BMJ Open

Losing ground at the wrong time: trends in self-reported influenza vaccination uptake in Switzerland, Swiss Health Survey 2007–2017

Kathrin Zürcher ,[1] Marcel Zwahlen ,[1] Claudia Berlin ,[1] Matthias Egger ,[1,2] Lukas Fenner [1,3]

To cite: Zürcher K, Zwahlen M, Berlin C, *et al*. Losing ground at the wrong time: trends in self-reported influenza vaccination uptake in Switzerland, Swiss Health Survey 2007–2017. *BMJ Open* 2021;**11**:e041354. doi:10.1136/bmjopen-2020-041354

► Prepublication history and additional materials for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2020-041354).

Received 05 June 2020
Revised 15 October 2020
Accepted 22 December 2020

[1]Institute of Social & Preventive Medicine, University of Bern, Bern, Switzerland
[2]Population Health Sciences, Bristol Medical School, University of Bristol, BristolUK
[3]Kanton Solothurn Gesundheitsamt, Solothurn, Switzerland

Correspondence to
Dr Lukas Fenner;
lukas.fenner@ispm.unibe.ch

ABSTRACT

Objectives We studied time trends in seasonal influenza vaccination and associations with socioeconomic and health-related determinants in Switzerland, overall and in people aged ≥65 years.

Design Three cross-sectional surveys.

Participants Individuals who participated in the Swiss Health Surveys 2007, 2012 and 2017. We calculated the proportion reporting influenza vaccination in the last 12 months, and performed multivariable logistic regression analyses.

Results We included 51 582 individuals in this analysis. The median age was 49 years (IQR 25–64), and 27 518 were women (53.3%). The proportion of reporting a history of influenza vaccination overall was 31.9% (95% CI 31.4 to 32.4); and dropped from 34.5% in 2007 to 28.8% in 2017. The uptake of vaccination within the past 12 months was 16% in 2007 and similar in 2012 and 2017 (around 14%). In people with chronic disease, uptake dropped from 43.8% in 2007 to 37.1% in 2012 and to 31.6% in 2017 (p<0.001). In people aged ≥65 years, uptake dropped from 47.8% in 2007 to 38.5% in 2012 to 36.2% in 2017 (p<0.001). In logistic regression, self-reported vaccination coverage decreased in the 65–75 years old (adjusted OR (aOR) 0.56, 95% CI 0.48 to 0.66 between 2007 and 2012; aOR 0.89, 95% CI 0.77 to 1.03 between 2012 and 2017). Uptake was positively associated with the ≥65 age group, living in French-speaking and urban areas, history of smoking, bad self-reported health status, private/semiprivate health insurance, having a medical profession and having any underlying chronic disease.

Conclusion Influenza vaccination coverage was low in older and chronically ill persons. Significant efforts are required in preparing for the influenza season 2020/2021 to reduce the double burden of COVID-19 and seasonal influenza. These efforts should include campaigns but also novel approaches using social media.

Strengths and limitations of this study

- The Swiss Health Survey is a nationwide, representative survey that is repeated every 5 years using the same sampling methodology.
- Data analysis of the Swiss Health Survey 2007, 2012 and 2017 focussing on influenza vaccine uptake overall and in the age group ≥65 years in Switzerland.
- We calculated per cent of people reporting having been vaccinated, analysed time trends and associations between vaccination status and sociodemographic and health-related factors.
- The analyses were weighted and adjusted for a range of potential confounders, which did not substantially change the results.
- Influenza vaccination status is self-reported in the Swiss Health Survey and the reliability of the data is not ascertained.

