 negatively associated with the dietary pattern characterized by high intakes of fruits and
178 vegetables, but positively associated with the dietary pattern characterized by high intakes of
179 meat and dairy, and low intakes of fish. Similarly, reporting price as a barrier to healthy eating
180 was positively associated with the adherence pattern for fruits and vegetables, reflecting the
181 main findings.

182 **Discussion**

183 In this large representative sample of the Swiss adult population, barriers to healthy
184 eating related to taste, daily habits, time and lack of willpower were associated with a lower
185 compliance to Swiss dietary guidelines. Conversely, barriers to healthy eating related to price,
186 lack of options in restaurants, and lack of options in food markers were associated with
187 increased adherence to the guidelines for fruits, vegetables, fish, and meat.

188 *Barriers to healthy eating and adherence to dietary guidelines*

189 Perceived barriers regarding price, lack of options in restaurants, and lack of options in
190 food markets were associated with increased adherence to most dietary guidelines. These
191 associations contradicted previous findings (18) and our initial hypothesis. A possible
192 explanation is that participants who regularly search for and purchase healthy foods are more
193 aware of the higher price of healthy products and the lack of healthy options in restaurants and

194 supermarkets. For such individuals, these perceived barriers to healthy eating may hinder
195 further improvement of their diets.

196 As we hypothesized, perceived barriers regarding daily habits, taste, lack of time, and
197 lack of willpower were associated with lower adherence to most dietary guidelines, findings
198 that accord with published work (17, 18, 22). The associations with the barriers of daily habits
199 and time likely reflect the greater effort needed to buy, prepare and/or cook certain foods such
200 as vegetables and fish, as opposed to less nutritious foods that are readily available and
201 consumed (23). The associations with lack of willpower may stem from the fact that public
202 nutrition messages and the media strongly emphasize individual responsibility in healthy eating
203 (24, 25), which may push individuals to blame themselves when failing to eat healthily in a
204 predominantly obesogenic environment (26). The associations of taste with lower adherence to
205 guidelines on fruits, vegetables, and meat, likely reflect the innate human affinity towards
206 sugary, salty, and fatty foods (27), which in the current obesogenic environments with abundant
207 energy-rich and nutrient-poor foods, condition people's palates to dislike healthier foods (26-
208 28).

209 In stratified analyses after testing for potential effect modification, we found that the
210 strength of the association between barriers and adherence to guidelines varied across
211 sociodemographic subgroups, similar to findings reported by Pinho et al (18). For instance, the
212 association of lack of willpower and gluttony with a low adherence to the meat recommendation
213 was stronger in men than in women; this may be due to well-known sex differences, with
214 women being much more likely to follow healthier diets (5, 6). Reporting time as a barrier was
215 associated with lower adherence to the vegetable and fish guidelines only among the younger
216 age group, which reflects previous research (18). The association between daily habits, taste,
217 and time as barriers and lower adherence to the dietary guidelines for meat and dairy was

218 stronger among obese participants, which contrasts with previous work which found such no
219 effect modification by BMI group (18).

220 We attempted to further explore the association between barriers to healthy eating and
221 diet by characterizing dietary patterns. In these analyses, we identified three patterns for dietary
222 intake, and one pattern for adherence to the dietary guidelines. The association of these patterns
223 with barriers to healthy eating was largely similar to those observed in the main analyses. To
224 our knowledge, no previous study has assessed the association between dietary patterns and
225 barriers to healthy eating, so these results cannot be compared to the literature. More research
226 is needed regarding a potential association between barriers to healthy eating and dietary
227 patterns, given the increasing epidemiological evidence indicating that the overall quality of
228 dietary patterns is more important in chronic disease risk than single food groups (2, 6, 13);
229 furthermore, increasing evidence also reveals that suboptimal consumption of healthy foods
230 appears to be more detrimental for chronic disease risk than the high consumption of unhealthier
231 foods (29-31).

