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1 **Trends in vitamin, mineral and dietary supplement use in Switzerland. The CoLaus study.**

2 **Running title:** trends in vitamin/mineral supplement use

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23 **CONFLICT OF INTEREST**

24 PV and GW received funding from the Swiss National Science Foundation (Bern, Switzerland);
25 GlaxoSmithKline (Philadelphia, PA, USA) and the Faculty of Biology and Medicine of Lausanne (Lausanne,
26 Switzerland) to conduct the CoLaus study. PMV indicates no conflict of interest.

28 **ABSTRACT**

29 **Background:** vitamin/mineral (VMS) and dietary supplements (DS) use is common in Switzerland, but
30 nothing is known regarding the factors associated with their initiation, discontinuation or continuation of
31 intake.

32 **Methods:** prospective study conducted between 2003-6 and 2009-12 in Lausanne, Switzerland among 4676
33 participants (2525 women, age range 35-75 years). VMS were defined as single or
34 multivitamin/multimineral preparations; DS were defined as any dietary supplement.

35 **Results:** VMS use was 20.6% at baseline and 20.3% at follow-up (p=0.69): 559 (12.0%) participants
36 discontinued; 545 (11.7%) initiated and 404 (8.6%) continued VMS use. On multivariable analysis, men had
37 a lower relative risk ratio (RRR) of discontinuing, initiation or continuing; older age and being physically
38 active were associated with a higher RRR of initiation or continuing; lower education and higher body mass
39 index were associated with a lower RRR of discontinuing or continuing of VMS.

40 DS use decreased from 10.4% to 6.8% (p<0.001): 405 (8.7%) participants discontinued; 239 (5.1%) initiated
41 and 81 (1.7%) continued DS use. On multivariable analysis, men had a lower RRR of discontinuing,
42 initiation or continuing; older age had a higher RRR of initiation, discontinuing or continuing; being
43 physically active was associated with a higher RRR of initiation or continuing; Swiss citizens and former
44 smokers had a higher RRR of discontinuing.

45 **Conclusion:** VMS use is stable in the Lausanne population, while DS use appears to be decreasing.
46 Individuals can be categorized either as users or non-users depending on the study period, and consistent
47 users are only a small fraction of prevalent users.

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50

51 **INTRODUCTION**

52 Vitamin and mineral supplements (VMS) are taken by a significant fraction of the general population
53 ¹⁻⁵, although their health benefits are questionable ⁶⁻⁸. If some VMS might be of interest (i.e. iron for anaemia
54 and calcium/vitamin D for osteoporosis), several studies suggested that VMS either have no effect ⁹ or even
55 increase total mortality ¹⁰. Still, despite recommendations against the use of specific vitamins to prevent
56 disease ¹¹, the prevalence of VMS use is increasing in Europe and the USA ¹²⁻¹⁴. Interestingly, VMS and
57 dietary supplements (DS) use appears to be a fairly unstable behaviour in the general population, with high
58 rates of initiation or discontinuing ¹⁵. Several socio-demographic characteristics such as female gender, older
59 age and lower body mass index have been shown to be associated with consistent VMS use ¹⁵, but the
60 number of studies that assessed trends and determinants of VMS and DS use are relatively scarce ^{15, 16}.

61 In a previous study, we showed that a sizable fraction of the Lausanne population consumed VMS or
62 DS ¹⁷. We now assessed trends in VMS and DS use and the factors associated with initiation, discontinuing
63 and persistence of in VMS and DS use in the population of Lausanne, Switzerland.

64 **MATERIALS AND METHODS**

65 *Sampling*

66 The CoLaus Study is a prospective study aiming to assess the prevalence of cardiovascular risk
67 factors and to identify new molecular determinants of these risk factors in the population of the city of
68 Lausanne, Switzerland. The sampling procedure of the CoLaus Study has been described previously ¹⁸. In
69 summary, a simple, non-stratified random sample of the overall population of Lausanne was drawn. The
70 following inclusion criteria were applied: (a) written informed consent and (b) willingness to take part in the
71 examination and to provide blood samples. Recruitment began in June 2003 and ended in May 2006 and
72 included 6184 Caucasian participants. The evaluation included an interview, a physical exam, blood
73 sampling and a set of questionnaires. The follow-up was performed between April 2009 and September
74 2012, five and a half years on average after the collection of baseline data and was similar to the baseline
75 evaluation.

76 *Vitamin/mineral and dietary supplements*

77 Vitamin/mineral supplements were defined as previously¹⁷. VMS and DS, including omega-3
78 supplements, were identified. Specific combinations of calcium and vitamin D were also identified.

79 For each group (VMS and DS) users were categorized as never (absent at baseline and follow-up),
80 initiators (absent at baseline but present at follow-up), discontinuers (present at baseline but absent at follow-
81 up) and continuers (present at baseline and follow-up) as performed in other studies conducted in
82 antihypertensive drug treatment^{19, 20}. In the prospective survey, drugs prescribed by a doctor were
83 differentiated from those bought over-the-counter. As calcium + vitamin D supplements might be prescribed
84 for osteoporosis prevention and iron ± vitamin B₁₂ for anaemia, sensitivity analyses were carried excluding
85 participants taking such combinations. Also for sensitivity analyses, participants were categorized as never,
86 inconsistent (initiators or discontinuers) or consistent (continuers) users, as performed previously¹⁵.

87 *Other data*

88 Educational level was categorized into mandatory school, apprenticeship, high school and university.
89 Marital status was categorized into single/divorced/widowed and married/cohabitating. Country of birth was
90 categorized into Swiss-born and born in another country. Smoking status was defined as never, former and
91 current. A participant was considered as physically active if he/she practiced at least twice per week leisure-
92 time physical activities with a minimal duration of 20 minutes.

93 As presence of cardiovascular risk factors has been associated with initiation or maintenance of
94 VMS¹⁵, awareness of hypertension, dyslipidemia or diabetes was considered if the participant responded
95 positively to the questions “did a doctor tell you that you were hypertensive / had high cholesterol levels /
96 were diabetic?” respectively. No data was collected regarding other diseases such as arthrosis, cancer or
97 osteoporosis.

