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Longitudinal Study of Self-Rated health among Migrants of the CoLaus study in French-speaking Switzerland, 2003-2017.

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3 **1 Longitudinal Study of Self-Rated health among Migrants**
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5 **2 of the CoLaus study in French-speaking Switzerland, 2003-2017.**
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7 **3 Mota P^{1*}, Saez M^{2,3}, Selby K⁴, Bodenmann P.^{1,4}**
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10 **4**
11 **5 * corresponding author:**
12 **6**

13 **7 Department of Vulnerabilities and Social Medicine,**
14 **8 University Center for General Medicine and Public Health**
15 **9 44, Rue du Bugnon. CH – 1011 Lausanne, Switzerland**
16 **10 Phone: +41787708423**
17 **11 Email: paumotamoya@gmail.com**
18 **12**

19
20
21 **13 1. Department of Vulnerabilities and Social Medicine, University Center for General Medicine**
22 **14 and Public Health, Lausanne, Switzerland.**
23 **15**

24 **16 2. Research Group on Statistics, Econometrics and Health (GRECS), University of**
25 **17 Girona, Girona, Spain.**

26 **18 3. CIBER of Epidemiology and Public Health (CIBERESP), Madrid, Spain**

27
28 **19 4. Department the Polyclinics, University Center for General Medicine and Public Health,**
29 **20 Lausanne, Switzerland.**
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33 **21**
34
35 **22**
36
37 **23 Email addresses:**
38

39 **24 Mota P: paumotamoya@gmail.com**
40

41 **25 Saez M: marc.saez@udg.edu**
42

43 **26 Selby K: kevin.selby@hospvd.ch**
44

45 **27 Bodenmann P: patrick.bodenmann@hospvd.ch**
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ABSTRACT

Introduction: Studies have documented poorer health among migrants than natives of several European countries, but little is known for Switzerland. **Aim:** To assess the association between self-reported health, country of birth, socio-economic factors and poor health in a prospective cohort of adults living in Lausanne, Switzerland. **Design:** We used the data from the Colaus prospective study for three periods: 2003-6 (n=6733), 2009-12 (n=5064) and 2014-17 (n=4555). The response variable was self-reported health (SRH). Main explanatory variables were socioeconomic status, educational level, professional status, income, gender, age and years in Switzerland. The main covariate was country of birth, dichotomized as born in Switzerland or not. **Method:** we specified random effects logistic regressions and used Bayesian methods for the inference. **Results:** Being born outside of Switzerland was not associated with worse SRH (OR 1.09 (95%CI 0.52-2.31)). Several other patient variables were, however, predictive of poor health. Educational level was inversely associated with the risk of reporting poor health. Monthly household income showed a gradient where higher income was associated with lower odds of reporting poor SRH, for both for migrants and non-migrants. Migrant women had lower odds of reporting poor SRH than men (OR=0.73, CI=0.55-0.98). Migrant people living in couple have less risk of reporting poor SRH than people who live alone and the risk is lower for migrant people living in couple with children (OR=0.66, 95% CI=0.55-0.80). **Conclusions:** Migrant status was not associated with poorer SRH. However, differences in SRH were observed based on gender, age and several social determinants of health.

Keywords

Migration, self-rated health, social determinants of health, longitudinal study.

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3 53 **Article Summary**
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5 54 **Strengths and limitations of this study**
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- 7
- 8 55 • First cohort study where we compare SRH between migrants and non-migrants populations
9 in Switzerland.
10 56
 - 11 57 • The strengths of this study are the size of the sample and the rigorous collection of data.
12
 - 13 58 • Another strengths are the advanced statistical approaches that made it possible to control
14 both measured and unmeasured confounding factors.
15 59
 - 16 60 • Among the weaknesses, the predominant migration groups included in this study may be
17 more similar to those born in Switzerland than more recent migrant groups particularly.
18 61
 - 19 62 • The complex modelling used in this study generates large confidence intervals makes it
20 more difficult to exclude a small influence of the country of birth.
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34 66 **Word count: 2373**
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68 **Introduction**

69 Differences in Self-Rated Health (SRH) between migrants and natives have been documented in
70 several European countries but not yet in Switzerland (1–4). SRH is a well-established indicator
71 used in epidemiology and public health research and has been fully documented to be an
72 independent predictor of health outcomes such as morbidity and mortality (5–9). Numerous studies
73 in European countries have reported that in regard to SRH, most migrant and ethnic minority groups
74 studied appear, on average, to have lower health status compared with the majority population
75 (6,7,10,11). Moreover, SRH appears to be associated with the patient's mental health (12–16).

76
77 However, it is also possible that differences in health status are attributable to migrants being of
78 lower socio-economic status than non-migrants populations within a same society and this is a key
79 factor to be taken into account in a comparative analysis of SRH (19). The scientific evidence of
80 the social determinants of health (SDH) is well-known (17–19). Socioeconomic status is linked to
81 overall health status not simply through the direct physical effects of exposure to better or worse
82 material conditions, it is also a matter of position in the social hierarchy (17,18). The migratory
83 process often leads to a period of vulnerability to arrival in the host country as well as a sharp change
84 in the socio-economic status that have an impact on health condition.. Some authors even consider
85 the migratory process as a SDH (20).

86
87 Our main objective was to investigate differences in SRH of migrants compared to non-migrants in
88 a representative cohort of Swiss adults followed for 10+ years. We focus on migrants as people born
89 outside Switzerland and we analysed differences on country of birth and years living in the country.

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3 90 We focus on SDH and the specific characteristics of migrant Cohort patients compared to
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5 91 individuals who have not experienced a migration process (21–26).
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10 11 93 **Method**

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13 94 We used data from the Colaus cohort in Lausanne, Switzerland, and from the PsyCoLaus study, a
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15 95 subsample from the larger CoLaus study focus on mental health. The CoLaus cohort is a population-
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17 96 based study designed to assess the prevalence and determinants of cardiovascular risk factors and
18
19 97 diseases in Lausanne, a city of 145,000 inhabitants of whom 62,000 (43%) were born outside of
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21 98 Switzerland. Its aims and sampling strategy have been reported previously (27).
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25 99 The source population was defined as all subjects aged between 35 and 75 years registered in the
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27 100 population register of the city. A simple, non-stratified random sample of 19,830 subjects
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29 101 (corresponding to 35% of the source population) was drawn and the selected subjects were invited
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31 102 to participate. The inclusion criteria were to sign the written informed consent and the willingness
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33 103 to take part in the examination.
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38 105 Recruitment was performed between 2003 and 2006 and included 6733 participants. The first
39
40 106 follow-up visit was conducted between April 2009 and September 2012 and included 5064
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42 107 participants; the second follow-up was conducted between May 2014 and April 2017 and included
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44 108 4555 participants. The first and second follow-ups included all participants willing to be re-
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46 109 contacted. For this study, data from baseline study and both follow-up examinations was used.
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52 111 The response variable is SRH from self reported Likert scale that we transformed into a dichotomic
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54 112 variable. The following categories: very good and good transformed as a single variable -good
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3 113 health- and categories fair, bad and very bad transformed as a single variable -poor health-. We also
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5 114 considered the mental health as a dependent or response variable through 3 main different indicators
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8 115 (each categorized as present or absent (1 or 0 respectively): Anxiety disorders (General anxiety,
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10 116 trouble panic, social phobia, agoraphobia, other), Depressive disorders (atypical depressive
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12 117 disorder, depressive disorder, other) and the Post-Traumatic Stress Disorder (PTSD). The remaining
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14
15 118 participants born in other countries were grouped in a single category (n=1191).

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17 119
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19 120 The main explanatory variables are being born outside Switzerland, the country of birth and the
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21 121 years living in Switzerland. We include interactions between being born abroad and the years living
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23 122 in Switzerland with all explanatory variables. The control variables were gender, age, the Socio
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25 123 Economic Status (SES) following the Hollingshead scale, the educational level, job type, current
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27 124 professional status, monthly household gross income and alcohol consumption.

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33 126 We compared individuals by using Student's t-test and the Mann-Whitney U test for quantitative
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35 127 variables and Pearson's chi-square for qualitative variables. For the multivariable analysis, we used
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37 128 a Generalized Linear Mixed Model (GLMM) with binomial response and a logistic link,

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$$\log \left(\frac{\text{Pr ob}(Y_{it} = 1)}{1 - \text{Pr ob}(Y_{it} = 1)} \right) = \eta_{it}$$

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48
49 133 where Y corresponds to the response variable, i the individual studied, t the year of the follow-up,
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51 134 and η_{it} a linear predictor for the subject i and the year of follow-up t . We included in the linear
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53 135 predictor of each individual in the logistic model, the explanatory variables of interest that could

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3 136 explain the probability of being a case (i.e. poor SRH, presence of an anxiety disorder, presence of
4
5 137 a depressive disorder or presence of a PTSD).
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10 139 The interactions between the variables "country of birth" and "number of years of life lived in
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12 140 Switzerland" and the rest of the variables was also tested. In addition, we checked for the
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14 141 confounding factors observed (including all control variables) and those possibly not measured by
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16 142 the available data. These have been highlighted by including several random effects in the linear
17
18 143 prediction. In particular, we checked the presence of heterogeneity of individuals (i.e. variables that
19
20 144 were not initially observed, did not change over time and were specific to each person). We also
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22 145 accounted for possible temporal heterogeneity by including a random effect of order (28).
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28 147 The reduced number of cases (i.e. poor SRH, presence of an anxiety disorder, presence of depressive
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30 148 disorder, and presence of PTSD) reduced the statistical power to demonstrate differences between
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32 149 groups. To increase any the statistical power - not increasing the sample size - we increased the
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34 150 level of significance (i.e. alpha), reducing the likelihood of making a Type II error while increasing
35
36 151 statistical power. Given the complexity of our model, we preferred to make the inferences using a
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38 152 Bayesian conceptual framework. This model allowed as to incorporate several levels of uncertainty
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40 153 in our reported credibility intervals, including model uncertainty, missing data and unobserved
41
42 154 confounding. In particular, we used the Integrated Nested Laplace Approach (INLA) in a pure
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44 155 Bayesian conceptual framework (29).
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49 156 Apart from the odds ratios (OR) and their credibility intervals at 95% (95% ICr), the probability of
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51 157 the parameter estimator (the log(OR) as an absolute value being more than 1 (Prob) is also shown
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53 158 (note that it is unilateral and so does not necessarily have to coincide with the ICr in all the cases).
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3 159 Unlike the p-value in a usual environment, this probability allows us to make inferences about the
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5 160 possible association.
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8 161 All analyses were performed with the free software R (version3.5.1) through the INLA approach
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10 162 (28–31).
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12 163 *Patient and Public Involvement*

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14 164 No patient involved in the study
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20 166 **Results**