232 *Importance for public health*

233 Our findings indicate that interventions aimed at increasing adherence to the dietary
234 guidelines need to be sensitive to the way the population perceives how difficult it is to achieve
235 and maintain a healthy diet. Impediments to healthy eating in our study included price,
236 availability, taste, and time, which encompass factors that mostly lie beyond an individual's
237 influence (13, 32). Ultimately, interventions that aim to mitigate barriers to healthy eating need
238 to address the diverse determinants of dietary behavior and food environments. These will
239 necessitate policy changes and multi-faceted actions across different levels of society (14, 32-
240 34). Government-mandated reformulation of food products would help to minimize detrimental

241 ingredients in food and maximize healthy ones (32). Another important intervention would be
242 increased subsidies for the production, availability and affordability of healthy foods, contrary
243 to the current subsidies to food systems promoting cheap and obesogenic foods (32-34). These
244 wide-ranging multi-faceted interventions are likely to transform food environments towards
245 ones that promotes and facilitates healthy eating.

246 *Strengths and limitations*

247 Strengths of our study include the large population-based and representative sample and
248 the number of barriers to healthy eating that were measured. Nevertheless, our study is limited
249 by the use of cross-sectional data, as well as the self-reported nature of the data, which are
250 susceptible to recall and social desirability bias, particularly in regards to adherence to the
251 dietary guidelines. The dichotomous nature of the barrier variables prevented us from
252 examining potential dose-effects of each barrier. Furthermore, the limited data available
253 regarding dietary intake prevented us from examining other important food and nutrient groups,
254 such as whole grains, salt, beans and legumes, and unsaturated fats, etc. In our dietary pattern
255 analyses, this presented a major limitation, as dietary patterns were estimated using only five
256 broad food groups, from which we estimated daily portions. This was a limitation of the diet-
257 related questions in the Swiss Health Survey. More detailed dietary information, such as from
258 Food Frequency Questionnaires or 24h dietary recalls are needed to better assess dietary
259 patterns and their association with barriers to healthy eating. Such a detailed analysis could
260 provide greater insight into which barriers may be preventing individuals from accessing
261 healthy foods such as specific fruits, vegetables, legumes, nuts and seeds, as well as promoting
262 or facilitating access to unhealthier foods such as processed red meat and highly processed
263 packaged foods. Finally, a sizable number of participants were excluded from the analysis;

264 however, this exclusion was necessary as these participants lacked information on barriers to
265 healthy eating, and excluded participants did not differ significantly from included ones.

266 *Conclusion*

267 In a representative sample of the Swiss adult population, barriers related to price and
268 availability were associated with higher adherence to the dietary guidelines, while barriers
269 related to taste, time, daily habits, and lack of willpower were associated with lower adherence.
270 Further research is needed to elucidate the association between barriers to healthy eating and
271 dietary behavior.

272 **Conflict of interest:** The authors report no conflict of interest

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274 **Contributions:** CdM, SKS, and PMV originated the concept for paper. All authors agreed on
275 analysis plan. CdM conducted analyses, constructed tables, and wrote manuscript. All authors
276 contributed to content of final draft and approved its submission.

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Table 1. Descriptive characteristics of included participants, the Swiss Health Survey 2012
(N=15450)

	Total	Men	Women	p-value
N	15,450	7287	8163	
Age, mean (SD)	48.8 (17.4)	48.8 (17.4)	48.8 (17.3)	0.94
BMI, mean (SD)	24.8 (4.4)	25.7 (3.8)	23.9 (4.6)	
Current smoker, n (%)	4180 (27.1)	2198 (30.2)	1982 (24.3)	
Educational level, n (%)				<0.001
Tertiary	4783 (31.0)	2811 (38.6)	1972 (24.2)	
Secondary	8740 (56.7)	3697 (50.8)	5043 (61.9)	
Mandatory	1894 (12.3)	766 (10.5)	1128 (13.9)	
Household composition, n (%)				<0.001
1 person	2628 (17.0)	1056 (14.5)	1572 (19.3)	
2 people	5912 (38.3)	2925 (40.1)	2987 (36.6)	
3 people	2530 (16.4)	1169 (16.0)	1361 (16.7)	
4 people or more	4380 (28.3)	2137 (29.3)	2243 (27.5)	
Language region, n (%)				<0.01
German	10103 (65.4)	4815 (66.1)	5288 (64.8)	
French	4188 (27.1)	1937 (26.6)	2251 (27.6)	
Italian	1159 (7.5)	535 (7.3)	624 (7.6)	
Adherence to Swiss dietary guidelines, n (%)				
Fruits (≥ 2 serving/day)	5999 (38.8)	2229 (30.6)	3770 (46.2)	<0.001
Vegetables (≥ 3 serving/day)	3167 (20.5)	914 (12.5)	2253 (27.6)	<0.001
Dairy (≥ 3 serving/day)	2993 (19.4)	1319 (18.1)	1674 (20.5)	<0.001
Fish (≥ 2 serving/week)	3477 (22.5)	1110 (15.2)	2367 (29.0)	<0.001
Meat (≤ 2 serving/week)	1413 (9.1)	711 (9.8)	702 (8.6)	0.01
Liquids (≥ 2 liters/d)	6069 (39.4)	3223 (44.3)	2846 (34.9)	<0.001
Barriers to healthy eating, n (%)				
Price	6137 (39.7)	2620 (36.0)	3517 (43.1)	<0.001
Daily habits	5889 (38.1)	2709 (37.2)	3180 (39.0)	0.02
Taste	6932 (44.9)	3717 (51.0)	3215 (39.4)	<0.001
Time	4921 (31.9)	2116 (29.0)	2805 (34.4)	<0.001
Willpower	3308 (21.4)	1538 (21.1)	1770 (21.7)	0.38
Limited options in restaurants	2827 (18.3)	1249 (17.1)	1578 (19.3)	<0.001
Gluttony	2088 (13.5)	1196 (16.4)	892 (10.9)	<0.001
No social support	1076 (7.0)	442 (6.1)	634 (7.8)	<0.001
Limited options at market	930 (6.0)	452 (6.2)	478 (5.9)	0.37
Social group opposition	377 (2.4)	136 (1.9)	241 (3.0)	<0.001