98 Body weight and height were measured with participants standing without shoes in light indoor
99 clothes. Body weight was measured in kilograms to the nearest 100 g using a Seca[®] scale, which was
100 calibrated regularly. Height was measured to the nearest 5 mm using a Seca[®] height gauge. Overweight was
101 defined as body mass index (BMI) ≥ 25 and < 30 kg/m² and obesity as BMI ≥ 30 kg/m². As the number of

102 underweight (BMI<18.5 kg/m²) participants was very small (N=83 or 1.8% of the total sample), they were
103 included in a “normal + underweight” category.

104 *Statistical analysis*

105 Participants were excluded if (a) they did not participate in the follow-up survey and (b) they had any
106 missing socio-demographic data. Statistical analyses were performed using Stata version 13.1 for windows
107 (Stata Corp, College Station, TX, USA). Descriptive results were expressed as number of participants
108 (percentage) or as mean±standard deviation. Bivariate analyses were performed using chi-square for
109 categorical variables and Student’s t-test or analysis of variance for continuous variables. For continuous
110 variables, post-hoc pairwise comparisons using the method of Scheffe were performed when the results of
111 the ANOVA were statistically significant. In agreement with a previous study ¹⁵, multivariable analysis was
112 performed with multinomial logistic regression using never users as the reference; the results were expressed
113 as relative risk ratio (RRR) and 95% confidence interval (CI). Multi-collinearity of the dependent variables
114 was tested using the collin function of Stata; variance inflation factors between 1.01 and 1.20 were obtained,
115 suggesting that multi-collinearity was not present. Tests were two-sided and statistical significance was
116 assessed for p<0.05.

117 *Ethics statement*

118 The CoLaus study was approved by the Institutional Ethics Committee of the University of
119 Lausanne. The study was conducted according to the Declaration of Helsinki and all participants provided
120 written informed consent prior to participating.

121 **RESULTS**

122 *Selection procedure and characteristics of participants*

123 Of the initial 6184 participants at baseline, 1501 (24.3%) did not participate in the follow-up survey
124 and 7 (0.1%) had missing socio-demographic data. The selection procedure is summarized in **Figure 1** and
125 the comparison between included and excluded participants is summarized in **supplemental Table 1**.
126 Excluded participants were older, less frequently women, had a lower educational level, were less frequently
127 born in Switzerland, were more frequently smokers, sedentary or obese and had a higher prevalence of self-
128 reported hypertension and diabetes than included participants. Prevalence of VMS and DS use was also
129 lower among excluded participants (**supplemental table 1**).

130 *Trends and determinants of vitamin/mineral supplement use*

131 Prevalence of VMS use was 20.6% at baseline and 20.3% at follow-up (p=0.69). During the 5.5 year
132 study period, 559 (12.0%) participants discontinued; 545 (11.7%) initiated and 404 (8.6%) continued VMS
133 use, while 3168 (67.8%) did not use any VMS at baseline and follow-up.

134 The bivariate associations between socio-demographic and clinical factors and being never using,
135 initiating, discontinuing or continuing VMS are summarized in **supplemental table 2**. Significant
136 associations were found with gender, age, educational level, marital status, Swiss citizenship, physical
137 activity and BMI categories. These associations were partly confirmed by multivariate analysis, the results of
138 which are summarized in **table 1**. Men had a lower RRR of discontinuing, initiating or continuing VMS use.
139 Older age and being physically active were associated with a higher RRR of initiating and continuing VMS
140 use. Having a lower education or a higher BMI was associated with a lower RRR of discontinuing and
141 continuing VMS use. Finally, presence of reported dyslipidemia was associated with a higher RRR of
142 continuing VMS use (**table 1**). Similar findings were obtained when the analysis was split by gender (not
143 shown).

144 *Trends and determinants of dietary supplements use*

145 Prevalence of DS use was 10.4% at baseline and decreased to 6.8% at follow-up (p<0.001). During
146 the 5.5 year study period, 405 (8.7%) participants discontinued; 239 (5.1%) initiated and 81 (1.7%)
147 continued DS use, while 3951 (84.5%) did not use any DS at baseline and follow-up.

148 The bivariate associations between socio-demographic and clinical factors and being never using,
149 initiating, discontinuing or continuing DS are summarized in **supplemental table 3**. Significant associations
150 were found with gender, age, marital status, Swiss citizenship, smoking status, physical activity and BMI
151 categories. These associations were partly confirmed by multivariate analysis, the results of which are
152 summarized in **table 2**. Men had a lower RRR of discontinuing, initiating or continuing DS use. Older age
153 was associated with a higher RRR of initiating, discontinuing and continuing DS use. Being physically active
154 was associated with a higher RRR of initiating and continuing DS use. Swiss citizenship and being former
155 smoker was associated with a higher RRR of discontinuing DS use (**table 2**). Similar findings were obtained
156 when the analysis was split by gender (not shown).

157 *Sensitivity analyses*

158 The results of the sensitivity analysis on VMS use excluding calcium and vitamin D or iron and
159 vitamin B₁₂ combinations were similar to those obtained when the analysis included all VMS, except that
160 some associations were no longer significant due to smaller sample sizes (not shown).

161 The results of the sensitivity analysis on never, inconsistent (initiating or discontinuing) and
162 consistent (continuing) use of VMS are summarized in **supplemental tables 4 and 5**. On bivariate analysis,
163 inconsistent use of VMS was associated with age, BMI, gender, educational level, marital and physical
164 activity status (**supplemental table 4**). Multivariate analysis showed that participants of male gender, lower
165 education, married or obese had a lower RRR of inconsistent users, while older or physically active
166 participants had a higher RRR of inconsistent use (**supplemental table 5**). Similar findings were obtained
167 when the analysis was split by gender (not shown).

168 The results of the sensitivity analysis on never, inconsistent (initiating or discontinuing) and
169 consistent (continuing) use of DS are summarized in **supplemental tables 6 and 7**. On bivariate analysis,
170 inconsistent use of DS was associated with age, BMI, gender, educational level, country of birth, smoking,
171 marital and physical activity status (**supplemental table 6**). Multivariate analysis showed that participants of
172 male gender or of lower education had a lower RRR of inconsistent use, while older, former smoker or
173 physically active participants had a higher RRR of inconsistent use (**supplemental table 7**). Similar findings
174 were obtained when the analysis was split by gender (not shown).