21
22 167 Table 1 shows descriptive statistics for all variables included. Our sample included mainly people
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24 168 from Switzerland (n= 4031, 60%), France (n=447, 6.6%), Italy (n=409, 6.1%), Portugal (n=391,
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26 169 5.8%), Spain (n=262, 3.9%), and 1191 from all other countries (18%) (See table 1, 2).
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30 170 In unadjusted analyses, people born outside Switzerland reported having worse SRH during the
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32 171 second and third CoLaus waves ($p < 0.001$ for both waves). Nevertheless, in models adjusting for
33
34 172 other participant characteristics, we did not find a statistically significant difference for SRH among
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36 173 the migrant and non-migrant populations. This result implies that other factors might explain
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38 174 observed differences in SRH.
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42 175 Older age groups were more likely to report poor health than younger age groups, with stronger
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44 176 associations among those from certain countries. All individuals aged 55 to 64 years had 44%
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46 177 greater odds (OR = 1.44, 95% Credibility interval, CrI = 0.97-2.15) of reporting poor health than
47
48 178 younger populations. Interactions between country of birth and years of residence in Switzerland
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50 179 showed that those born in France and living in Switzerland for 54 years had a 121% higher risk of
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52 180 reporting poor health (OR = 2.21, CrI to 95% = 0.94-5.19) than those born in France and living in
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3 181 Switzerland for 32 years. The same pattern was found among people born in Spain who have lived
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5 182 in Switzerland for 54 years. They were 146% more likely to report health problems (OR = 2.46,
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7 183 95% CrI = 0.87-6.98) than those born in Spain and living in Switzerland for less than 32 years.
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11 184 There was a gradient in health status by level of education. The higher the level of education, the
12
13 185 better the SRH among both migrant and non-migrant populations. Those with the level of an
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15 186 apprenticeship had 33% less risk (OR = 0.66, 95% CrI = 0.49-0.90) of reporting poor health when
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17 187 compared to those with compulsory education only. Those with a high school education were 37%
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19 188 less likely and those with a higher education level 60% less likely to report poor health (OR = 0.40,
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21 189 95% CrI 0.42) -0.92) than those with compulsory schooling. This is important since 33% of the
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23 190 migrant population had only a compulsory education compared to 13% of the Swiss born.
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28 191 The monthly household income also showed a gradient in health status. Households with a monthly
29
30 192 gross income between CHF 7,000 and CHF 9,499 were 32% less likely to report poor SRH than
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32 193 households with incomes below CHF 3,000. Households with a monthly income greater than CHF
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34 194 13'000 had a 45% lower risk of (OR = 0.55, 95% CrI = 0.28-1.06) describing a poor SRH. This
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36 195 monthly income gradient was the same for migrant's households. We found significant different
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38 196 effects for the current profession for both migrant and non-migrant populations. A Swiss born with
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40 197 a liberal profession had a 62% lower risk of reporting poor SRH (OR = 0.38, 95% CrI = 0.16-0.91)
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42 198 than a manual labourer; in contrast migrants with a liberal profession the risk of reporting poor
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44 199 health was. Indeed, we found that migrants with a liberal profession (doctor or lawyer) had 152%
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46 200 higher risk of describing a poor SRH (OR = 2.52, CrI to 95% = 0.91 to 6.96) than manual labourer.
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51 201 For the group of people born in Switzerland, all categories of civil status had the same risk of
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53 202 perceiving poor SRH as people living alone. However, childless migrant couples were 22% less
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3 203 likely (OR = 0.78, 95% CrI = 0.67-0.92) to report poor SRH than those living alone and migrant
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5 204 couples with children were 34% less likely (OR = 0.66, 95% CrI = 0.55-0.80) of perceived poor
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8 205 SRH than people living alone. The interaction between country of birth and couple with children
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10 206 was also statistically significant, and a foreign-born couple with children was at 41% lower risk of
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12 207 poor SRH health (OR = 0.59, 95% CrI = 0.40-0.87) than people living alone.
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15 208 There was no association between the risk of having a psychiatric illness (major depressive disorder,
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17 209 generalized anxiety disorder, panic disorder, social phobia, PTSD or agoraphobia) and belonging
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20 210 to the migrant group. Habitual alcohol consumers had 37% less risk of SRH (OR = 0.63, 95% CrI
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22 211 = 0.51-0.78) than non-consumers (p = 0.999) and this pattern was the same for both groups.
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27 28 213 **Discussion**

29 30 214 *Summary*

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33 215 Studies in other European countries have shown that migrants often have poorer health than non-
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35 216 migrants. However, no longitudinal studies have compared the self-reported health (SRH) of
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38 217 migrants and non-migrants SRH in Switzerland. In this study, we focused on the migrant / non-
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40 218 migrant populations of the CoLaus cohort and their SRH.
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44 45 46 220 *Comparison with existing literature*

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49 221 Scientific literature has shown that a perceived poor SRH is correlated with greater morbidity and
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51 222 mortality. In addition, studies in other European countries have shown that, with regard to SRH,
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3 223 most of the groups of migrants and ethnic minorities report poorer health than local and non-migrant
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5 224 populations (6,7,10,11). This was also the case in our unadjusted results (See table 3, 4, 5).
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8 225 However, in our statistical model with a complete adjustment of both measured and unmeasured
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10 226 confounding factors, we found no statistically significant difference in SRH between those born
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12 227 outside of Switzerland and in Switzerland. Instead, several SDH and some socio-demographic
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14 228 characteristics appeared to be stronger explanatory variables for SRH than migrant / non-migrant
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16 229 status. In particular, there is a gradient for the level of education and for the monthly income,
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18 230 regardless of the migration status. These gradients are found in other countries, although the strength
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20 231 of the relationship varies somewhat across countries, for different age groups, by health measures
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22 232 used, and by sex of collectives (31,32).
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28 233 On the mental health aspects, although migration is often seen as a risk factor contributing to
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30 234 psychopathology and this psychopathology may have an adverse impact on SRH, in this study, the
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32 235 risk of presenting a severe psychiatric illness was not greater among migrants (33–35).
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35 236 Finally, in the population born in Switzerland, all categories of civil status have the same risk of
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37 237 reporting poor SRH as people living alone. However, childless migrant couples were less likely to
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39 238 report poor SRH than people living alone, and this risk was even lower for migrant couples with
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41 239 children. This is also reflected in the literature, where migrant women are described as a key player
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43 240 in health - for their health, as well as of their children and their families - single migrants are more
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45 241 likely to view their health as poor both men and women, than those who were married or in a
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47 242 common-law relationship (33–35).
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52 243 The strengths of this study are the size of the sample, the rigorous collection of data and the
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54 244 advanced statistical approaches that made it possible to control both measured and unmeasured
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3 245 confounding factors. Among the weaknesses, the predominant migration groups included in this
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5 246 study (from other European countries and often >25 years in Switzerland) may be more similar to
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7
8 247 those born in Switzerland than more recent migrant groups particularly with regard to SRH. Finally,
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10 248 the complex modelling used in this study generates large confidence intervals makes it more
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12 249 difficult to exclude a small influence of the country of birth.
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19 251 *Implications for Research and/or practice*
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22 252 This is a first Swiss cohort study where we compare SRH between migrants and non-migrants
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24 253 populations in Switzerland. After controlling for various factors, we did not observe a difference in
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26 254 SRH based on migrant status. Several markers of socio-economic status were strongly associated
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29 255 with SRH and may explain population-level differences in SRH. The implication in practice is to
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31 256 target these factors when delivering care to migrant populations.
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40 259 **Abbreviations**
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42 260 Self-Rated Health (SRH)
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44 261 Social determinants of health (SDH)
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46 262 Post-Traumatic Stress Disorder (PTSD)
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48 263 Socio Economic Status (SES)
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50 264 Generalized Linear Mixed Model (GLMM)
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52 265 Integrated Nested Laplace Approach (INLA)
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8 **268 Declarations**9
10 **269 Ethics approval and consent to participate**11
12 270 The institutional Ethics Committee of the University of Lausanne, which afterwards became the13
14 271 Ethics Commission of Canton Vaud (www.cer-vd.ch) approved the first (reference 33/09, decision15
16 272 of 23rd February 2009) and the second (reference 26/14, decision of 11th March 2014) follow-ups.17
18 273 The study was performed in agreement with the Helsinki declaration and its former amendments.19
20 274 All participants gave their signed informed consent before entering the study.21
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27 **276 Consent to publish**28
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30 277 All participants gave their consent to publish.31
32 27833
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35 **279 Availability of data and materials**36
37 280 CoLaus study (<https://www.colaus-psycholaus.ch/>).38
39 28140
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42 **282 Competing interests**43
44 283 The authors declare that they have no competing interests.45
46 28447
48
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51 286 No additional funding was required for this research.52
53 287

288 **Author contributions**

289 MP had the research proposal and wrote most of the article. MS made the statistical analyses. KS
290 revised the article for important intellectual content. PB have full access to the data. PB is the
291 guarantor of the study.

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Tables & Figures

	Period 1 2003-2006 (n=6,733)	Period 2 2009-2012 (n=5,064)	Period 3 2014-2017 (4,881)
Variable	N (%)	N (%)	N (%)
Self-reported Health Status (Good or Very Good)	-	4,164 (82%)	3,743 (78%)
Fair, Poor or Very Poor	-	873 (17%)	1,088 (22%)
Country of birth (Other than Switzerland)	2,700 (40%)	1,880 (37%)	1,818 (37%)
Switzerland	4,031 (60%)	3,184 (63%)	3,062 (63%)
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)	271 (4%)	130 (3%)	-
21-39	658 (10%)	386 (8%)	-
30-39	1027 (15%)	781 (15%)	-
40-54	982 (15%)	905 (18%)	-
=>55	781 (12%)	624 (12%)	-
Missing	3,014 (45%)	2,238 (44%)	
Educational level (Mandatory education)	1,397 (21%)	878 (17%)	839 (17%)
Apprenticeship	2,377 (35%)	1,796 (35%)	1,749 (36%)
High school	1,625 (24%)	1,306 (26%)	1,258 (26%)
University education	1,320 (20%)	1,079 (21%)	1,031 (21%)
Job type (High)	803 (12%)	458 (9%)	476 (11%)
Middle	2662 (40%)	1,111 (22%)	714 (16%)
Low	1306 (19%)	1,479 (29%)	939 (22%)
Not working	1945 (29%)	1,772 (35%)	2,205 (51%)
Current situation (living alone)	-	1,414 (28%)	1,286 (30%)

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	Single parent family	-	285 (6%)	228 (5%)
	Couple without children	-	1,757 (35%)	1,508 (35%)
	Couple with children	-	1,547 (31%)	1,074 (25%)
	Missing	-	61 (1%)	238 (5%)
	Current professional status (Manoeuvre)	-	207 (4%)	138 (3%)
	Qualified worker	-	249 (5%)	194 (4%)
	Farmer	-	7 (0.1%)	8 (0.2%)
	Non qualified employee	-	262 (5%)	147 (3%)
	Qualified employee (f.e. secretary)	-	781 (15%)	543 (11%)
	Low manager	-	789 (16%)	247 (5%)
	Middle manager	-	335 (7%)	515 (11%)
	Top manager	-	262 (5%)	363 (7%)
	Liberal professional (medical doctor, lawyer)	-	197 (4%)	145 (3%)
	Not employed or missing	-	1,975 (39%)	2,581 (53%)
	Monthly household gross income (<2.999 CHF)	-	-	253 (6%)
	3000-4999 CHF	-	-	656 (15%)
	5000-6999 CHF	-	-	792 (18%)
	7000-9499 CHF	-	-	715 (17%)
	9500-13000 CHF	-	-	543 (13%)
	> 13000 CHF	-	-	466 (11%)
	Refused or missing	-	-	909 (21%)
	Do you currently drink alcohol (no)	1505 (22%)	878 (17%)	939 (19%)
	Yes	5221 (78%)	4123 (82%)	3,419 (70%)
	Missing	7 (0.1%)	63 (1%)	523 (11%)
	Gender (Man)	3,189 (47%)	2,357 (47%)	2,193 (45%)
	Women	3,544 (53%)	2,707 (53%)	2,688 (55%)
	Age category (0-44 years)	1,987 (30%)	-	-
	45-54 years	1,967 (29%)	-	-
	55-64 years	1,778 (26%)	-	-
	65-74 years	988 (15%)	-	-
	> 75 years	13 (0.2%)	-	-
	How many years have you lived in Switzerland (<25 years)	1,389 (21%)	-	-
	25-39 years	1,274 (19%)	-	-
	40-48 years	1,407 (21%)	-	-
	49-59 years	1,230 (18%)	-	-
	60-75 years	1,284 (19%)	-	-

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391 Table 1. Descriptive statistics of demographic characteristics and variables for the three periods analyzed.
392 It should be noted that several variables have missing data for one or two waves of CoLaus. This has been
393 taken into account in the context of the Bayesian analysis which takes into account the missing values in
394 the treatment of uncertainty.
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Time period	Group	Self-reported health status				
		Very good	Good	Fair	Poor	Very poor
Period 2 2009-2012	Born in Switzerland	838 (26%)	1,870 (59%)	416 (13%)	38 (1%)	4 (0.1%)
	Born in another country	381 (20%)	1,075 (57%)	362 (19%)	44 (2%)	9 (0.5%)
Period 3 2014-2017	Born in Switzerland	702 (23%)	1,731 (57%)	537 (18%)	54 (2%)	6 (0.2%)
	Born in another country	330 (18%)	979 (54%)	429 (24%)	56 (3%)	6 (0.3%)

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Table 2. Proportions of SHR during waves 2 (2009-2012) and 3 (2014-2017), stratified by place of birth (non-migrants = born in Switzerland vs. migrants = born in another country). The very good and good categories (perceived health status) were transformed into a single variable - good health - and the average, poor and very poor health categories perceived as a second variable - poor health -