INTRODUCTION

Seasonal influenza is pandemic, and a challenge for surveillance, control and treatment.[1] Worldwide, it causes 3–5 million cases of severe illness each year and kills 250 000–500 000 people,[2] particularly infants, the elderly and the chronically ill. In Switzerland, influenza is responsible for 111 000–331 000 medical consultations yearly and 1000–5000 hospitalisations.[3] The current COVID-19 pandemic shows the impact of respiratory viruses on the burden of infectious diseases and the importance of vaccines in the control of viral respiratory diseases.[4 5]

In 2003, the World Health Assembly adopted a resolution urging member states to reach a target for uptake of influenza vaccines of 75% among people at high risk by 2010.[6] The Federal Office of Public Health in Switzerland has vaccine recommendations in place since 2007, which target mainly elderly people, but also those with chronic illnesses (including children older than 6 months), premature infants, pregnant women, residents of long-term healthcare facilities and those are in regular contact with vulnerable populations.[7]

We earlier analysed the data from the Swiss Health Survey 2007 and 2012 and showed that overall influenza vaccine uptake in

Switzerland decreased from 2007 to 2012.[8] To examine recent trends and associations of sociodemographic characteristics and health-related factors with influenza vaccination practices in Switzerland, we analysed the data from the most recent nationally representative health survey, in 2017, and compared the results with those from 2012 and 2007.

MATERIAL AND METHODS

Survey sample

The cross-sectional Swiss Health Survey has been conducted every 5 years since 1992 by the Swiss Federal Statistical Office (SFSO). The survey is a multistage probability sample drawn from all residents not living in institutions in Switzerland.[8 9] Conducted between January and December of the year, the survey collects data using computer-assisted telephone interviews and self-completed questionnaires.

We compared the data set from 2017 with the data from 2012 and 2007 and only used survey data from the written forms. We excluded the telephone interviews because they were shorter and did not include all the questions. We included a total of 51 582 people who responded to a written questionnaire; 14 393 responded in 2007, 18 357 in 2012 and 18 632 in 2017.

Data collection and definitions

From all three surveys, we extracted data on influenza vaccination within the past 12 months.[9]

The questionnaire collected demographic and socioeconomic as well as health-related information (table 1) on chronic diseases such as diabetes, cancer, lung, cerebrovascular and cardiovascular disease. The basic health insurance is mandatory in Switzerland and provides cover for illness, maternity, and accidents, offering the same range of services to all insured people.[10] The respondents' health insurance plan regarding coverage in case of hospitalisation (private, semiprivate, or general ward), free choice of physicians and coverage of complementary medicine (including acupuncture, traditional Chinese medicine, homoeopathy, and osteopathy) in the past 12 months was recorded as well.

Pregnancy was recorded as current pregnancy among women 15–49 years old. Current chronic lung diseases included asthma, chronic bronchitis and emphysema. Diabetes was defined by the use of any diabetic drug, cardiovascular disease by the use of any heart medication, and all other chronic diseases were recorded as self-reported. We defined any chronic disease as the presence of at least one of the mentioned diseases. Healthcare workers were defined as individuals reporting profession in the healthcare system.

Cantons are the administrative subdivisions of Switzerland (see figure 1).

Statistical analysis

For each of the three survey years we calculated the proportions (overall and ≥65 years) that reported having been vaccinated within the last 12 months. We estimated associations between vaccination status and sociodemographic and health-related factors. We included an interaction term with the year of survey and the variable of interest in multivariable logistic regression models. We used the SFSO's survey weights and reported all proportions and unadjusted and adjusted OR (aOR) with the corresponding 95% CIs derived from robust SE calculations (table 2). All analyses were performed in Stata (V.15.1).

We visualised changes in the frequency of vaccination uptake, and geographical distributions of the population that reported vaccination for influenza at the cantonal level using ArcGIS V.10.5 (Redlands, California, USA).