175 **DISCUSSION**

176 VMS use changes with time, a sizable number of users discontinuing during a 5.5 year follow-up,
177 being replaced by an almost similar number of previous never users initiating VMS, leading to a relatively
178 stable number of VMS users. Conversely, the prevalence of DS use decreased significantly.

179 *Trends and determinants of vitamin/mineral supplement use*

180 Several cross-sectional and prospective studies have shown an increase in VMS use in the general
181 population or in specific groups. In this study, VMS was relatively stable, the large number of participants
182 discontinuing being compensated by an almost similar number of participants initiating VMS use.
183 Interestingly, a large fraction of initiators was due to calcium and vitamin D combinations and not to generic

184 VMS, suggesting that this increase was medically driven. These findings are partly in agreement with a
185 previous study ¹⁵, with the difference that in the previous study the number of participants initiating VMS
186 outweighed the number of participants discontinuing. Overall, our results indicate that individuals can be
187 categorized either as VMS users or never users depending on the study period, and that VMS continuers are
188 only a small fraction of prevalent VMS users.

189 Women and older age were significantly associated with both initiating and continuing VMS use, a
190 finding in agreement with the literature ¹⁵. A first explanation is that women and elderly people tend to be
191 more health conscious and to adopt health-promoting behaviours such as VMS use. Another explanation is
192 the prevention of osteoporosis in elderly women by vitamin D + calcium combinations. Indeed, among
193 women, 273 (10.9% of all women, 71.6% of all women initiators) initiated the vitamin D + calcium
194 combination, versus 63 (2.5% of all women, 11.3% of all women discontinuers) who discontinued. Thus, and
195 in agreement with another study ¹⁶, our results suggest that most women VMS initiators did so for a medical
196 and not for a personal reason.

197 Being physically active was associated with both the initiation and the continuation of VMS, a
198 finding also reported elsewhere ¹⁵. Physically active people tend to be more health-conscious and to adopt
199 more frequently healthy eating and VMS use ²¹. Whether physically active people initiated VMS to promote
200 their health or to improve physical performance remains to be assessed.

201 In the sensitivity analyses, participants of lower education had a lower RRR of inconsistent
202 (initiating or discontinuing) or consistent (continuing) VMS use, a finding partly in agreement with a
203 previous study ¹⁵, where such associations were found in men only. Interestingly, when inconsistent users
204 were split into initiators and discontinuers, the association with education was for discontinuing VMS only.
205 The lower likelihood of discontinuing VMS among less educated people might be explained by the fact that
206 participants with higher education consume more non-prescribed medicines ²², and thus change consumption
207 more frequently.

208 Presence of disease has been shown to increase the initiation of VMS by patients ¹⁵, although this
209 statement has been challenged ²³. Still, in this study, no consistent associations were found between self-
210 reported hypertension, dyslipidemic or diabetic status and initiation of VMS. Interestingly, participants who

211 reported dyslipidemia had a higher RRR of continuing VMS, a finding also reported elsewhere ¹⁵. Although
212 some studies have shown a small effect of VMS on lipid levels ²⁴ or carotid atherosclerosis ²⁵, still VMS use
213 is not recommended for the primary prevention of cardiovascular disease ¹¹.

214 *Trends and determinants of dietary supplements use*

215 Contrary to a study conducted in the USA ¹⁶ but in agreement with another conducted in Scandinavia
216 ²⁶, the prevalence of DS users decreased. Possible explanations include the absence or low efficiency of DS
217 ²⁷⁻³⁰ and tighter regulations regarding their health claims ³¹. Still, it would be of interest that the decrease
218 observed in this study could be confirmed by other independent studies. As for VMS, our results suggest that
219 only a small fraction of all DS users continuously consumes them.⁴⁵ A possible explanation is that people
220 adopt DS based on their health promises ³², then discontinue when these benefits are not met or when side
221 effects occur ³³. Still, as the reasons for discontinuing were not collected, these explanations remain
222 speculative. Also, the diversity of DS precluded any analysis of the associations between discontinuing DS
223 and the type of DS used. Conversely, DS maintenance continuation could be due to the presence of an effect
224 (or to the absence of adverse effects) of DS. Again, the reasons for continuation are unknown and it would be
225 of interest that further studies focus on the reasons for initiating, continuing or discontinuing DS.

226 Former smokers were more likely to be discontinuers than never or current smokers. It is possible
227 that former smokers initially used DS as aid to prevent smoking relapse or to prevent weight gain induced by
228 quitting smoking, then quit DS due to their relative inefficiency ^{34, 35}.

229 Physical activity was associated with DS initiation, discontinuing and continuation. If the findings
230 regarding initiation and continuation are in agreement with the literature ^{15, 36, 37}, the association of physical
231 activity with DS discontinuing was unexpected. A possible explanation is that physically active participants
232 initially relied on DS to boost their performances and discontinued if the DS did not meet their expectations.
233 As no information was collected regarding the reasons for discontinuing, this explanation should be
234 confirmed in other studies.

235 *Implications for public health nutrition*

236 Our findings have several implications for public health nutrition. First, they confirm that both VMS
237 and DS use is an unstable behaviour and that a sizable fraction of that discontinuers are replaced by

238 initiators. Thus, the overall effect of VMS or DS use on health outcomes might be considerably decreased.
239 Indeed, our results may partly explain the lack of effect of VMS on mortality ⁹, as VMS intake might not
240 have been consistent throughout the study period. Finally, the “cycling” of VMS or DS could also lead to the
241 sporadic occurrence of side effects due to interactions of VMS or DS with prescribed drugs, with potentially
242 major health consequences ³⁸.