Self Rated Health	OR (95% Credibility interval)	Prob(log(OR))>0
Country of birth (Other than Switzerland)		
Switzerland	1.09(0.52-2.31)	0.5932
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	0.92(0.65-1.30)	0.6821
30-39	1.11(0.81-1.51)	0.7439
40-54	0.83(0.60-1.14)	0.8754
=>55	0.82(0.55-1.20)	0.8479
Educational level (Mandatory education)		
Apprenticeship	0.67(0.49-0.90)	0.9960*
High school	0.63(0.45-0.84)	0.9992*
University education	0.40(0.28-0.58)	0.9999*
Job type (High)		
Middle	0.58(0.35-0.95)	0.9853*
Low	0.60(0.41-0.88)	0.9958*
Not working	0.62(0.42-0.92)	0.9917*
Current situation (living alone)		

Single parent family	1.17(0.78-1.78)	0.7758
Couple without children	0.84(0.64-1.09)	0.9115
Couple with children	0.89(0.68-1.16)	0.8084
Current professional status (manoeuvre)		
Qualified worker	0.81(0.45-1.45)	0.7646
Farmer	0.58(0.04-7.49)	0.6631
Non-qualified worker (office assistant)	1.09(0.70-1.70)	0.6530
Qualified employee (f.e. secretary)	0.90(0.61-1.32)	0.7119
Low manager	0.94(0.59-1.49)	0.6063
Middle manager	1.03(0.62-1.69)	0.5382
Top manager	1.13(0.85-1.51)	0.7991
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.04(0.73-1.47)	0.5761
5000-6999 CHF	1.01(0.70-1.46)	0.5187
7000-9499 CHF	0.68(0.45-1.02)	0.9690*
9500-13000 CHF	1.21(0.76-1.92)	0.7886
> 13000 CHF	0.55(0.29-1.06)	0.9640*
Do you currently drink alcohol (no)		
Yes	0.63(0.51-0.79)	0.9999*
Gender (Man)		
Women	1.28(1.02-1.60)	0.9850*
Age category (0-45 years)		
45-54 years	1.17(0.82-1.68)	0.8047
55-64 years	1.44(0.97-2.15)	0.9643*
65-74 years	1.29(0.82-2.04)	0.8667
> 75 years	1.17(0.67-2.06)	0.7130
How many years have you been living in Switzerland (First quintile <32 years)		
Second quintile	0.92(0.72-1.18)	0.7364
Third quintile	0.92(0.70-1.22)	0.7108
Fourth quintile	0.93(0.68-1.28)	0.6691

Fifth quintile	1.03(0.68-1.57)	0.5552
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Table 3. Results of the mixed models of the explanatory variables for the perceived health of the entire cohort.

Self Rated Health	OR (95% Credibility interval)	Prob(log(OR))>0
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	1.04(0.63-1.73)	0.5646
30-39	0.94(0.63-1.39)	0.6305
40-54	1.18(0.78-1.77)	0.7817
=>55	1.22(0.74-2.03)	0.7812
Educational level (Mandatory education)		
Apprenticeship	0.97(0.65-1.46)	0.5584
High school	0.97(0.63-1.49)	0.5622
University education	1.15(0.68-1.93)	0.6961
Job type (High)		
Middle	1.45(0.75-2.78)	0.8664
Low	1.36(0.82-2.25)	0.8807
Not working	1.30(0.74-2.29)	0.8202
Current situation (living alone)		
Single parent family	0.82(0.46-1.47)	0.7483
Couple without children	0.93(0.67-1.29)	0.6620
Couple with children	0.59(0.40-0.87)	0.9965*
Current professional status (manoeuvre)		
Qualified worker	1.24(0.49-3.13)	0.6780
Farmer	1.59(0.05-52.74)	0.6009
Non-qualified worker (office assistant)	0.81(0.39-1.66)	0.7221
Qualified employe (f.e. secretary)	0.91(0.53-1.57)	0.6357
Low manager	0.97(0.53-1.78)	0.5354
Middle manager	0.62(0.31-1.25)	0.9117
Top manager	0.99(0.69-1.45)	0.5033

Liberal professional (medical doctor, lawyer)	2.52(0.91-6.96)	0.9623
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.30(0.81-2.10)	0.8636
5000-6999 CHF	1.24(0.78-1.99)	0.8177
7000-9499 CHF	1.39(0.82-2.37)	0.8876
9500-13000 CHF	0.92(0.51-1.68)	0.6051
> 13000 CHF	1.24(0.56-2.74)	0.7032
Do you currently drink alcohol (no)		
Yes	1.01(0.75-1.34)	0.5188
Gender (Man)		
Women	0.73(0.55-0.98)	0.9826*
Age category (0-45 years)		
45-54 years	0.80(0.46-1.40)	0.7833
55-64 years	0.62(0.33-1.15)	0.9363
65-74 years	0.45(0.22-0.92)	0.9862*
> 75 years	0.75(0.35-1.63)	0.7673

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408 Table 4. Results of the mixed models of the explanatory variables for the perceived health of people born
409 in Switzerland.
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Self Rated Health	OR (95% Credibility interval)	Prob(log(OR))>0
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	1.04(0.63-1.73)	0.5646
30-39	0.94(0.63-1.39)	0.6305
40-54	1.18(0.78-1.77)	0.7817
=>55	1.22(0.74-2.03)	0.7812
Educational level (Mandatory education)		
Apprenticeship	0.97(0.65-1.46)	0.5584
High school	0.97(0.63-1.49)	0.5622
University education	1.15(0.68-1.93)	0.6961
Job type (High)		

Middle	1.45(0.75-2.78)	0.8664
Low	1.36(0.82-2.25)	0.8807
Not working	1.30(0.74-2.29)	0.8202
Current situation (living alone)		
Single parent family	0.82(0.46-1.47)	0.7483
Couple without children	0.93(0.67-1.29)	0.6620
Couple with children	0.59(0.40-0.87)	0.9965*
Current professional status (manoeuvre)		
Qualified worker	1.24(0.49-3.13)	0.6780
Farmer	1.59(0.05-52.74)	0.6009
Non-qualified worker (office assistant)	0.81(0.39-1.66)	0.7221
Qualified employe (f.e. secretary)	0.91(0.53-1.57)	0.6357
Low manager	0.97(0.53-1.78)	0.5354
Middle manager	0.62(0.31-1.25)	0.9117
Top manager	0.99(0.69-1.45)	0.5033
Liberal professional (medical doctor, lawyer)	2.52(0.91-6.96)	0.9623
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.30(0.81-2.10)	0.8636
5000-6999 CHF	1.24(0.78-1.99)	0.8177
7000-9499 CHF	1.39(0.82-2.37)	0.8876
9500-13000 CHF	0.92(0.51-1.68)	0.6051
> 13000 CHF	1.24(0.56-2.74)	0.7032
Do you currently drink alcohol (no)		
Yes	1.01(0.75-1.34)	0.5188
Gender (Man)		
Women	0.73(0.55-0.98)	0.9826*
Age category (0-45 years)		
45-54 years	0.80(0.46-1.40)	0.7833
55-64 years	0.62(0.33-1.15)	0.9363
65-74 years	0.45(0.22-0.92)	0.9862*
> 75 years	0.75(0.35-1.63)	0.7673

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412
413 Table 5. Results of the mixed models of the explanatory variables for the perceived health of people born
414 outside of Switzerland.

For peer review only

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	Lines: 1-2 Lines: 30-48
Introduction		
Background/rationale	2	Lines: 69-85
Objectives	3	Lines: 87-91
Methods		
Study design	4	Lines: 37-38
Setting	5	Lines 94-109
Participants	6	Lines: 99-103 Not applicable
Variables	7	Lines: 111-124
Data sources/ measurement	8*	Lines: 126-145
Bias	9	Lines 139-145
Study size	10	Lines:147-155
Quantitative variables	11	Lines:126-145
Statistical methods	12	Lines 126-162 Lines: 139-145 Lines: 126-137 Lines: 126-162 Lines: 147-160
Results		
Participants	13*	Lines: 167-169 Not Applicable Not Applicable
Descriptive data	14*	Lines: 167-169 Tables 1 and 2 Tables 1 and 2
Outcome data	15*	Report numbers of outcome events or summary measures over time
Main results	16	Lines: 170-211 Not Applicable Not Applicable
Other analyses	17	Not Applicable
Discussion		
Key results	18	Lines:220-249
Limitations	19	Lines_245-249
Interpretation	20	Lines:251-259
Generalisability	21	Lines:251-259
Other information		
Funding	22	Line:286

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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1 **Longitudinal Panel Data Study of Self-Rated health among Migrants**
2 **in French-speaking Switzerland, 2003-2017.**

3 Mota P^{1*}, Saez M^{2,3}, Selby K⁴, Bodenmann P.^{1,4}

4
5 * corresponding author:

6
7 Department of Vulnerabilities and Social Medicine,
8 University Center for General Medicine and Public Health
9 44, Rue du Bugnon. CH – 1011 Lausanne, Switzerland
10 Phone: +41787708423
11 Email: paumotamoya@gmail.com
12

13 1. Department of Vulnerabilities and Social Medicine, University Center for General Medicine
14 and Public Health, Lausanne, Switzerland.

15
16 2. Research Group on Statistics, Econometrics and Health (GRECS), University of
17 Girona, Girona, Spain.

18 3. CIBER of Epidemiology and Public Health (CIBERESP), Madrid, Spain

19 4. Department of the Polyclinics, University Center for General Medicine and Public Health,
20 Lausanne, Switzerland.

21
22 Email addresses:

23 Mota P: paumotamoya@gmail.com

24 Saez M: marc.saez@udg.edu

25 Selby K: kevin.selby@hospvd.ch

26 Bodenmann P: patrick.bodenmann@hospvd.ch
27

Abstract

Introduction: Studies have documented poorer health among migrants than natives of several European countries, but little is known for Switzerland. We assessed the association between country of birth, socio-economic factors and self-reported health in a prospective cohort of adults living in Lausanne, Switzerland.

Methods: We used the data from the Colaus panel data study for three periods: 2003-6 (n=6733), 2009-12 (n=5064) and 2014-17 (n=4555) corresponding to 35% of the source population. The response variable was self-reported health (SRH). Main explanatory variables were socioeconomic status, educational level, professional status, income, gender, age and years in Switzerland. The main covariate was country of birth, dichotomized as born in Switzerland or not. We specified random effects logistic regressions and used Bayesian methods for the inference.

Results: Being born outside of Switzerland was not associated with worse SRH (OR 1.09 (95%CI 0.52-2.31)). Several other patient variables were, however, predictive of poor health. Educational level was inversely associated with the risk of reporting poor health. Monthly household income showed a gradient where higher income was associated with lower odds of reporting poor SRH, for both for migrants and non-migrants. Migrant women had lower odds of reporting poor SRH than men (OR=0.73, CI=0.55-0.98). Migrant people living in couple have less risk of reporting poor SRH than people who live alone and the risk is lower for migrant people living in couple with children (OR=0.66, 95% CI=0.55-0.80).

Conclusions: Migrant status was not associated with poorer SRH. However, differences in SRH were observed based on gender, age and several social determinants of health.

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Keywords: migration, self-rated health, social determinants of health, longitudinal study.

51 **Article summary**

52 *Strengths and limitations of this study*

- 53 • The strengths of this study are the large size of the sample and rigorous collection of data.
- 54 • Among the weaknesses, the predominant migration groups included in this study (from other
55 European countries and often >25 years in Switzerland) may be more similar to those born
56 in Switzerland, limiting the generalizability of the results.
- 57 • The lack of recent migrants in the sample is one of the main limitations of the current study.

59 **Introduction**

60 Differences in Self-Rated Health (SRH) between migrants and natives have been documented in
61 several European countries but not yet in Switzerland (1–4). SRH is a well-established indicator
62 used in epidemiology and public health research and is an independent predictor of health outcomes
63 such as morbidity and mortality (5–9). Numerous studies in European countries have reported that
64 in regard to SRH, most migrant and ethnic minority groups studied appear, on average, to have
65 lower health status compared with the majority population (6,7,10,11). Moreover, SRH appears to
66 be associated with patient's mental health (12–16).