RESULTS

Trends of influenza vaccinations over time

The proportion of survey participants reporting a history of influenza vaccination overall was 31.9% (95% CI 31.4 to 32.4), having dropped from 34.5% in 2007 to 28.8% in 2017. The proportion reporting vaccination within the past 12 months was 16.4% (95% CI 15.6 to 17.2) in 2007, dropped to 14.1% (95% CI 13.5 to 14.8) in 2012, and remained at this level in 2017 (14.4%, 95% CI 13.8 to 15.0, p<0.001, table 1). Among those ≥65 years old, the principal target population of the Swiss recommendations,[7] vaccination in the past 12 months dropped from 47.8% (95% CI 45.7 to 49.9) in 2007 to 38.5% (95% CI 36.6 to 40.5) in 2012, and 36.2% (95% CI 34.6 to 37.9) in 2017 (p<0.001). For those with any chronic disease, another at-risk population, the frequency of influenza vaccination dropped from 43.8% (95% CI 40.9 to 46.8) in 2007 to 37.1% (95% CI 34.6 to 39.7) in 2012, and further to 31.6% (95% CI 29.7 to 33.6) in 2017. Similarly, a decrease in vaccine uptake was seen in people with poor self-reported health status (39.4%, 33.1% and 27.0%, figure 2).

From 2007 to 2012 the self-reported influenza vaccination in the last 12 months decreased in age group 15–19 years (aOR 0.51, 95% CI 0.27 to 0.99) but increased from 2012 to 2017 in the younger age groups (eg, aOR 1.59, 95% CI 0.92 to 2.74 in the 15–19 years age group; aOR 1.19. 96% CI 0.84 to 1.69 in the 20–29 years age group, figure 2 and table 2). In contrast, it decreased in the 65–75 years old between 2007 and 2017 (aOR 0.56, 95% CI 0.48 to 0.66 for 2007–2012; aOR 0.89, 95% CI 0.77 to 1.03 for 2012–2017, table 2). The p value from the test for an interaction between period and age group was 0.01 for 2007–2012 and 0.051 for 2012–2017. In pregnant women, an increase of influenza vaccination was observed between 2007 and 2012 (aOR 4.43, 95% CI 0.96 to 20.42, p=0.02), with no further increase between 2012 and 2017 (aOR 0.94, 95% CI 0.36 to 2.47, p=0.45). The temporal trends over the period 2007–2012 and 2012–2017 were not associated with age, language region, urban/rural setting, citizenship, any chronic disease, smoking status, use of complementary medicine or type of hospital stay insurance (p>0.05, table 2).

Table 1 Percent of people reporting having been vaccinated for influenza in the last 12 months in Switzerland, 2007, 2012 and 2017, overall and among people ≥65 years old