243 *Study limitations*

244 This study has several limitations worth acknowledging. First, excluded participants differed
245 significantly from the included ones. Thus, it is likely that our results are based on a more health-conscious
246 sample than the general population and that the prevalence estimates for VMS and DS use might be
247 overestimated. Still, our drop-out rate (24.4%) is comparable to the one of a previous study assessing trends
248 in VMS use (23.1%) ¹⁵. Second, no data on duration or amount of VMS or DS use was collected; hence, it is
249 possible that our estimates for the prevalence of continuers might be overestimated, as during the follow-up
250 period some participants could have undergone several cycles of use/non-use of VMS or DS. Thus, future
251 studies should consider the number and duration of use/non-use cycles when assessing VMS or DS use.
252 Third, no information was collected regarding the type, intensity, duration and patterns of physical activity,
253 and only the status of being physically active was collected; hence, it is likely that this assessment might be
254 too weak to draw precise conclusions regarding the impact of physical activity on VMS or DS changes. Still,
255 physical activity was significantly associated with initiation of VMS or DS, suggesting that even raw
256 evaluations of physical activity status can be used in such studies. Fourth, changes in the baseline
257 independent variables during follow-up (i.e. age, educational level, BMI changes) were not taken into
258 account in the multinomial logistic model; still using time varying variables would preclude comparison with
259 similar studies ^{15, 38} and could differ according to the criteria used to define change (i.e. in BMI levels) ³⁹.
260 Finally, only data from Caucasian participants living in a Swiss city was available, and it is currently
261 unknown if our findings apply to other ethnicities or to other countries; for instance, a prospective study
262 conducted in UK women ⁴⁰ showed a much higher frequency of consistent users (54%, vs. 8.6% in our
263 study), while the frequency of inconsistent (initiation + discontinuation) users was comparable (25%, vs.
264 23.6% in our study). Thus, the prevalence of never users, initiators, discontinuers and continuers might not

265 be comparable between countries. Still, as the factors associated with VMS and DS use appear to be
266 independent of the cultural and ethnic context^{36,37}, they might be extrapolated to other countries.

267 *Conclusion*

268 In this population-based sample of the city of Lausanne, the prevalence of VMS use remained stable,
269 but this apparent stability was due to high and comparable discontinuing and initiation rates. Conversely, DS
270 use appears to be decreasing. Being physically active favours the initiation of VMS or DS, and older age
271 favours the initiation of VMS.

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277 writing of the report; and in the decision to submit the article for publication.

278 **CONFLICT OF INTEREST**

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280 GlaxoSmithKline (Philadelphia, PA, USA) and the Faculty of Biology and Medicine of Lausanne (Lausanne,
281 Switzerland) to conduct the CoLaus study. PMV indicates no conflict of interest.

282 **AUTHORS' CONTRIBUTIONS**

283 PMV designed and conducted research, analyzed data and wrote paper; PV and GW provided
284 essential materials and revised the article for important intellectual content. PMV had primary responsibility
285 for final content, had full access to the data and is the guarantor of the study. All authors have read and
286 approved the manuscript.

287 **ACKNOWLEDGEMENTS**

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Figure 1: selection procedure.

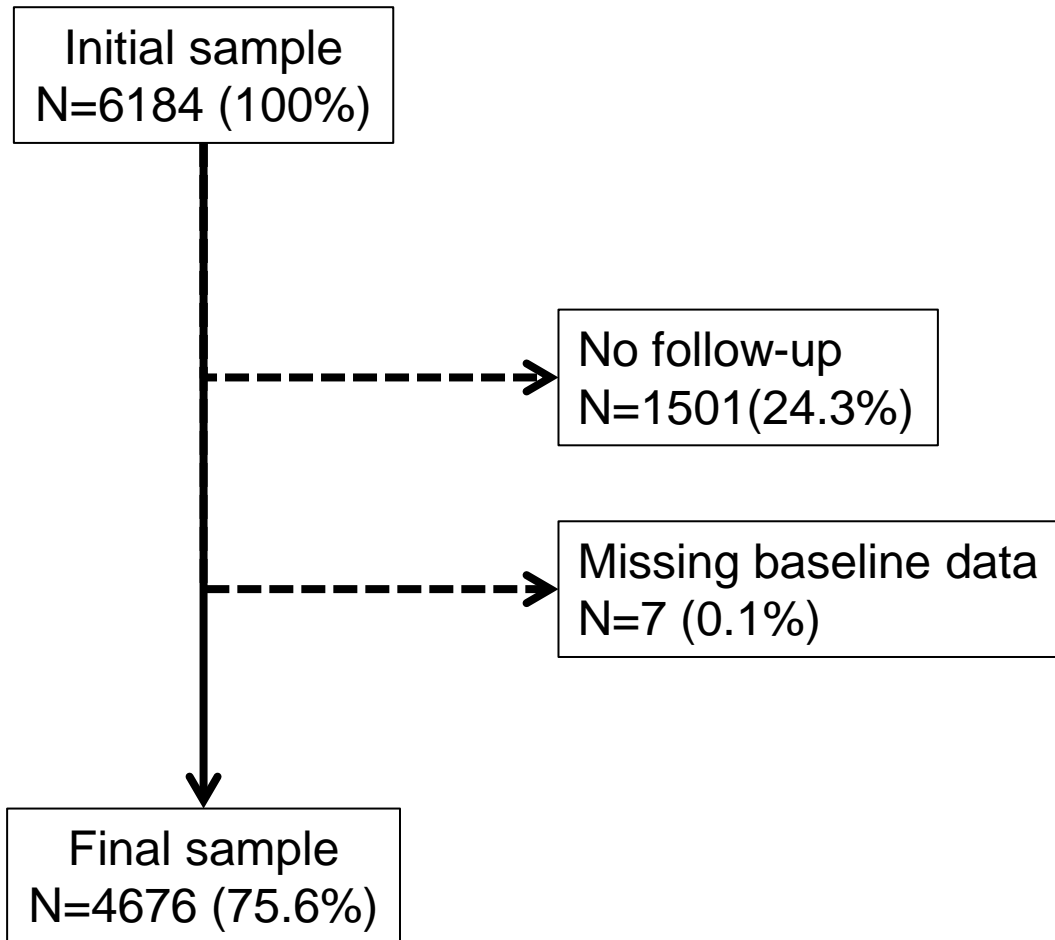


Table 1: multivariable associations between socio-demographic and clinical variables with changes in vitamin supplement use occurring between 2003-6 and 2009-12, CoLaus study, Lausanne, Switzerland, all participants.