67
68 Alternatively, differences in health status could be attributable to migrants being of lower socio-
69 economic status than non-migrants, and this key factor must be adequately accounted for when
70 comparing SRH (17). The scientific evidence of the social determinants of health (SDH) is well-
71 known (17–19). Socioeconomic status is linked to overall health status not only through the direct
72 physical effects of exposure to better or worse material conditions, but also as a result of one's
73 position in the social hierarchy (17,18). The migratory process often creates a period of vulnerability

74 after arrival in the host country, as well as a sharp change in the socio-economic status that has an
75 impact on health condition. Some authors even consider the migratory process as a SDH (20).

76
77 Our main objective was to investigate differences in SRH of migrants compared to non-migrants in
78 a representative cohort of Swiss adults followed for 10+ years. We focused on migrants as people
79 born outside Switzerland and we analysed differences on country of birth and the number of years
80 living in Switzerland. We focused on socioeconomic status and the specific characteristics of
81 migrant Cohort patients compared to individuals who reported being born in Switzerland (21–26).

83 **Methods**

84 *Population*

85 We used data from the Colaus cohort in Lausanne, Switzerland, and from the PsyCoLaus study, a
86 subsample from the larger CoLaus study focused on mental health. The Colaus cohort is a simple,
87 non-stratified random sample of 19,830 subjects (corresponding to 35% of the source population)
88 invited to participate. The CoLaus cohort is a population-based study designed to assess the
89 prevalence and determinants of cardiovascular risk factors and diseases in Lausanne, a city of
90 145,000 inhabitants of whom 62,000 (43%) were born outside of Switzerland.

91 The source population was defined as all subjects aged between 35 and 75 years registered in the
92 population register of the city. The inclusion criteria were to sign the written informed consent and
93 be willing to take part in the study.

94 Its aims and sampling strategy have been reported previously (27).

95 *Data collected*

1
2
3 96 Recruitment was performed between 2003 and 2006 and included 6733 participants. The first
4
5 97 follow-up visit was conducted between April 2009 and September 2012 and included 5064
6
7 98 participants; the second follow-up was conducted between May 2014 and April 2017 and included
8
9 99 4555 participants. The first and second follow-ups included all participants willing to be re-
10
11
12 100 contacted. For this study, data from the baseline study and both follow-up examinations was used.

101 *Measurement*

102 The response variable is SRH from self reported Likert scale that we transformed into a dichotomic
103 variable. The SRH has been collected since the second period (2009-2012). The following
104 categories: very good and good transformed as a single variable -good health- and categories fair,
105 bad and very bad transformed as a single variable -poor health-. We also considered the mental
106 health as a dependent or response variable through 3 main different indicators (each categorized as
107 present or absent (1 or 0 respectively): Anxiety disorders (General anxiety, trouble panic, social
108 phobia, agoraphobia, other), Depressive disorders (atypical depressive disorder, depressive
109 disorder, other) and the Post-Traumatic Stress Disorder (PTSD). Participants born in other
110 countries, i.e. outside Switzerland, were grouped in a single category (n=1191).

111
112 The main explanatory variables were being born outside Switzerland, the country of birth and the
113 years living in Switzerland. We included interactions between being born abroad and the years
114 living in Switzerland with all explanatory variables. The control variables were gender, age, the
115 Socio Economic Status (SES) following the Hollingshead scale, the educational level, job type,
116 current professional status, monthly household gross income and alcohol consumption.

117 118 *Statistical analysis*

1
2
3 119 We compared individuals by using Student's t-test and the Mann-Whitney U test for quantitative
4
5 120 variables and Pearson's chi-square for qualitative variables. For the multivariable analysis, we used
6
7
8 121 a Generalized Linear Mixed Model (GLMM) with binomial response and a logistic link,
9

10 122

$$12 123 \log \left(\frac{\text{Pr ob}(Y_{it}=1)}{1 - \text{Pr ob}(Y_{it}=1)} \right) = \eta_{it}$$

14 124

15
16
17 125
18
19 126 We included in the linear predictor of each individual in the logistic model, the explanatory
20
21 127 variables of interest that could explain the probability of being a case (i.e. poor SRH, presence of
22
23 128 an anxiety disorder, presence of a depressive disorder or presence of a PTSD).
24
25

26 129

27
28 130 In addition, we checked for the confounding factors observed (including all control variables) and
29
30 131 those possibly not measured by the available data. These have been highlighted by including several
31
32 132 random effects in the linear prediction. In particular, we checked the presence of heterogeneity of
33
34 133 individuals (i.e. variables that were not initially observed, did not change over time and were
35
36 134 specific to each person). We also accounted for possible temporal heterogeneity by including a
37
38 135 random effect of order (28).
39
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42
43
44 137 The reduced number of cases (i.e. poor SRH, presence of an anxiety disorder, presence of
45
46 138 depressive disorder, and presence of PTSD) reduced the statistical power to demonstrate differences
47
48 139 between groups. To increase any the statistical power - not increasing the sample size - we increased
49
50 140 the level of significance (i.e. alpha), reducing the likelihood of making a Type II error while
51
52 141 increasing statistical power. Given the complexity of our model, we preferred to make the inferences
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1
2
3 142 using a Bayesian conceptual framework. This model allowed us to incorporate several levels of
4
5 143 uncertainty in our reported credibility intervals, including model uncertainty, missing data and
6
7 144 unobserved confounding. In particular, we used the Integrated Nested Laplace Approach (INLA) in
8
9 145 a pure Bayesian conceptual framework (29). Today, in the Bayesian approach two great alternatives
10
11 146 can be used to make the Markov chain Monte Carlo (MCMC) and the integrated nested Laplace
12
13 147 approximation (INLA) inferences. The latter is both significantly faster and more robust than
14
15 148 MCMC and, therefore, has become the most widely used alternative for inference.

16
17 149 Apart from the odds ratios (OR) and their credibility intervals at 95% (95% ICr), the probability of
18
19 150 the parameter estimator (the log(OR) as an absolute value being more than 1 (Prob) is also shown
20
21 151 (note that it is unilateral and so does not necessarily have to coincide with the ICr in all the cases).
22
23 152 Unlike the p-value in a usual environment, this probability allows us to make inferences about the
24
25 153 possible association.

26
27 154 All analyses were performed with the free software R (version3.5.1) through the INLA approach
28
29 155 (28–31).

156 *Patient and Public Involvement*

157 No patient involved.

158

159 **Results**

160 Table 1 and 2 show descriptive statistics for all variables included. Our sample included mainly
161 people from Switzerland (n= 4031, 60%), France (n=447, 6.6%), Italy (n=409, 6.1%), Portugal
162 (n=391, 5.8%), Spain (n=262, 3.9%), and 1191 from all other countries (18%).

163 “Table 1 about here”

164 “Table 2 about here”

1
2
3 165 In unadjusted analyses, people born outside Switzerland reported having worse SRH during the
4
5 166 second and third CoLaus waves ($p < 0.001$ for both waves). Nevertheless, in models adjusting for
6
7 167 other participant characteristics, we did not find a statistically significant difference for SRH among
8
9 168 the migrant and non-migrant populations. This result showed implies that other factors might
10
11 169 explain observed differences in SRH.
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15 170 “Table 3 about here”
16
17

18 171 Table 3 shows that older age groups were more likely to report poor health than younger age groups,
19
20 172 with stronger associations among those from certain countries. All individuals aged 55 to 64 years
21
22 173 had 44% greater odds (OR = 1.44, 95% Credibility interval, CrI = 0.97-2.15) of reporting poor
23
24 174 health than younger populations. Interactions between country of birth and years of residence in
25
26 175 Switzerland showed that those born in France and living in Switzerland for 54 years had a 121%
27
28 176 higher risk of reporting poor health (OR = 2.21, CrI to 95% = 0.94-5.19) than those born in France
29
30 177 and living in Switzerland for 32 years. The same pattern was found among people born in Spain
31
32 178 who have lived in Switzerland for 54 years. They were 146% more likely to report health problems
33
34 179 (OR = 2.46, 95% CrI = 0.87-6.98) than those born in Spain and living in Switzerland for less than
35
36 180 32 years.
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42 181 There was a gradient in health status by level of education. The higher the level of education, the
43
44 182 better the SRH among both migrant and non-migrant populations. Those with the level of an
45
46 183 apprenticeship had 33% less risk (OR = 0.66, 95% CrI = 0.49-0.90) of reporting poor health when
47
48 184 compared to those with compulsory education only. Those with a high school education were 37%
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50 185 less likely and those with a higher education level 60% less likely to report poor health (OR = 0.40,
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186 95% CrI 0.42) -0.92) than those with compulsory schooling. This is important since 33% of the
187 migrant population had only a compulsory education compared to 13% of the Swiss born.

188 The monthly household income also showed a gradient in health status. Households with a monthly
189 gross income between CHF 7,000 and CHF 9,499 had 32% lower odds of reporting poor SRH than
190 households with incomes below CHF 3,000. Households with a monthly income greater than CHF
191 13'000 had a 45% lower odds of (OR = 0.55, 95% CrI = 0.28-1.06) describing a poor SRH. This
192 monthly income gradient was the same for migrant's households. We found significant different
193 effects for the current profession for both migrant and non-migrant populations. A Swiss born with
194 a liberal profession had a 62% lower risk of reporting poor SRH (OR = 0.38, 95% CrI = 0.16-0.91)
195 than a manual labourer; in contrast migrants with a liberal profession the risk of reporting poor
196 health was greater. Indeed, we found that migrants with a liberal profession (doctor or lawyer) had
197 152% higher risk of describing a poor SRH (OR = 2.52, CrI to 95% = 0.91 to 6.96) than manual
198 labourer.

199 Table 4 and table 5, for the group of people born in Switzerland, all categories of civil status had
200 the same risk of perceiving poor SRH as people living alone. However, childless migrant couples
201 were 22% less likely (OR = 0.78, 95% CrI = 0.67-0.92) to report poor SRH than those living alone
202 and migrant couples with children were 34% less likely (OR = 0.66, 95% CrI = 0.55-0.80) of
203 perceived poor SRH than people living alone. The interaction between country of birth and couple
204 with children was also statistically significant, and a foreign-born couple with children was at 41%
205 lower risk of poor SRH health (OR = 0.59, 95% CrI = 0.40-0.87) than people living alone.

206 There was no association between the risk of having a psychiatric illness (major depressive disorder,
207 generalized anxiety disorder, panic disorder, social phobia, PTSD or agoraphobia) and belonging

208 to the migrant group. Habitual alcohol consumers had 37% less risk of poor SRH (OR = 0.63, 95%
209 CrI = 0.51-0.78) than non-consumers (p = 0.999) and this pattern was the same for both groups.

210 “Table 4 about here”

211 “Table 5 about here”

212 **Discussion**

213 In this study, we focused on the migrant / non-migrant populations of the CoLaus cohort and their
214 SRH. Scientific literature has shown that a perceived poor SRH is correlated with greater morbidity
215 and mortality. In addition, studies in other countries have shown that, with regard to SRH, most of
216 the groups of migrants and ethnic minorities report poorer health than local and non-migrant
217 populations (6,7,10,11). This was also the case in our unadjusted results.

218 However, in our statistical model with complete adjustment of both measured and unmeasured
219 confounding factors, we found no statistically significant difference in SRH between those born
220 outside of Switzerland and in Switzerland. Instead, several SDH and some socio-demographic
221 characteristics appeared to be stronger explanatory variables for SRH than migrant / non-migrant
222 status. In particular, there is a gradient for the level of education and for the monthly income,
223 regardless of the migration status. These gradients are found in other countries, although the strength
224 of the relationship varies somewhat across countries, for different age groups, by health measures
225 used, and by sex of collectives (31–33).

226 Regarding mental health diagnoses, migration is often seen as a risk factor contributing to
227 psychopathology, which may then have an adverse impact on SRH. In this study, however, the risk
228 of presenting a severe psychiatric illness was not greater among migrants (34–36).