Statistical significance for difference between groups tested with student t-test for continuous variables, and with Chi-square test for categorical variables.

Table 2. Association between barriers to healthy eating and adherence to dietary guidelines among Swiss adults, the Swiss Health Survey 2012 (N = 15450)

Barriers to healthy eating	Multivariable-adjusted odd ratio (95% CI)					
	Fruits	Vegetables	Fish	Meat	Dairy	Liquids
Price	1.13 (1.06, 1.21)	1.20 (1.11, 1.30)	1.09 (1.01, 1.19)	1.29 (1.20, 1.40)^a	0.97 (0.87, 1.09) ^{a,d}	1.06 (0.99, 1.13)
Daily habits	0.91 (0.85, 0.98)^{b,f}	1.05 (0.97, 1.14) ^f	0.82 (0.75, 0.90)	0.89 (0.82, 0.97)^{b,c,e}	0.97 (0.86, 1.09) ^f	0.91 (0.85, 0.97)^{d,f}
Taste	0.85 (0.79, 0.91)^{d,f}	0.72 (0.66, 0.78)	1.01 (0.93, 1.10) ^d	0.66 (0.61, 0.72)^{d,f}	1.03 (0.92, 1.15) ^c	0.98 (0.91, 1.04)
Time	0.97 (0.91, 1.04)	0.97 (0.89, 1.05) ^{a,b,e}	0.86 (0.78, 0.94)^b	0.97 (0.89, 1.05) ^{c,d,f}	0.88 (0.78, 0.99)	0.93 (0.87, 1.00) ^f
Willpower	0.96 (0.88, 1.04)	0.91 (0.82, 1.00)	0.78 (0.70, 0.87)^a	0.84 (0.76, 0.92)^{a,f}	1.09 (0.96, 1.24)	0.96 (0.89, 1.04)
Limited options in restaurants	1.33 (1.23, 1.45)	1.56 (1.42, 1.72)	1.26 (1.14, 1.39)^d	1.56 (1.42, 1.71)^{c,e}	0.94 (0.81, 1.08)	1.12 (1.03, 1.22)^f
Gluttony	1.02 (0.92, 1.12)	1.17 (1.04, 1.31)^b	0.86 (0.76, 0.98)^c	0.66 (0.58, 0.75)^{a,f}	1.26 (1.09, 1.46)^e	1.07 (0.98, 1.18)
No social support	1.11 (0.98, 1.25)	1.14 (0.98, 1.32)	0.98 (0.84, 1.16)	1.11 (0.96, 1.29)	0.91 (0.73, 1.13)	1.00 (0.88, 1.14)
Limited options at market	1.18 (1.03, 1.35)^{a,f}	1.25 (1.07, 1.47)^{a,e}	1.40 (1.20, 1.63)	1.84 (1.59, 2.13)^f	0.79 (0.62, 1.02)	1.04 (0.91, 1.20)
Social group opposition	1.10 (0.89, 1.35)	1.48 (1.18, 1.85)	1.12 (0.86, 1.45)	1.29 (1.02, 1.62)^f	1.11 (0.80, 1.54)	1.10 (0.90, 1.35)

Odds ratios and 95% confidence intervals adjusted for age, sex, BMI, education, household composition, and language region, computed from logistic regression model run separately for each barrier exposure and adherence food group. Interaction with: ^a sex; ^b age; ^c BMI; ^d education; ^e household composition; ^f language. Results in bold indicate p<0.05.