	Initiators	Discontinuers	Continuers
N	545	559	404
Gender (man vs. woman)	0.37 (0.30 - 0.46) ***	0.38 (0.31 - 0.47) ***	0.22 (0.17 - 0.29) ***
Age groups			
[35-45[	1 (ref.)	1 (ref.)	1 (ref.)
[45-55[	1.80 (1.38 - 2.36) ***	1.04 (0.82 - 1.31)	2.09 (1.44 - 3.04) ***
[55-65[	2.25 (1.71 - 2.96) ***	0.99 (0.77 - 1.28)	4.56 (3.19 - 6.50) ***
[65+	2.36 (1.70 - 3.28) ***	1.10 (0.80 - 1.53)	6.35 (4.28 - 9.44) ***
Education			
University	1 (ref.)	1 (ref.)	1 (ref.)
High school	0.99 (0.75 - 1.31)	0.77 (0.59 - 1.01)	1.03 (0.75 - 1.42)
Apprenticeship	0.81 (0.62 - 1.06)	0.78 (0.60 - 1.00) *	0.66 (0.48 - 0.91) **
Mandatory	0.85 (0.61 - 1.17)	0.57 (0.41 - 0.78) ***	0.52 (0.35 - 0.78) ***
Marital status (married/cohab vs. other)	0.81 (0.66 - 0.98) *	0.89 (0.73 - 1.08)	0.78 (0.62 - 0.98)
Born in Switzerland vs. other country	1.16 (0.94 - 1.44)	1.04 (0.85 - 1.28)	1.23 (0.96 - 1.59)
Smoking			
Never	1 (ref.)	1 (ref.)	1 (ref.)
Former	1.05 (0.85 - 1.31)	1.21 (0.97 - 1.49)	1.29 (1.00 - 1.66)
Current	0.95 (0.75 - 1.21)	0.98 (0.78 - 1.25)	1.05 (0.79 - 1.41)
Physically active (yes vs. no)	1.30 (1.07 - 1.59) **	1.05 (0.87 - 1.28)	1.44 (1.13 - 1.82) **

BMI groups			
Normal + underweight	1 (ref.)	1 (ref.)	1 (ref.)
Overweight	0.82 (0.66 - 1.02)	0.83 (0.67 - 1.02)	0.68 (0.53 - 0.88) **
Obese	0.81 (0.60 - 1.10)	0.59 (0.42 - 0.82) **	0.65 (0.45 - 0.94) *
Hypertension (yes vs. no)	1.14 (0.91 - 1.44)	1.11 (0.87 - 1.41)	0.88 (0.67 - 1.15)
Dyslipidemia (yes vs. no)	0.89 (0.70 - 1.13)	1.08 (0.85 - 1.37)	1.34 (1.04 - 1.73) *
Diabetes (yes vs. no)	1.53 (0.99 - 2.37)	1.08 (0.65 - 1.81)	1.29 (0.75 - 2.21)

Results are expressed as relative risk ratio and (95% confidence interval). BMI, body mass index. Statistical analysis by multinomial logistic regression using never users as reference. *, p<0.05; **, p<0.01; ***, p<0.001.

Table 2: multivariable associations between socio-demographic and clinical variables with changes in dietary supplement use occurring between 2003-6 and 2009-12, CoLaus study, Lausanne, Switzerland, all participants.

	Initiators	Discontinuers	Continuers
N	239	405	81
Gender (man vs. woman)	0.41 (0.30 - 0.56) ***	0.30 (0.23 - 0.39) ***	0.30 (0.17 - 0.53) *
Age groups			
[35-45[	1 (ref.)	1 (ref.)	1 (ref.)
[45-55[	1.38 (0.95 - 1.99)	1.47 (1.09 - 1.97) **	2.42 (1.10 - 5.35) *
[55-65[	1.76 (1.22 - 2.55) **	1.77 (1.31 - 2.39) ***	4.53 (2.13 - 9.65) ***
[65+	1.14 (0.70 - 1.87)	1.57 (1.09 - 2.27) *	3.14 (1.29 - 7.62) **
Education			
University	1 (ref.)	1 (ref.)	1 (ref.)
High school	1.02 (0.70 - 1.49)	0.99 (0.73 - 1.35)	1.04 (0.53 - 2.03)
Apprenticeship	0.76 (0.52 - 1.10)	0.79 (0.59 - 1.07)	0.88 (0.46 - 1.68)
Mandatory	0.73 (0.45 - 1.18)	0.77 (0.53 - 1.11)	0.82 (0.36 - 1.84)
Marital status (married/cohab vs. other)	0.75 (0.57 - 0.99) *	1.07 (0.85 - 1.33)	0.81 (0.51 - 1.29)
Born in Switzerland vs. other country	1.37 (1.00 - 1.87) §	1.30 (1.02 - 1.66) *	1.23 (0.73 - 2.08)
Smoking			
Never	1 (ref.)	1 (ref.)	1 (ref.)
Former	1.22 (0.91 - 1.65)	1.31 (1.03 - 1.66) *	1.34 (0.81 - 2.21)
Current	0.75 (0.52 - 1.08)	0.92 (0.69 - 1.21)	0.88 (0.48 - 1.64)
Physically active (yes vs. no)	1.66 (1.23 - 2.24) ***	1.33 (1.06 - 1.66) *	1.84 (1.09 - 3.09) *

BMI groups			
Normal + underweight	1 (ref.)	1 (ref.)	1 (ref.)
Overweight	0.71 (0.52 - 0.98) *	1.00 (0.79 - 1.28)	0.75 (0.45 - 1.27)
Obese	0.82 (0.52 - 1.30)	0.80 (0.55 - 1.16)	0.65 (0.29 - 1.46)
Hypertension (yes vs. no)	0.77 (0.53 - 1.11)	0.91 (0.70 - 1.20)	0.96 (0.55 - 1.67)
Dyslipidemia (yes vs. no)	0.96 (0.68 - 1.35)	1.02 (0.79 - 1.33)	1.24 (0.73 - 2.10)
Diabetes (yes vs. no)	1.38 (0.69 - 2.77)	0.93 (0.51 - 1.70)	0.33 (0.04 - 2.46)

Results are expressed as relative risk ratio and (95% confidence interval). BMI, body mass index. Statistical analysis by multinomial logistic regression using never users as reference. §, p=0.051; *, p<0.05; **, p<0.01; ***, p<0.001.