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3 229 Finally, in the population born in Switzerland, all categories of civil status had the same risk of
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5 230 reporting poor SRH as people living alone. However, childless migrant couples were less likely to
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8 231 report poor SRH than people living alone, and this risk was even lower for migrant couples with
9
10 232 children. This is also reflected in the literature, where migrant women are described as a key player
11
12 233 in health - for their health, as well as of their children and their families. Conversely, single migrants
13
14 234 were more likely to view their health as poor among both men and women, when compared to those
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16
17 235 who were married or in a common-law relationship (34–36).
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19

20 236 The strengths of this study were the size of the sample, the rigorous collection of data and the
21
22 237 advanced statistical approaches that made it possible to control both measured and unmeasured
23
24 238 confounding factors. Among the weaknesses, the predominant migration groups included in this
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27 239 study (from other European countries and often >25 years in Switzerland) may be more similar to
28
29 240 those born in Switzerland, limiting the generalizability of these results to other countries with
30
31 241 different composition of their migrant populations. The lack of recent migrants in the sample is one
32
33 242 of the main limitations of the current study. Another weakness is the likely selection bias in the
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36 243 participants of the study due to the relative low participant rate of 34% of the invited population.
37
38 244 We didn't captured the health status at baseline as in many other longitudinal studies of health-
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40 245 selective migration. Finally, the complex modelling used in this study generates large confidence
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43 246 intervals makes it more difficult to exclude a small influence of the country of birth.
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48 248 **References**

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337 **Ethics approval and consent to participate**

338 The institutional Ethics Committee of the University of Lausanne, which afterwards became the
339 Ethics Commission of Canton Vaud (www.cer-vd.ch) approved the first (reference 33/09, decision
340 of 23rd February 2009) and the second (reference 26/14, decision of 11th March 2014) follow-ups.
341 The study was performed in agreement with the Helsinki declaration and its former amendments.
342 All participants gave their signed informed consent before entering the study.
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3 344 **Availability of data and materials**
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5 345 CoLaus study (<https://www.colaus-psycolaus.ch/>).
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8 346
9

10 347 **Competing interests**
11

12 348 The authors declare that they have no competing interests
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14

15 349

16
17 350 **Funding**
18

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20
21

22 352
23

24 353 **Authors' contributions**
25

26 354 MP had the research proposal and wrote most of the article. SM made the statistical analyses. SK
27

28 355 and MP revised the article for important intellectual content. BP and MP have full access to the
29

30 356 data. BP is the guarantor of the study.
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34

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38

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42

43 362 study design, data collection, analysis and interpretation, writing of the report, or decision to submit
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45 363 the article for publication.
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368 **TABLES & FIGURES**

369 Table 1. Descriptive statistics of demographic characteristics and variables for the three periods analyzed
 370 (2003-2006; 2009-2012; 2014-2017) of the CoLaus study. It should be noted that several variables have
 371 missing data for one or two waves of CoLaus. This has been taken into account in the context of the
 372 Bayesian analysis which takes into account the missing values in the treatment of uncertainty.
 373

	Period 1 2003-2006 (n=6,733)	Period 2 2009-2012 (n=5,064)	Period 3 2014-2017 (4,881)
Variable	N (%)	N (%)	N (%)
Self-reported Health Status (Good or Very Good)	-	4,164 (82%)	3,743 (78%)
Fair, Poor or Very Poor	-	873 (17%)	1,088 (22%)
Country of birth (Other than Switzerland)	2,700 (40%)	1,880 (37%)	1,818 (37%)
Switzerland	4,031 (60%)	3,184 (63%)	3,062 (63%)
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)	271 (4%)	130 (3%)	-
21-39	658 (10%)	386 (8%)	-
30-39	1027 (15%)	781 (15%)	-
40-54	982 (15%)	905 (18%)	-
=>55	781 (12%)	624 (12%)	-
Missing	3,014 (45%)	2,238 (44%)	
Educational level (Mandatory education)	1,397 (21%)	878 (17%)	839 (17%)
Apprenticeship	2,377 (35%)	1,796 (35%)	1,749 (36%)
High school	1,625 (24%)	1,306 (26%)	1,258 (26%)
University education	1,320 (20%)	1,079 (21%)	1,031 (21%)
Job type (High)	803 (12%)	458 (9%)	476 (11%)
Middle	2662 (40%)	1,111 (22%)	714 (16%)
Low	1306 (19%)	1,479 (29%)	939 (22%)
Not working	1945 (29%)	1,772 (35%)	2,205 (51%)
Current situation (living alone)	-	1,414 (28%)	1,286 (30%)
Single parent family	-	285 (6%)	228 (5%)
Couple without children	-	1,757 (35%)	1,508 (35%)
Couple with children	-	1,547 (31%)	1,074 (25%)
Missing	-	61 (1%)	238 (5%)
Current professional status (Manoeuvre)	-	207 (4%)	138 (3%)
Qualified worker	-	249 (5%)	194 (4%)
Farmer	-	7 (0.1%)	8 (0.2%)
Non qualified employee	-	262 (5%)	147 (3%)
Qualified employee (f.e. secretary)	-	781 (15%)	543 (11%)
Low manager	-	789 (16%)	247 (5%)
Middle manager	-	335 (7%)	515 (11%)
Top manager	-	262 (5%)	363 (7%)

Liberal professional (medical doctor, lawyer)	-	197 (4%)	145 (3%)
Not employed or missing	-	1,975 (39%)	2,581 (53%)
Monthly household gross income (<2.999 CHF)	-	-	253 (6%)
3000-4999 CHF	-	-	656 (15%)
5000-6999 CHF	-	-	792 (18%)
7000-9499 CHF	-	-	715 (17%)
9500-13000 CHF	-	-	543 (13%)
> 13000 CHF	-	-	466 (11%)
Refused or missing	-	-	909 (21%)
Do you currently drink alcohol (no)	1505 (22%)	878 (17%)	939 (19%)
Yes	5221 (78%)	4123 (82%)	3,419 (70%)
Missing	7 (0.1%)	63 (1%)	523 (11%)
Gender (Man)	3,189 (47%)	2,357 (47%)	2,193 (45%)
Women	3,544 (53%)	2,707 (53%)	2,688 (55%)
Age category (0-44 years)	1,987 (30%)	-	-
45-54 years	1,967 (29%)	-	-
55-64 years	1,778 (26%)	-	-
65-74 years	988 (15%)	-	-
> 75 years	13 (0.2%)	-	-
How many years have you lived in Switzerland (<25 years)	1,389 (21%)	-	-
25-39 years	1,274 (19%)	-	-
40-48 years	1,407 (21%)	-	-
49-59 years	1,230 (18%)	-	-
60-75 years	1,284 (19%)	-	-

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375 Table 2. Proportions of SHR during waves 2 (2009-2012) and 3 (2014-2017), stratified by place of birth
376 (non-migrants = born in Switzerland vs. migrants = born in another country) of the CoLaus study. The very
377 good and good categories (perceived health status) were transformed into a single variable - good health -
378 and the average, poor and very poor health categories perceived as a second variable - poor health -
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Time period	Group	Self-reported health status				
		Very good	Good	Fair	Poor	Very poor
Period 2 2009-2012	Born in Switzerland	838 (26%)	1,870 (59%)	416 (13%)	38 (1%)	4 (0.1%)
	Born in another country	381 (20%)	1,075 (57%)	362 (19%)	44 (2%)	9 (0.5%)
Period 3 2014-2017	Born in Switzerland	702 (23%)	1,731 (57%)	537 (18%)	54 (2%)	6 (0.2%)
	Born in another country	330 (18%)	979 (54%)	429 (24%)	56 (3%)	6 (0.3%)

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Table 3. Results of the mixed models of the explanatory variables for the perceived health of the entire cohort of the CoLaus study for the period 2003-2017.

Self Rated Health	OR (95% Credibility interval)	Prob(log(OR))>0
Country of birth (Other than Switzerland)		
Switzerland	1.09(0.52-2.31)	0.5932
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	0.92(0.65-1.30)	0.6821
30-39	1.11(0.81-1.51)	0.7439
40-54	0.83(0.60-1.14)	0.8754
=>55	0.82(0.55-1.20)	0.8479
Educational level (Mandatory education)		
Apprenticeship	0.67(0.49-0.90)	0.9960*
High school	0.63(0.45-0.84)	0.9992*
University education	0.40(0.28-0.58)	0.9999*
Job type (High)		
Middle	0.58(0.35-0.95)	0.9853*
Low	0.60(0.41-0.88)	0.9958*
Not working	0.62(0.42-0.92)	0.9917*
Current situation (living alone)		
Single parent family	1.17(0.78-1.78)	0.7758
Couple without children	0.84(0.64-1.09)	0.9115
Couple with children	0.89(0.68-1.16)	0.8084
Current professional status (manoeuvre)		
Qualified worker	0.81(0.45-1.45)	0.7646
Farmer	0.58(0.04-7.49)	0.6631
Non-qualified worker (office assistant)	1.09(0.70-1.70)	0.6530
Qualified employee (f.e. secretary)	0.90(0.61-1.32)	0.7119
Low manager	0.94(0.59-1.49)	0.6063

Middle manager	1.03(0.62-1.69)	0.5382
Top manager	1.13(0.85-1.51)	0.7991
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.04(0.73-1.47)	0.5761
5000-6999 CHF	1.01(0.70-1.46)	0.5187
7000-9499 CHF	0.68(0.45-1.02)	0.9690*
9500-13000 CHF	1.21(0.76-1.92)	0.7886
> 13000 CHF	0.55(0.29-1.06)	0.9640*
Do you currently drink alcohol (no)		
Yes	0.63(0.51-0.79)	0.9999*
Gender (Man)		
Women	1.28(1.02-1.60)	0.9850*
Age category (0-45 years)		
45-54 years	1.17(0.82-1.68)	0.8047
55-64 years	1.44(0.97-2.15)	0.9643*
65-74 years	1.29(0.82-2.04)	0.8667
> 75 years	1.17(0.67-2.06)	0.7130
How many years have you been living in Switzerland (First quintile <32 years)		
Second quintile	0.92(0.72-1.18)	0.7364
Third quintile	0.92(0.70-1.22)	0.7108
Fourth quintile	0.93(0.68-1.28)	0.6691
Fifth quintile	1.03(0.68-1.57)	0.5552

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Table 4. Results of the mixed models of the explanatory variables for the perceived health of people born in Switzerland of the CoLaus study population of the CoLaus study for the period 2009-2012 and 2014-2017.

Self Rated Health	OR (95% Credibility interval)	Prob(log(OR))>0
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	1.04(0.63-1.73)	0.5646
30-39	0.94(0.63-1.39)	0.6305

40-54	1.18(0.78-1.77)	0.7817
=>55	1.22(0.74-2.03)	0.7812
Educational level (Mandatory education)		
Apprenticeship	0.97(0.65-1.46)	0.5584
High school	0.97(0.63-1.49)	0.5622
University education	1.15(0.68-1.93)	0.6961
Job type (High)		
Middle	1.45(0.75-2.78)	0.8664
Low	1.36(0.82-2.25)	0.8807
Not working	1.30(0.74-2.29)	0.8202
Current situation (living alone)		
Single parent family	0.82(0.46-1.47)	0.7483
Couple without children	0.93(0.67-1.29)	0.6620
Couple with children	0.59(0.40-0.87)	0.9965*
Current professional status (manoeuvre)		
Qualified worker	1.24(0.49-3.13)	0.6780
Farmer	1.59(0.05-52.74)	0.6009
Non-qualified worker (office assistant)	0.81(0.39-1.66)	0.7221
Qualified employe (f.e. secretary)	0.91(0.53-1.57)	0.6357
Low manager	0.97(0.53-1.78)	0.5354
Middle manager	0.62(0.31-1.25)	0.9117
Top manager	0.99(0.69-1.45)	0.5033
Liberal professional (medical doctor, lawyer)	2.52(0.91-6.96)	0.9623
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.30(0.81-2.10)	0.8636
5000-6999 CHF	1.24(0.78-1.99)	0.8177
7000-9499 CHF	1.39(0.82-2.37)	0.8876
9500-13000 CHF	0.92(0.51-1.68)	0.6051
> 13000 CHF	1.24(0.56-2.74)	0.7032
Do you currently drink alcohol (no)		
Yes	1.01(0.75-1.34)	0.5188

Gender (Man)		
Women	0.73(0.55-0.98)	0.9826*
Age category (0-45 years)		
45-54 years	0.80(0.46-1.40)	0.7833
55-64 years	0.62(0.33-1.15)	0.9363
65-74 years	0.45(0.22-0.92)	0.9862*
> 75 years	0.75(0.35-1.63)	0.7673

Table 5. Results of the mixed models of the explanatory variables for the perceived health of people born outside of Switzerland of the CoLaus study population of the CoLaus study for the period 2009-2012 and 2014-2017.