Table 3. Dietary and dietary guidelines adherence patterns according to barriers to healthy eating among Swiss adults, the Swiss Health Survey 2012 (N = 15450)

	Pattern 1	Pattern 2	Pattern 3	Adherence
Price				
No	-0.26 ± 10.2	0.68 ± 9.98	0.09 ± 9.95	0.26 ± 0.27
Yes	0.40 ± 9.72	-1.04 ± 9.94	-0.13 ± 10.1	0.30 ± 0.28
p-value	<0.001	<0.001	0.177	<0.001
Daily habits				
No	0.04 ± 10.1	-0.15 ± 10.1	0.20 ± 10.0	0.28 ± 0.28
Yes	-0.06 ± 9.87	0.24 ± 9.86	-0.32 ± 9.98	0.27 ± 0.28
p-value	0.562	0.018	0.002	0.072
Taste				
No	0.48 ± 9.72	-1.18 ± 10.1	0.01 ± 10.0	0.30 ± 0.29
Yes	-0.59 ± 10.3	1.45 ± 9.67	-0.02 ± 10.0	0.25 ± 0.26
p-value	<0.001	<0.001	0.857	<0.001
Time				
No	0.08 ± 9.99	-0.01 ± 10.0	0.16 ± 9.94	0.27 ± 0.28
Yes	-0.17 ± 10.0	0.03 ± 9.94	-0.35 ± 10.1	0.27 ± 0.28
p-value	0.15	0.814	0.003	0.834
Willpower				
No	0.12 ± 9.89	-0.32 ± 9.94	0.00 ± 10.0	0.28 ± 0.28
Yes	-0.44 ± 10.4	1.18 ± 10.1	0.02 ± 9.95	0.26 ± 0.28
p-value	0.005	<0.001	0.917	<0.001
Limited options in restaurants				
No	-0.29 ± 10.2	0.48 ± 9.87	0.12 ± 9.96	0.26 ± 0.27
Yes	1.29 ± 8.84	-2.13 ± 10.3	-0.54 ± 10.2	0.33 ± 0.30
p-value	<0.001	<0.001	0.002	<0.001
Gluttony				
No	0.06 ± 9.98	-0.44 ± 9.91	0.00 ± 10.0	0.28 ± 0.28
Yes	-0.41 ± 10.1	2.83 ± 10.1	0.02 ± 9.78	0.26 ± 0.28
p-value	0.046	<0.001	0.917	0.002
No social support				
No	0.04 ± 9.96	0.03 ± 9.97	0.01 ± 10.0	0.27 ± 0.28
Yes	-0.47 ± 10.6	-0.46 ± 10.4	-0.16 ± 10.0	0.29 ± 0.28
p-value	0.108	0.115	0.595	0.023
Limited options at food				
No	0.01 ± 9.99	0.17 ± 9.93	0.12 ± 9.93	0.27 ± 0.28
Yes	-0.16 ± 10.1	-2.61 ± 10.6	-1.95 ± 10.9	0.32 ± 0.29
p-value	0.62	<0.001	<0.001	<0.001
Social group opposition				
No	-0.01 ± 10.0	0.03 ± 9.98	0.01 ± 10.0	0.27 ± 0.28
Yes	0.26 ± 10.1	-1.28 ± 10.8	-0.32 ± 9.82	0.27 ± 0.28
p-value	0.604	0.012	0.532	0.003

Results are expressed as average ± standard deviation. Between-group comparisons performed using student's t-test. Pattern 1 was associated with higher consumption of fruits and vegetables; pattern 2 was associated with higher consumption of dairy and meat, and to low consumption of fish; pattern 3 was associated with high consumption of meat and fish. Adherence pattern was characterized by high adherence to fruits and vegetable guidelines (see Supplemental table 9).