ONLINE SUPPORTING MATERIAL

Supplemental table 1: comparison of baseline characteristics between included and excluded participants

	Included	Excluded	P-value
N	4676	1508	
Woman	2505 (53.6)	746 (49.5)	0.006
Age (years)	52.6 ± 10.6	54.6 ± 11.3	<0.001
Age groups (%)			<0.001
[35-45[	1362 (29.1)	384 (25.5)	
[45-55[	1365 (29.2)	393 (26.1)	
[55-65[	1288 (27.5)	418 (27.7)	
[65+	661 (14.1)	312 (20.7)	
Education (%)			<0.001
University	939 (20.1)	201 (13.4)	
High school	1185 (25.3)	283 (18.8)	
Apprenticeship	1741 (37.2)	544 (36.2)	
Mandatory	811 (17.3)	475 (31.6)	
Married/cohabiting (%)	3152 (67.4)	982 (65.3)	0.122
Born in Switzerland (%)	3164 (67.7)	838 (55.6)	<0.001
Smoking (%)			<0.001
Never	1889 (40.4)	588 (39.0)	
Former	1580 (33.8)	452 (30.0)	
Current	1207 (25.8)	466 (30.9)	
Physically active (%)	2690 (57.5)	739 (49.1)	<0.001
Body mass index (kg/m ²)	25.6 ± 4.4	26.5 ± 4.9	<0.001
BMI groups (%)			<0.001
Normal + underweight	2318 (49.6)	651 (43.2)	
Overweight	1705 (36.5)	548 (36.4)	
Obese	653 (14.0)	307 (20.4)	
Self-reported (%)			
Hypertension	1147 (24.5)	483 (32.1)	<0.001
Dyslipidemia	1087 (23.3)	383 (25.4)	0.086
Diabetes	204 (4.4)	106 (7.0)	<0.001
Vitamin supplement use (%)	963 (20.6)	274 (18.2)	0.041
Dietary supplement use (%)	486 (10.4)	128 (8.5)	0.031

Results are expressed as number of participants (percentage) or as average ± standard deviation. BMI, body mass index. Statistical analysis using chi-square or Student's t-test.

Supplemental table 2: bivariate associations between socio-demographic and clinical variables with changes in vitamin supplement use occurring between 2003-6 and 2009-12, CoLaus study, Lausanne, Switzerland.

	Never users	Initiators	Discontinuers	Continuers	P-value
N (%)	3168 (67.8)	545 (11.7)	559 (12.0)	404 (8.6)	
Woman (%)	1425 (45.0)	381 (69.9)	379 (67.8)	320 (79.2)	<0.001
Age (years)	51.6 ± 10.5 ^a	55.1 ± 10.1 ^b	51.6 ± 10.6 ^a	58.4 ± 9.4 ^c	<0.001
Age groups (%)					<0.001
[35-45[	1034 (32.6)	102 (18.7)	179 (32.0)	47 (11.6)	
[45-55[	941 (29.7)	166 (30.5)	170 (30.4)	88 (21.8)	
[55-65[	803 (25.4)	183 (33.6)	138 (24.7)	164 (40.6)	
[65+	390 (12.3)	94 (17.3)	72 (12.9)	105 (26.0)	
Education (%)					0.003
University	625 (19.7)	104 (19.1)	134 (24.0)	76 (18.8)	
High school	770 (24.3)	146 (26.8)	139 (24.9)	130 (32.2)	
Apprenticeship	1191 (37.6)	197 (36.2)	210 (37.6)	143 (35.4)	
Mandatory	582 (18.4)	98 (18.0)	76 (13.6)	55 (13.6)	
Married/cohabiting (%)	2236 (70.6)	330 (60.6)	357 (63.9)	229 (56.7)	<0.001
Born in Switzerland (%)	2094 (66.1)	387 (71.0)	385 (68.9)	298 (73.8)	0.004
Smoking (%)					0.195
Never	1266 (40.0)	233 (42.8)	225 (40.3)	165 (40.8)	
Former	1049 (33.1)	183 (33.6)	197 (35.2)	151 (37.4)	
Current	853 (26.9)	129 (23.7)	137 (24.5)	88 (21.8)	
Physically active (%)	1735 (54.8)	345 (63.3)	332 (59.4)	278 (68.8)	<0.001

Body mass index (kg/m ²)	25.9 ± 4.3 ^a	25.3 ± 4.8 ^b	24.8 ± 4.3 ^b	24.7 ± 4.5 ^b	<0.001
BMI groups (%)					<0.001
Normal + underweight	1463 (46.2)	293 (53.8)	323 (57.8)	239 (59.2)	
Overweight	1230 (38.8)	175 (32.1)	182 (32.6)	118 (29.2)	
Obese	475 (15.0)	77 (14.1)	54 (9.7)	47 (11.6)	
Self-reported (%)					
Hypertension	771 (24.3)	149 (27.3)	126 (22.5)	101 (25.0)	0.304
Dyslipidemia	727 (23.0)	120 (22.0)	120 (21.5)	120 (29.7)	0.011
Diabetes	136 (4.3)	30 (5.5)	19 (3.4)	19 (4.7)	0.377

Results are expressed as number of participants (percentage) or as mean± standard deviation. BMI, body mass index. Statistical analysis using chi-square or analysis of variance. For continuous variables, post-hoc pairwise comparisons using the method of Scheffe were performed when the results of the ANOVA were statistically significant. Results with differing subscripts are significantly different at a p<0.05 level (corrected for multiple comparisons).

Supplemental table 3: bivariate associations between socio-demographic and clinical variables with changes in dietary supplement use occurring between 2003-6 and 2009-12, CoLaus study, Lausanne, Switzerland.

	Never users	Initiators	Discontinuers	Continuers	P-value
N (%)	3951 (84.5)	239 (5.1%)	405 (8.7)	81 (1.7)	
Woman (%)	1959 (49.6)	174 (72.8)	308 (76.1)	64 (79.0)	<0.001
Age (years)	52.2 ± 10.6 ^a	53.7 ± 9.9 ^b	54.5 ± 10.2 ^b	56.5 ± 9.7 ^b	<0.001
Age groups (%)					<0.001
[35-45[	1211 (30.7)	56 (23.4)	86 (21.2)	9 (11.1)	
[45-55[	1152 (29.2)	71 (29.7)	121 (29.9)	21 (25.9)	
[55-65[	1034 (26.2)	83 (34.7)	134 (33.1)	37 (45.7)	
[65+	554 (14.0)	29 (12.1)	64 (15.8)	14 (17.3)	
Education (%)					0.285
University	788 (19.9)	54 (22.6)	82 (20.3)	15 (18.5)	
High school	975 (24.7)	72 (30.1)	115 (28.4)	23 (28.4)	
Apprenticeship	1482 (37.5)	82 (34.3)	146 (36.1)	31 (38.3)	
Mandatory	706 (17.9)	31 (13.0)	62 (15.3)	12 (14.8)	
Married/cohabiting (%)	2707 (68.5)	138 (57.7)	261 (64.4)	46 (56.8)	<0.001
Born in Switzerland (%)	2630 (66.6)	178 (74.5)	296 (73.1)	60 (74.1)	0.003
Smoking (%)					0.016
Never	1590 (40.2)	102 (42.7)	164 (40.5)	33 (40.7)	
Former	1302 (33.0)	91 (38.1)	155 (38.3)	32 (39.5)	
Current	1059 (26.8)	46 (19.3)	86 (21.2)	16 (19.8)	
Physically active (%)	2194 (55.5)	170 (71.1)	266 (65.7)	60 (74.1)	<0.001