Self Rated Health	OR (95% Credibility interval)	Prob(log(OR))>0
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	1.04(0.63-1.73)	0.5646
30-39	0.94(0.63-1.39)	0.6305
40-54	1.18(0.78-1.77)	0.7817
=>55	1.22(0.74-2.03)	0.7812
Educational level (Mandatory education)		
Apprenticeship	0.97(0.65-1.46)	0.5584
High school	0.97(0.63-1.49)	0.5622
University education	1.15(0.68-1.93)	0.6961
Job type (High)		
Middle	1.45(0.75-2.78)	0.8664
Low	1.36(0.82-2.25)	0.8807
Not working	1.30(0.74-2.29)	0.8202
Current situation (living alone)		
Single parent family	0.82(0.46-1.47)	0.7483
Couple without children	0.93(0.67-1.29)	0.6620
Couple with children	0.59(0.40-0.87)	0.9965*
Current professional status (manoeuvre)		
Qualified worker	1.24(0.49-3.13)	0.6780

Farmer	1.59(0.05-52.74)	0.6009
Non-qualified worker (office assistant)	0.81(0.39-1.66)	0.7221
Qualified employe (f.e. secretary)	0.91(0.53-1.57)	0.6357
Low manager	0.97(0.53-1.78)	0.5354
Middle manager	0.62(0.31-1.25)	0.9117
Top manager	0.99(0.69-1.45)	0.5033
Liberal professional (medical doctor, lawyer)	2.52(0.91-6.96)	0.9623
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.30(0.81-2.10)	0.8636
5000-6999 CHF	1.24(0.78-1.99)	0.8177
7000-9499 CHF	1.39(0.82-2.37)	0.8876
9500-13000 CHF	0.92(0.51-1.68)	0.6051
> 13000 CHF	1.24(0.56-2.74)	0.7032
Do you currently drink alcohol (no)		
Yes	1.01(0.75-1.34)	0.5188
Gender (Man)		
Women	0.73(0.55-0.98)	0.9826*
Age category (0-45 years)		
45-54 years	0.80(0.46-1.40)	0.7833
55-64 years	0.62(0.33-1.15)	0.9363
65-74 years	0.45(0.22-0.92)	0.9862*
> 75 years	0.75(0.35-1.63)	0.7673

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	Lines: 1-2 Lines: 30-48
Introduction		
Background/rationale	2	Lines: 69-85
Objectives	3	Lines: 87-91
Methods		
Study design	4	Lines: 37-38
Setting	5	Lines 94-109
Participants	6	Lines: 99-103 Not applicable
Variables	7	Lines: 111-124
Data sources/ measurement	8*	Lines: 126-145
Bias	9	Lines 139-145
Study size	10	Lines:147-155
Quantitative variables	11	Lines:126-145
Statistical methods	12	Lines 126-162 Lines: 139-145 Lines: 126-137 Lines: 126-162 Lines: 147-160
Results		
Participants	13*	Lines: 167-169 Not Applicable Not Applicable
Descriptive data	14*	Lines: 167-169 Tables 1 and 2 Tables 1 and 2
Outcome data	15*	Report numbers of outcome events or summary measures over time
Main results	16	Lines: 170-211 Not Applicable Not Applicable
Other analyses	17	Not Applicable
Discussion		
Key results	18	Lines:220-249
Limitations	19	Lines_245-249
Interpretation	20	Lines:251-259
Generalisability	21	Lines:251-259
Other information		
Funding	22	Line:286

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

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Longitudinal Panel Data Study of Self-Rated health among Migrants in French-speaking Switzerland, 2003-2017

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3 **1 Longitudinal Panel Data Study of Self-Rated health among Migrants**
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5 **2 in French-speaking Switzerland, 2003-2017.**
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7 **3 Mota P^{1*}, Saez M^{2,3}, Selby K⁴, Bodenmann P.^{1,4}**
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10 **4**
11 **5 * corresponding author:**
12 **6**

13 **7 Department of Vulnerabilities and Social Medicine,**
14 **8 University Center for General Medicine and Public Health**
15 **9 44, Rue du Bugnon. CH – 1011 Lausanne, Switzerland**
16 **10 Phone: +41787708423**
17 **11 Email: paumotamoya@gmail.com**
18 **12**

19
20
21 **13 1. Department of Vulnerabilities and Social Medicine, University Center for General Medicine**
22 **14 and Public Health, Lausanne, Switzerland.**
23 **15**

24 **16 2. Research Group on Statistics, Econometrics and Health (GRECS), University of**
25 **17 Girona, Girona, Spain.**

26 **18 3. CIBER of Epidemiology and Public Health (CIBERESP), Madrid, Spain**

27
28
29 **19 4. Department of the Polyclinics, University Center for General Medicine and Public Health,**
30 **20 Lausanne, Switzerland.**
31
32

33 **21**
34
35 **22 Email addresses:**
36

37 **23 Mota P: paumotamoya@gmail.com**
38

39 **24 Saez M: marc.saez@udg.edu**
40

41 **25 Selby K: kevin.selby@hospvd.ch**
42

43
44 **26 Bodenmann P: patrick.bodenmann@hospvd.ch**
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Abstract

Introduction: Studies have documented poorer health among migrants than natives of several European countries, but little is known for Switzerland. We assessed the association between country of birth, socio-economic factors and self-reported health in a prospective cohort of adults living in Lausanne, Switzerland.

Methods: We used the data from the Colaus panel data study for three periods: 2003-6 (n=6733), 2009-12 (n=5064) and 2014-17 (n=4555) corresponding to 35% of the source population. The response variable was self-reported health (SRH). Main explanatory variables were socioeconomic status, educational level, professional status, income, gender, age and years in Switzerland. The main covariate was country of birth, dichotomized as born in Switzerland or not. We specified random effects logistic regressions and used Bayesian methods for the inference.

Results: Being born outside of Switzerland was not associated with worse SRH (OR 1.09 (95%CI 0.52-2.31)). Several other patient variables were, however, predictive of poor health. Educational level was inversely associated with the risk of reporting poor health. Monthly household income showed a gradient where higher income was associated with lower odds of reporting poor SRH, for both for migrants and non-migrants. Migrant women had lower odds of reporting poor SRH than men (OR=0.73, CI=0.55-0.98). Migrant people living in couple have less risk of reporting poor SRH than people who live alone and the risk is lower for migrant people living in couple with children (OR=0.66, 95% CI=0.55-0.80).

Conclusions: Migrant status was not associated with poorer SRH. However, differences in SRH were observed based on gender, age and several social determinants of health.

Total word count: 2147. Number of tables: 4

Keywords: migration, self-rated health, social determinants of health, longitudinal study.

51 **Article summary**

52 *Strengths and limitations of this study*

- 53 • The strengths of this study are the large size of the sample and rigorous collection of data.
- 54 • Among the weaknesses, the predominant migration groups included in this study (from other
55 European countries and often >25 years in Switzerland) may be more similar to those born
56 in Switzerland, limiting the generalizability of the results.
- 57 • The lack of recent migrants in the sample is one of the main limitations of the current study.
- 58 • Lack of variables in the original Panel Study focusing on acculturation or experienced
59 discrimination that which may influence SRH of migrants is another limitation of the study.

61 **Introduction**

62 Differences in Self-Rated Health (SRH) between migrants and natives have been documented in
63 several European countries but not yet in Switzerland (1–4). SRH is a well-established indicator
64 used in epidemiology and public health research and is an independent predictor of health outcomes
65 such as morbidity and mortality (5–9). Numerous studies in European countries have reported that
66 in regard to SRH, most migrant and ethnic minority groups studied appear, on average, to have
67 lower health status compared with the majority population (6,7,10,11). Moreover, SRH appears to
68 be associated with patient's mental health (12–16).

69
70 Alternatively, differences in health status could be attributable to migrants being of lower socio-
71 economic status than non-migrants, and this key factor must be adequately accounted for when
72 comparing SRH (17). The scientific evidence of the social determinants of health (SDH) is well-
73 known (17–19). Socioeconomic status is linked to overall health status not only through the direct

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3 74 physical effects of exposure to better or worse material conditions, but also as a result of one's
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5 75 position in the social hierarchy (17,18). The migratory process often creates a period of vulnerability
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8 76 after arrival in the host country, as well as a sharp change in the socio-economic status that has an
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10 77 impact on health condition. Some authors even consider the migratory process as a SDH (20).
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14 79 Our main objective was to investigate differences in SRH of migrants compared to non-migrants in
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16 80 a representative cohort of Swiss adults followed for 10+ years. We focused on migrants as people
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18 81 born outside Switzerland and we analysed differences on country of birth and the number of years
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20 82 living in Switzerland. We focused on socioeconomic status and the specific characteristics of
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22 83 migrant Cohort patients compared to individuals who reported being born in Switzerland (21–26).
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29 85 **Methods**

30 86 *Population*

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33 87 We used data from the Colaus cohort in Lausanne, Switzerland, and from the PsyCoLaus study, a
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35 88 subsample from the larger CoLaus study focused on mental health. The Colaus cohort is a simple,
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37 89 non-stratified random sample of 19,830 subjects (corresponding to 35% of the source population)
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39 90 invited to participate. The CoLaus cohort is a population-based study designed to assess the
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41 91 prevalence and determinants of cardiovascular risk factors and diseases in Lausanne, a city of
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43 92 145,000 inhabitants of whom 62,000 (43%) were born outside of Switzerland.
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47 93 The source population was defined as all subjects aged between 35 and 75 years registered in the
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49 94 population register of the city. The inclusion criteria were to sign the written informed consent and
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51 95 be willing to take part in the study.
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54 96 Its aims and sampling strategy have been reported previously (27).
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3 97 *Data collected*
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5 98 Recruitment was performed between 2003 and 2006 and included 6733 participants. The first
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7 99 follow-up visit was conducted between April 2009 and September 2012 and included 5064
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10 100 participants; the second follow-up was conducted between May 2014 and April 2017 and included
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12 101 4555 participants. The first and second follow-ups included all participants willing to be re-
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14 102 contacted. For this study, data from the baseline study and both follow-up examinations was used.
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17 103 *Measurement*
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19 104 The response variable is SRH from self reported Likert scale that we transformed into a dichotomic
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21 105 variable. The SRH has been collected since the second period (2009-2012). The following
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23 106 categories: very good and good transformed as a single variable -good health- and categories fair,
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25 107 bad and very bad transformed as a single variable -poor health-. We also considered the mental
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27 108 health as a dependent or response variable through 3 main different indicators (each categorized as
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29 109 present or absent (1 or 0 respectively): Anxiety disorders (General anxiety, trouble panic, social
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31 110 phobia, agoraphobia, other), Depressive disorders (atypical depressive disorder, depressive
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33 111 disorder, other) and the Post-Traumatic Stress Disorder (PTSD). Participants born in other
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35 112 countries, i.e. outside Switzerland, were grouped in a single category (n=1191).
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42 114 The main explanatory variables were being born outside Switzerland, the country of birth and the
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44 115 years living in Switzerland. We included interactions between being born abroad and the years
45
46 116 living in Switzerland with all explanatory variables. The control variables were gender, age, the
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48 117 Socio Economic Status (SES) following the Hollingshead scale, the educational level, job type,
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50 118 current professional status, monthly household gross income and alcohol consumption.
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56 120 *Statistical analysis*
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3 121 We compared individuals by using Student's t-test and the Mann-Whitney U test for quantitative
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5 122 variables and Pearson's chi-square for qualitative variables. For the multivariable analysis, we used
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8 123 a Generalized Linear Mixed Model (GLMM) with binomial response and a logistic link,
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$$12 \quad \log \left(\frac{\text{Pr ob}(Y_{it}=1)}{1 - \text{Pr ob}(Y_{it}=1)} \right) = \eta_{it}$$

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19 128 We included in the linear predictor of each individual in the logistic model, the explanatory
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21 129 variables of interest that could explain the probability of being a case (i.e. poor SRH, presence of
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24 130 an anxiety disorder, presence of a depressive disorder or presence of a PTSD).

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28 132 In addition, we checked for the confounding factors observed (including all control variables) and
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31 133 those possibly not measured by the available data. These have been highlighted by including several
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33 134 random effects in the linear prediction. In particular, we checked the presence of heterogeneity of
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35 135 individuals (i.e. variables that were not initially observed, did not change over time and were
36
37
38 136 specific to each person). We also accounted for possible temporal heterogeneity by including a
39
40 137 random effect of order (28).

42 138

44 139 The reduced number of cases (i.e. poor SRH, presence of an anxiety disorder, presence of
45
46 140 depressive disorder, and presence of PTSD) reduced the statistical power to demonstrate differences
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49 141 between groups. To increase any the statistical power - not increasing the sample size - we increased
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51 142 the level of significance (i.e. alpha), reducing the likelihood of making a Type II error while
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54 143 increasing statistical power. Given the complexity of our model, we preferred to make the inferences

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3 144 using a Bayesian conceptual framework. This model allowed us to incorporate several levels of
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5 145 uncertainty in our reported credibility intervals, including model uncertainty, missing data and
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7 146 unobserved confounding. In particular, we used the Integrated Nested Laplace Approach (INLA) in
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10 147 a pure Bayesian conceptual framework (29). Today, in the Bayesian approach two great alternatives
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12 148 can be used to make the Markov chain Monte Carlo (MCMC) and the integrated nested Laplace
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14 149 approximation (INLA) inferences. The latter is both significantly faster and more robust than
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17 150 MCMC and, therefore, has become the most widely used alternative for inference.

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19 151 Apart from the odds ratios (OR) and their credibility intervals at 95% (95% ICr), the probability of
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21 152 the parameter estimator (the log(OR) as an absolute value being more than 1 (Prob) is also shown
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23 153 (note that it is unilateral and so does not necessarily have to coincide with the ICr in all the cases).
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26 154 Unlike the p-value in a usual environment, this probability allows us to make inferences about the
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28 155 possible association.

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31 156 All analyses were performed with the free software R (version3.5.1) through the INLA approach
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33 157 (28–31).

34 35 158 *Patient and Public Involvement*

36
37 159 No patient involved.
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41 42 161 **Results**

43
44 162 Table 1 and 2 show descriptive statistics for all variables included. Our sample included mainly
45
46 163 people from Switzerland (n= 4031, 60%), France (n=447, 6.6%), Italy (n=409, 6.1%), Portugal
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48 164 (n=391, 5.8%), Spain (n=262, 3.9%), and 1191 from all other countries (18%).

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52 165 “Table 1 about here”
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55 166 “Table 2 about here”
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3 167 In unadjusted analyses, people born outside Switzerland reported having worse SRH during the
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5 168 second and third CoLaus waves ($p < 0.001$ for both waves). Nevertheless, in models adjusting for
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8 169 other participant characteristics, we did not find a statistically significant difference for SRH among
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10 170 the migrant and non-migrant populations. This result showed implies that other factors might
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12 171 explain observed differences in SRH.
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15 172 “Table 3 about here”
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19 173 Table 3 shows that older age groups were more likely to report poor health than younger age groups,
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21 174 with stronger associations among those from certain countries. All individuals aged 55 to 64 years
22
23 175 had 44% greater odds (OR = 1.44, 95% Credibility interval, CrI = 0.97-2.15) of reporting poor
24
25 176 health than younger populations. Interactions between country of birth and years of residence in
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28 177 Switzerland showed that those born in France and living in Switzerland for 54 years had a 121%
29
30 178 higher risk of reporting poor health (OR = 2.21, CrI to 95% = 0.94-5.19) than those born in France
31
32 179 and living in Switzerland for 32 years. The same pattern was found among people born in Spain
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35 180 who have lived in Switzerland for 54 years. They were 146% more likely to report health problems
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37 181 (OR = 2.46, 95% CrI = 0.87-6.98) than those born in Spain and living in Switzerland for less than
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39 182 32 years.
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43 183 There was a gradient in health status by level of education. The higher the level of education, the
44
45 184 better the SRH among both migrant and non-migrant populations. Those with the level of an
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47 185 apprenticeship had 33% less risk (OR = 0.66, 95% CrI = 0.49-0.90) of reporting poor health when
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49 186 compared to those with compulsory education only. Those with a high school education were 37%
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51 187 less likely and those with a higher education level 60% less likely to report poor health (OR = 0.40,
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188 95% CrI 0.42) -0.92) than those with compulsory schooling. This is important since 33% of the
189 migrant population had only a compulsory education compared to 13% of the Swiss born.

190 The monthly household income also showed a gradient in health status. Households with a monthly
191 gross income between CHF 7,000 and CHF 9,499 had 32% lower odds of reporting poor SRH than
192 households with incomes below CHF 3,000. Households with a monthly income greater than CHF
193 13'000 had a 45% lower odds of (OR = 0.55, 95% CrI = 0.28-1.06) describing a poor SRH. This
194 monthly income gradient was the same for migrant's households. We found significant different
195 effects for the current profession for both migrant and non-migrant populations. A Swiss born with
196 a liberal profession had a 62% lower risk of reporting poor SRH (OR = 0.38, 95% CrI = 0.16-0.91)
197 than a manual labourer; in contrast migrants with a liberal profession the risk of reporting poor
198 health was greater. Indeed, we found that migrants with a liberal profession (doctor or lawyer) had
199 152% higher risk of describing a poor SRH (OR = 2.52, CrI to 95% = 0.91 to 6.96) than manual
200 labourer.

201 Table 4 and table 5, for the group of people born in Switzerland, all categories of civil status had
202 the same risk of perceiving poor SRH as people living alone. However, childless migrant couples
203 were 22% less likely (OR = 0.78, 95% CrI = 0.67-0.92) to report poor SRH than those living alone
204 and migrant couples with children were 34% less likely (OR = 0.66, 95% CrI = 0.55-0.80) of
205 perceived poor SRH than people living alone. The interaction between country of birth and couple
206 with children was also statistically significant, and a foreign-born couple with children was at 41%
207 lower risk of poor SRH health (OR = 0.59, 95% CrI = 0.40-0.87) than people living alone.

208 There was no association between the risk of having a psychiatric illness (major depressive disorder,
209 generalized anxiety disorder, panic disorder, social phobia, PTSD or agoraphobia) and belonging

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3 210 to the migrant group. Habitual alcohol consumers had 37% less risk of poor SRH (OR = 0.63, 95%
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5 211 CrI = 0.51-0.78) than non-consumers (p = 0.999) and this pattern was the same for both groups.
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8 212 “Table 4 about here”
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11 213 “Table 5 about here”
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14 214 **Discussion**

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17 215 In this study, we focused on the migrant / non-migrant populations of the CoLaus cohort and their
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19 216 SRH. Scientific literature has shown that a perceived poor SRH is correlated with greater morbidity
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21 217 and mortality. In addition, studies in other countries have shown that, with regard to SRH, most of
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23 218 the groups of migrants and ethnic minorities report poorer health than local and non-migrant
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25 219 populations (6,7,10,11). This was also the case in our unadjusted results.
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29 220 However, in our statistical model with complete adjustment of both measured and unmeasured
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31 221 confounding factors, we found no statistically significant difference in SRH between those born
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33 222 outside of Switzerland and in Switzerland. Instead, several SDH and some socio-demographic
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35 223 characteristics appeared to be stronger explanatory variables for SRH than migrant / non-migrant
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37 224 status. In particular, there is a gradient for the level of education and for the monthly income,
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39 225 regardless of the migration status. These gradients are found in other countries, although the strength
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41 226 of the relationship varies somewhat across countries, for different age groups, by health measures
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43 227 used, and by sex of collectives (31–33).
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49 228 Regarding mental health diagnoses, migration is often seen as a risk factor contributing to
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51 229 psychopathology, which may then have an adverse impact on SRH. In this study, however, the risk
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53 230 of presenting a severe psychiatric illness was not greater among migrants (34–36).
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3 231 Finally, in the population born in Switzerland, all categories of civil status had the same risk of
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5 232 reporting poor SRH as people living alone. However, childless migrant couples were less likely to
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8 233 report poor SRH than people living alone, and this risk was even lower for migrant couples with
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10 234 children. This is also reflected in the literature, where migrant women are described as a key player
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12 235 in health - for their health, as well as of their children and their families. Conversely, single migrants
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14 236 were more likely to view their health as poor among both men and women, when compared to those
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17 237 who were married or in a common-law relationship (34–36).
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20 238 The strengths of this study were the size of the sample, the rigorous collection of data and the
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22 239 advanced statistical approaches that made it possible to control both measured and unmeasured
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24 240 confounding factors. Among the weaknesses, the predominant migration groups included in this
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27 241 study (from other European countries and often >25 years in Switzerland) may be more similar to
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29 242 those born in Switzerland, limiting the generalizability of these results to other countries with
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31 243 different composition of their migrant populations. The lack of recent migrants in the sample is one
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34 244 of the main limitations of the current study. The variables included in the Panel Data Study are
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36 245 lacking on variables focus on acculturation, intergroup relations or experienced discrimination that
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38 246 which may influence directly or indirectly the relationship between level of education and SRH of
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41 247 migrants. Another weakness is the likely selection bias in the participants of the study due to the
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43 248 relative low participant rate of 34% of the invited population. We did not captured the health status
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45 249 at baseline as in many other longitudinal studies of health-selective migration. Finally, the complex
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48 250 modelling used in this study generates large confidence intervals makes it more difficult to exclude
49
50 251 a small influence of the country of birth.
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55 253 **References**

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342 **Ethics approval and consent to participate**

343 The institutional Ethics Committee of the University of Lausanne, which afterwards became the
344 Ethics Commission of Canton Vaud (www.cer-vd.ch) approved the first (reference 33/09, decision
345 of 23rd February 2009) and the second (reference 26/14, decision of 11th March 2014) follow-ups.

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2
3 346 The study was performed in agreement with the Helsinki declaration and its former amendments.
4

5 347 All participants gave their signed informed consent before entering the study.
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10 349 **Availability of data and materials**

11
12 350 CoLaus study (<https://www.colaus-psycholaus.ch/>).
13
14

15 351

16 17 352 **Competing interests**

18
19 353 The authors declare that they have no competing interests
20
21

22 354

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25
26 356 No additional funding was required for this research.
27
28

29 357

30 31 358 **Authors' contributions**

32
33 359 MP had the research proposal and wrote most of the article. SM made the statistical analyses. SK
34

35 360 and MP revised the article for important intellectual content. BP and MP have full access to the
36

37 361 data. BP is the guarantor of the study.
38
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40 362

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49

50 367 study design, data collection, analysis and interpretation, writing of the report, or decision to submit
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52 368 the article for publication.
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373 **TABLES & FIGURES**

374 Table 1. Descriptive statistics of demographic characteristics and variables for the three periods analyzed
 375 (2003-2006; 2009-2012; 2014-2017) of the CoLaus study. It should be noted that several variables have
 376 missing data for one or two waves of CoLaus. This has been taken into account in the context of the
 377 Bayesian analysis which takes into account the missing values in the treatment of uncertainty.
 378

	Period 1 2003-2006 (n=6,733)	Period 2 2009-2012 (n=5,064)	Period 3 2014-2017 (4,881)
Variable	N (%)	N (%)	N (%)
Self-reported Health Status (Good or Very Good)	-	4,164 (82%)	3,743 (78%)
Fair, Poor or Very Poor	-	873 (17%)	1,088 (22%)
Country of birth (Other than Switzerland)	2,700 (40%)	1,880 (37%)	1,818 (37%)
Switzerland	4,031 (60%)	3,184 (63%)	3,062 (63%)
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)	271 (4%)	130 (3%)	-
21-39	658 (10%)	386 (8%)	-
30-39	1027 (15%)	781 (15%)	-
40-54	982 (15%)	905 (18%)	-
=>55	781 (12%)	624 (12%)	-
Missing	3,014 (45%)	2,238 (44%)	
Educational level (Mandatory education)	1,397 (21%)	878 (17%)	839 (17%)
Apprenticeship	2,377 (35%)	1,796 (35%)	1,749 (36%)
High school	1,625 (24%)	1,306 (26%)	1,258 (26%)
University education	1,320 (20%)	1,079 (21%)	1,031 (21%)
Job type (High)	803 (12%)	458 (9%)	476 (11%)
Middle	2662 (40%)	1,111 (22%)	714 (16%)
Low	1306 (19%)	1,479 (29%)	939 (22%)
Not working	1945 (29%)	1,772 (35%)	2,205 (51%)
Current situation (living alone)	-	1,414 (28%)	1,286 (30%)
Single parent family	-	285 (6%)	228 (5%)
Couple without children	-	1,757 (35%)	1,508 (35%)
Couple with children	-	1,547 (31%)	1,074 (25%)
Missing	-	61 (1%)	238 (5%)
Current professional status (Manoeuvre)	-	207 (4%)	138 (3%)
Qualified worker	-	249 (5%)	194 (4%)
Farmer	-	7 (0.1%)	8 (0.2%)