Body mass index (kg/m ²)	25.8 ± 4.4 ^a	24.7 ± 4.7 ^b	24.9 ± 4.2 ^b	24.5 ± 4.7 ^{a, b}	<0.001
BMI groups (%)					<0.001
Normal + underweight	1897 (48.0)	148 (61.9)	224 (55.3)	49 (60.5)	
Overweight	1481 (37.5)	63 (26.4)	137 (33.8)	24 (29.6)	
Obese	573 (14.5)	28 (11.7)	44 (10.9)	8 (9.9)	
Self-reported (%)					
Hypertension	990 (25.1)	46 (19.3)	91 (22.5)	20 (24.7)	0.163
Dyslipidemia	924 (23.4)	49 (20.5)	92 (22.7)	22 (27.2)	0.612
Diabetes	180 (4.6)	10 (4.2)	13 (3.2)	1 (1.2)	NA

Results are expressed as number of participants (percentage) or as mean± standard deviation. BMI, body mass index, NA, not assessable. Statistical analysis using chi-square or analysis of variance. For continuous variables, post-hoc pairwise comparisons using the method of Scheffe were performed when the results of the ANOVA were statistically significant. Results with differing subscripts are significantly different at a p<0.05 level (corrected for multiple comparisons)

Supplemental table 4: bivariate associations between socio-demographic and clinical variables with changes in vitamin supplement use occurring between 2003-6 and 2009-12, CoLaus study, Lausanne, Switzerland.

	Never	Inconsistent	Consistent	P-value
N (%)	3168 (67.8)	1104 (23.6)	404 (8.6)	
Woman (%)	1425 (45.0)	760 (68.8)	320 (79.2)	<0.001
Age (years)	51.6 ± 10.5	53.3 ± 10.5	58.4 ± 9.4	<0.001
Age groups (%)				<0.001
[35-45[	1034 (32.6)	281 (25.5)	47 (11.6)	
[45-55[	941 (29.7)	336 (30.4)	88 (21.8)	
[55-65[	803 (25.4)	321 (29.1)	164 (40.6)	
[65+	390 (12.3)	166 (15.0)	105 (26.0)	
Education (%)				0.007
University	625 (19.7)	238 (21.6)	76 (18.8)	
High school	770 (24.3)	285 (25.8)	130 (32.2)	
Apprenticeship	1191 (37.6)	407 (36.9)	143 (35.4)	
Mandatory	582 (18.4)	174 (15.8)	55 (13.6)	
Married/cohabiting (%)	2236 (70.6)	687 (62.2)	229 (56.7)	<0.001
Born in Switzerland (%)	2094 (66.1)	772 (69.9)	298 (73.8)	0.002
Smoking (%)				0.095
Never	1266 (40.0)	458 (41.5)	165 (40.8)	
Former	1049 (33.1)	380 (34.4)	151 (37.4)	
Current	853 (26.9)	266 (24.1)	88 (21.8)	
Physically active (%)	1735 (54.8)	677 (61.3)	278 (68.8)	<0.001
Body mass index (kg/m ²)	25.9 ± 4.3	25.1 ± 4.6	24.7 ± 4.5	<0.001
BMI groups (%)				<0.001
Normal + underweight	1463 (46.2)	616 (55.8)	239 (59.2)	
Overweight	1230 (38.8)	357 (32.3)	118 (29.2)	
Obese	475 (15.0)	131 (11.9)	47 (11.6)	
Self-reported (%)				
Hypertension	771 (24.3)	275 (24.9)	101 (25.0)	0.906
Dyslipidemia	727 (23.0)	240 (21.7)	120 (29.7)	0.004
Diabetes	136 (4.3)	49 (4.4)	19 (4.7)	0.921

Results are expressed as number of participants (percentage) or as average ± standard deviation. BMI, body mass index. Inconsistent=initiating or discontinuing; consistent=continuing. Statistical analysis using chi-square or analysis of variance.

Supplemental table 5: multivariable associations between socio-demographic and clinical variables with changes in vitamin supplement use occurring between 2003-6 and 2009-12, CoLaus study, Lausanne, Switzerland, all participants.

	Inconsistent	Consistent
N	1104	404
Gender (man vs. woman)	0.38 (0.32 - 0.44) ***	0.22 (0.17 - 0.29) ***
Age groups		
[35-45[	1 (ref.)	1 (ref.)
[45-55[	1.32 (1.09 - 1.59) **	2.09 (1.44 - 3.03) ***
[55-65[	1.45 (1.19 - 1.77) ***	4.55 (3.19 - 6.50) ***
[65+	1.57 (1.22 - 2.01) ***	6.35 (4.28 - 9.44) ***
Education		
University	1 (ref.)	1 (ref.)
High school	0.87 (0.70 - 1.07)	1.02 (0.74 - 1.41)
Apprenticeship	0.79 (0.65 - 0.96) *	0.66 (0.48 - 0.91) **
Mandatory	0.69 (0.54 - 0.89) **	0.52 (0.35 - 0.77) ***
Marital status (married/cohab vs. other)	0.85 (0.73 - 0.99) *	0.78 (0.63 - 0.98) *
Born in Switzerland vs. in other country	1.10 (0.94 - 1.29)	1.23 (0.96 - 1.59)
Smoking		
Never	1 (ref.)	1 (ref.)
Former	1.13 (0.96 - 1.33)	1.29 (1.01 - 1.66)
Current	0.97 (0.81 - 1.16)	1.05 (0.79 - 1.41)
Physically active (yes vs. no)	1.17 (1.01 - 1.36) *	1.43 (1.13 - 1.82) **
BMI groups		
Normal + underweight	1 (ref.)	1 (ref.)
Overweight	0.82 (0.70 - 0.97)	0.68 (0.53 - 0.88) **
Obese	0.70 (0.55 - 0.89) **	0.64 (0.44 - 0.94) *
Hypertension (yes vs. no)	1.13 (0.94 - 1.35)	0.88 (0.67 - 1.15)
Dyslipidemia (yes vs. no)	0.98 (0.82 - 1.17)	1.34 (1.04 - 1.73) *
Diabetes (yes vs. no)	1.31 (0.92 - 1.88)	1.29 (0.75 - 2.21)

Results are expressed as relative risk ratio and (95% confidence interval). BMI, body mass index.

Inconsistent=initiating or discontinuing; consistent=continuing. Statistical analysis by multinomial logistic regression using never users as reference. *, p<0.05; **, p<0.01; ***, p<0.001.

Supplemental table 6: bivariate associations between socio-demographic and clinical variables with changes in dietary supplement use occurring between 2003-6 and 2009-12, CoLaus study, Lausanne, Switzerland.

	Never	Inconsistent	Consistent	P-value
N (%)	3951 (84.5)	644 (13.8)	81 (1.7)	
Woman (%)	1959 (49.6)	482 (74.8)	64 (79.0)	<0.001
Age (years)	52.2 ± 10.6	54.2 ± 10.1	56.5 ± 9.7	<0.001
Age groups (%)				<0.001
[35-45[	1211 (30.7)	142 (22.1)	9 (11.1)	
[45-55[	1152 (29.2)	192 (29.8)	21 (25.9)	
[55-65[	1034 (26.2)	217 (33.7)	37 (45.7)	
[65+	554 (14.0)	93 (14.4)	14 (17.3)	
Education (%)				0.139
University	788 (19.9)	136 (21.1)	15 (18.5)	
High school	975 (24.7)	187 (29.0)	23 (28.4)	
Apprenticeship	1482 (37.5)	228 (35.4)	31 (38.3)	
Mandatory	706 (17.9)	93 (14.4)	12 (14.8)	
Married/cohabiting (%)	2707 (68.5)	399 (62.0)	46 (56.8)	0.001
Born in Switzerland (%)	2630 (66.6)	474 (73.6)	60 (74.1)	0.001
Smoking (%)				0.004
Never	1590 (40.2)	266 (41.3)	33 (40.7)	
Former	1302 (33.0)	246 (38.2)	32 (39.5)	
Current	1059 (26.8)	132 (20.5)	16 (19.8)	
Physically active (%)	2194 (55.5)	436 (67.7)	60 (74.1)	
Body mass index (kg/m ²)	25.8 ± 4.4	24.8 ± 4.4	24.5 ± 4.7	<0.001
BMI groups (%)				<0.001
Normal + underweight	1897 (48.0)	372 (57.8)	49 (60.5)	
Overweight	1481 (37.5)	200 (31.1)	24 (29.6)	
Obese	573 (14.5)	72 (11.2)	8 (9.9)	
Self-reported (%)				
Hypertension	990 (25.1)	137 (21.3)	20 (24.7)	0.117
Dyslipidemia	924 (23.4)	141 (21.9)	22 (27.2)	0.497
Diabetes	180 (4.6)	23 (3.6)	1 (1.2)	NA

Results are expressed as number of participants (percentage) or as mean±standard deviation. BMI, body mass index. Inconsistent=initiating or discontinuing; consistent=continuing. Statistical analysis using chi-square or analysis of variance. NA, not assessable.

Supplemental table 7: multivariable associations between socio-demographic and clinical variables with changes in dietary supplement use occurring between 2003-6 and 2009-12, CoLaus study, Lausanne, Switzerland, all participants.

	Inconsistent	Consistent
N	644	81
Gender (man vs. woman)	0.34 (0.28 - 0.41) ***	0.30 (0.17 - 0.53) ***
Age groups		
[35-45[	1 (ref.)	1 (ref.)
[45-55[	1.43 (1.13 - 1.82) **	2.42 (1.10 - 5.35) *
[55-65[	1.76 (1.38 - 2.25) ***	4.53 (2.13 - 9.65) ***
[65+	1.40 (1.03 - 1.90) *	3.14 (1.29 - 7.62) **
Education		
University	1 (ref.)	1 (ref.)
High school	1.00 (0.78 - 1.29)	1.04 (0.53 - 2.03)
Apprenticeship	0.78 (0.61 - 1.00) *	0.88 (0.46 - 1.68)
Mandatory	0.75 (0.56 - 1.02)	0.82 (0.36 - 1.84)
Marital status (married/cohab vs. other)	0.94 (0.78 - 1.12)	0.81 (0.51 - 1.29)
Born in Switzerland vs. other country	1.33 (1.09 - 1.62) **	1.23 (0.73 - 2.08)
Smoking		
Never	1 (ref.)	1 (ref.)
Former	1.28 (1.05 - 1.55) *	1.34 (0.81 - 2.21)
Current	0.85 (0.67 - 1.07)	0.88 (0.48 - 1.64)
Physically active (yes vs. no)	1.44 (1.19 - 1.73) ***	1.84 (1.09 - 3.09) *
BMI groups		
Normal + underweight	1 (ref.)	1 (ref.)
Overweight	0.89 (0.73 - 1.08)	0.75 (0.45 - 1.27)
Obese	0.81 (0.60 - 1.09)	0.65 (0.29 - 1.46)
Hypertension (yes vs. no)	0.86 (0.69 - 1.08)	0.96 (0.55 - 1.67)
Dyslipidemia (yes vs. no)	1.00 (0.80 - 1.24)	1.24 (0.73 - 2.10)
Diabetes (yes vs. no)	1.09 (0.68 - 1.74)	0.33 (0.04 - 2.46)

Results are expressed as relative risk ratio and (95% confidence interval). BMI, body mass index.

Inconsistent=initiating or discontinuing; consistent=continuing. Statistical analysis by multinomial logistic regression using never users as reference. *, p<0.05; **, p<0.01; ***, p<0.001.