Non qualified employee	-	262 (5%)	147 (3%)
Qualified employee (f.e. secretary)	-	781 (15%)	543 (11%)
Low manager	-	789 (16%)	247 (5%)
Middle manager	-	335 (7%)	515 (11%)
Top manager	-	262 (5%)	363 (7%)
Liberal professional (medical doctor, lawyer)	-	197 (4%)	145 (3%)
Not employed or missing	-	1,975 (39%)	2,581 (53%)
Monthly household gross income (<2.999 CHF)	-	-	253 (6%)
3000-4999 CHF	-	-	656 (15%)
5000-6999 CHF	-	-	792 (18%)
7000-9499 CHF	-	-	715 (17%)
9500-13000 CHF	-	-	543 (13%)
> 13000 CHF	-	-	466 (11%)
Refused or missing	-	-	909 (21%)
Do you currently drink alcohol (no)	1505 (22%)	878 (17%)	939 (19%)
Yes	5221 (78%)	4123 (82%)	3,419 (70%)
Missing	7 (0.1%)	63 (1%)	523 (11%)
Gender (Man)	3,189 (47%)	2,357 (47%)	2,193 (45%)
Women	3,544 (53%)	2,707 (53%)	2,688 (55%)
Age category (0-44 years)	1,987 (30%)	-	-
45-54 years	1,967 (29%)	-	-
55-64 years	1,778 (26%)	-	-
65-74 years	988 (15%)	-	-
> 75 years	13 (0.2%)	-	-
How many years have you lived in Switzerland (<25 years)	1,389 (21%)	-	-
25-39 years	1,274 (19%)	-	-
40-48 years	1,407 (21%)	-	-
49-59 years	1,230 (18%)	-	-
60-75 years	1,284 (19%)	-	-

379
380 Table 2. Proportions of SHR during waves 2 (2009-2012) and 3 (2014-2017), stratified by place of birth
381 (non-migrants = born in Switzerland vs. migrants = born in another country) of the CoLaus study. The very
382 good and good categories (perceived health status) were transformed into a single variable - good health -
383 and the average, poor and very poor health categories perceived as a second variable - poor health -
384
385

Time period	Group	Self-reported health status				
		Very good	Good	Fair	Poor	Very poor
Period 2	Born in Switzerland	838 (26%)	1,870 (59%)	416 (13%)	38 (1%)	4 (0.1%)

2009-2012	Born in another country	381 (20%)	1,075 (57%)	362 (19%)	44 (2%)	9 (0.5%)
Period 3 2014-2017	Born in Switzerland	702 (23%)	1,731 (57%)	537 (18%)	54 (2%)	6 (0.2%)
	Born in another country	330 (18%)	979 (54%)	429 (24%)	56 (3%)	6 (0.3%)

Table 3. Results of the mixed models of the explanatory variables for the perceived health of the entire cohort of the CoLaus study for the period 2003-2017.

Self Rated Health	OR (95% Credibility interval)	Prob(log(OR) >0)
Country of birth (Other than Switzerland)		
Switzerland	1.09(0.52-2.31)	0.5932
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	0.92(0.65-1.30)	0.6821
30-39	1.11(0.81-1.51)	0.7439
40-54	0.83(0.60-1.14)	0.8754
=>55	0.82(0.55-1.20)	0.8479
Educational level (Mandatory education)		
Apprenticeship	0.67(0.49-0.90)	0.9960*
High school	0.63(0.45-0.84)	0.9992*
University education	0.40(0.28-0.58)	0.9999*
Job type (High)		
Middle	0.58(0.35-0.95)	0.9853*
Low	0.60(0.41-0.88)	0.9958*
Not working	0.62(0.42-0.92)	0.9917*
Current situation (living alone)		
Single parent family	1.17(0.78-1.78)	0.7758
Couple without children	0.84(0.64-1.09)	0.9115
Couple with children	0.89(0.68-1.16)	0.8084
Current professional status (manoeuvre)		

Qualified worker	0.81(0.45-1.45)	0.7646
Farmer	0.58(0.04-7.49)	0.6631
Non-qualified worker (office assistant)	1.09(0.70-1.70)	0.6530
Qualified employee (f.e. secretary)	0.90(0.61-1.32)	0.7119
Low manager	0.94(0.59-1.49)	0.6063
Middle manager	1.03(0.62-1.69)	0.5382
Top manager	1.13(0.85-1.51)	0.7991
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.04(0.73-1.47)	0.5761
5000-6999 CHF	1.01(0.70-1.46)	0.5187
7000-9499 CHF	0.68(0.45-1.02)	0.9690*
9500-13000 CHF	1.21(0.76-1.92)	0.7886
> 13000 CHF	0.55(0.29-1.06)	0.9640*
Do you currently drink alcohol (no)		
Yes	0.63(0.51-0.79)	0.9999*
Gender (Man)		
Women	1.28(1.02-1.60)	0.9850*
Age category (0-45 years)		
45-54 years	1.17(0.82-1.68)	0.8047
55-64 years	1.44(0.97-2.15)	0.9643*
65-74 years	1.29(0.82-2.04)	0.8667
> 75 years	1.17(0.67-2.06)	0.7130
How many years have you been living in Switzerland (First quintile <32 years)		
Second quintile	0.92(0.72-1.18)	0.7364
Third quintile	0.92(0.70-1.22)	0.7108
Fourth quintile	0.93(0.68-1.28)	0.6691
Fifth quintile	1.03(0.68-1.57)	0.5552

Table 4. Results of the mixed models of the explanatory variables for the perceived health of people born in Switzerland of the CoLaus study population of the CoLaus study for the period 2009-2012 and 2014-2017.

Self Rated Health	OR (95% Credibility interval)	Prob(log(OR))>0
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	1.04(0.63-1.73)	0.5646
30-39	0.94(0.63-1.39)	0.6305
40-54	1.18(0.78-1.77)	0.7817
=>55	1.22(0.74-2.03)	0.7812
Educational level (Mandatory education)		
Apprenticeship	0.97(0.65-1.46)	0.5584
High school	0.97(0.63-1.49)	0.5622
University education	1.15(0.68-1.93)	0.6961
Job type (High)		
Middle	1.45(0.75-2.78)	0.8664
Low	1.36(0.82-2.25)	0.8807
Not working	1.30(0.74-2.29)	0.8202
Current situation (living alone)		
Single parent family	0.82(0.46-1.47)	0.7483
Couple without children	0.93(0.67-1.29)	0.6620
Couple with children	0.59(0.40-0.87)	0.9965*
Current professional status (manoeuvre)		
Qualified worker	1.24(0.49-3.13)	0.6780
Farmer	1.59(0.05-52.74)	0.6009
Non-qualified worker (office assistant)	0.81(0.39-1.66)	0.7221
Qualified employe (f.e. secretary)	0.91(0.53-1.57)	0.6357
Low manager	0.97(0.53-1.78)	0.5354
Middle manager	0.62(0.31-1.25)	0.9117
Top manager	0.99(0.69-1.45)	0.5033
Liberal professional (medical doctor, lawyer)	2.52(0.91-6.96)	0.9623
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.30(0.81-2.10)	0.8636
5000-6999 CHF	1.24(0.78-1.99)	0.8177

7000-9499 CHF	1.39(0.82-2.37)	0.8876
9500-13000 CHF	0.92(0.51-1.68)	0.6051
> 13000 CHF	1.24(0.56-2.74)	0.7032
Do you currently drink alcohol (no)		
Yes	1.01(0.75-1.34)	0.5188
Gender (Man)		
Women	0.73(0.55-0.98)	0.9826*
Age category (0-45 years)		
45-54 years	0.80(0.46-1.40)	0.7833
55-64 years	0.62(0.33-1.15)	0.9363
65-74 years	0.45(0.22-0.92)	0.9862*
> 75 years	0.75(0.35-1.63)	0.7673

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Table 5. Results of the mixed models of the explanatory variables for the perceived health of people born outside of Switzerland of the CoLaus study population of the CoLaus study for the period 2009-2012 and 2014-2017.

Self Rated Health	OR (95% Credibility interval)	Prob(log(OR))>0
Socio Economical Status quantiles following Hollingshead including relatives (1=<20)		
21-39	1.04(0.63-1.73)	0.5646
30-39	0.94(0.63-1.39)	0.6305
40-54	1.18(0.78-1.77)	0.7817
=>55	1.22(0.74-2.03)	0.7812
Educational level (Mandatory education)		
Apprenticeship	0.97(0.65-1.46)	0.5584
High school	0.97(0.63-1.49)	0.5622
University education	1.15(0.68-1.93)	0.6961
Job type (High)		
Middle	1.45(0.75-2.78)	0.8664
Low	1.36(0.82-2.25)	0.8807
Not working	1.30(0.74-2.29)	0.8202
Current situation (living alone)		

Single parent family	0.82(0.46-1.47)	0.7483
Couple without children	0.93(0.67-1.29)	0.6620
Couple with children	0.59(0.40-0.87)	0.9965*
Current professional status (manoeuvre)		
Qualified worker	1.24(0.49-3.13)	0.6780
Farmer	1.59(0.05-52.74)	0.6009
Non-qualified worker (office assistant)	0.81(0.39-1.66)	0.7221
Qualified employe (f.e. secretary)	0.91(0.53-1.57)	0.6357
Low manager	0.97(0.53-1.78)	0.5354
Middle manager	0.62(0.31-1.25)	0.9117
Top manager	0.99(0.69-1.45)	0.5033
Liberal professional (medical doctor, lawyer)	2.52(0.91-6.96)	0.9623
Monthly household gross income (< 2.999 CHF)		
3000-4999 CHF	1.30(0.81-2.10)	0.8636
5000-6999 CHF	1.24(0.78-1.99)	0.8177
7000-9499 CHF	1.39(0.82-2.37)	0.8876
9500-13000 CHF	0.92(0.51-1.68)	0.6051
> 13000 CHF	1.24(0.56-2.74)	0.7032
Do you currently drink alcohol (no)		
Yes	1.01(0.75-1.34)	0.5188
Gender (Man)		
Women	0.73(0.55-0.98)	0.9826*
Age category (0-45 years)		
45-54 years	0.80(0.46-1.40)	0.7833
55-64 years	0.62(0.33-1.15)	0.9363
65-74 years	0.45(0.22-0.92)	0.9862*
> 75 years	0.75(0.35-1.63)	0.7673

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STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation
Title and abstract	1	Lines: 1-2 Lines: 30-48
Introduction		
Background/rationale	2	Lines: 69-85
Objectives	3	Lines: 87-91
Methods		
Study design	4	Lines: 37-38
Setting	5	Lines 94-109
Participants	6	Lines: 99-103 Not applicable
Variables	7	Lines: 111-124
Data sources/ measurement	8*	Lines: 126-145
Bias	9	Lines 139-145
Study size	10	Lines:147-155
Quantitative variables	11	Lines:126-145
Statistical methods	12	Lines 126-162 Lines: 139-145 Lines: 126-137 Lines: 126-162 Lines: 147-160
Results		
Participants	13*	Lines: 167-169 Not Applicable Not Applicable
Descriptive data	14*	Lines: 167-169 Tables 1 and 2 Tables 1 and 2
Outcome data	15*	Report numbers of outcome events or summary measures over time
Main results	16	Lines: 170-211 Not Applicable Not Applicable
Other analyses	17	Not Applicable
Discussion		
Key results	18	Lines:220-249
Limitations	19	Lines 245-249
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Generalisability	21	Lines:251-259
Other information		
Funding	22	Line:286

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.