Characteristic	2007		2012		2017	
% (95% CI)	All	≥65 years old	All	≥65 years old	All	≥65 years old
Total	16.37 (15.61 to 17.16)	47.79 (45.66 to 49.93)	14.09 (13.45 to 14.75)	38.53 (36.60 to 40.49)	14.38 (13.81 to 14.97)	36.22 (34.58 to 37.90)
Age group, years						
15–19	7.75 (5.32 to 11.16)	–	5.23 (3.91 to 6.97)	–	6.51 (5.11 to 8.27)	–
20 to 29	5.45 (3.98 to 7.42)	–	4.94 (3.92 to 6.20)	–	7.17 (5.91 to 8.66)	–
30–39	7.05 (5.80 to 8.56)	–	4.55 (3.70 to 5.59)	–	6.37 (5.37 to 7.54)	–
40–49	8.80 (7.43 to 10.39)	–	6.67 (5.72 to 7.77)	–	7.52 (6.53 to 8.65)	–
50–64	14.94 (13.51 to 16.49)	–	12.65 (11.46 to 13.94)	–	12.26 (11.23 to 13.36)	–
65–75	41.64 (38.90 to 44.44)	41.64 (38.90 to 44.44)	29.31 (27.28 to 31.43)	29.31 (27.28 to 31.44)	26.74 (24.81 to 28.76)	26.74 (24.81 to 28.76)
>75	55.24 (51.94 to 58.50)	55.24 (51.94 to 58.50)	48.99 (45.73 to 52.26)	48.99 (45.73 to 52.26)	47.96 (45.29 to 50.63)	47.96 (45.29 to 50.63)
Sex						
Male	15.74 (14.67 to 16.86)	48.69 (45.39 to 52.00)	13.52 (12.67 to 14.43)	38.44 (35.81 to 41.15)	13.89 (13.08 to 14.73)	37.01 (34.65 to 39.43)
Female	16.97 (15.90 to 18.09)	47.11 (44.31 to 49.92)	14.63 (13.71 to 15.60)	38.57 (35.84 to 41.37)	14.86 (14.06 to 15.70)	35.56 (33.29 to 37.89)
Pregnancy (current)*						
Yes	2.25 (0.62 to 7.90)	–	8.95 (4.91 to 15.75)	–	8.48 (4.50 to 15.40)	–
No	7.88 (6.65 to 9.30)	–	5.11 (4.40 to 5.94)	–	7.34 (6.52 to 8.26)	–
BMI group						
Underweight	12.43 (9.21–16.57)	53.33 (39.66 to 66.52)	14.30 (11.07 to 18.29)	40.59 (29.03 to 53.30)	12.26 (9.65 to 15.44)	43.17 (32.16 to 54.89)
Normal	13.67 (12.74 to 14.67)	44.70 (41.63 to 47.81)	12.24 (11.44 to 13.08)	39.41 (36.54 to 42.36)	12.95 (12.20 to 13.74)	35.36 (32.91 to 37.90)
Overweight	20.49 (19.00 to 22.07)	50.42 (47.02 to 53.82)	15.99 (14.78 to 17.29)	37.26 (34.15 to 40.48)	15.85 (14.79 to 16.96)	35.67 (33.09 to 38.34)
Obese	23.03 (20.09 to 26.25)	52.81 (46.13 to 59.39)	18.20 (16.16 to 20.44)	38.52 (33.55 to 43.76)	18.23 (16.42 to 20.20)	39.80 (35.29 to 44.50)
Language region						
German-speaking	15.63 (14.70 to 16.60)	45.40 (42.78 to 48.06)	13.35 (12.57 to 14.17)	37.43 (35.03 to 39.88)	13.89 (13.18 to 14.63)	34.89 (32.88 to 36.96)
French-speaking	18.03 (16.62 to 19.53)	54.15 (50.18 to 58.06)	16.13 (14.96 to 17.37)	41.66 (38.17 to 45.23)	15.71 (14.66 to 16.81)	39.65 (36.62 to 42.75)
Italian-speaking	19.02 (16.45 to 21.88)	52.78 (46.15 to 59.31)	14.16 (12.22 to 16.34)	38.64 (32.81 to 44.82)	14.66 (12.78 to 16.75)	40.66 (35.09 to 46.48)
Setting						
Urban	17.30 (16.39 to 18.25)	48.70 (46.23 to 51.17)	15.07 (14.32 to 15.85)	39.79 (37.66 to 41.95)	15.40 (14.70 to 16.13)	37.82 (35.86 to 39.82)
Rural	13.82 (12.49 to 15.26)	45.00 (40.76 to 49.32)	11.38 (10.20 to 12.66)	34.40 (30.08 to 39.00)	11.49 (10.57 to 12.48)	31.45 (28.55 to 34.50)
Citizenship						
Swiss	17.13 (16.35 to 17.94)	48.06 (45.92 to 50.21)	15.20 (14.48 to 15.94)	38.64 (36.62 to 40.69)	15.27 (14.62 to 15.95)	36.36 (34.62 to 38.12)
Non-Swiss	13.46 (11.43 to 15.78)	45.44 (36.42 to 54.78)	10.37 (9.08 to 11.82)	37.46 (31.22 to 44.15)	11.60 (10.44 to 12.88)	35.15 (30.12 to 40.54)
Education level						
Primary	19.74 (17.85 to 21.77)	46.21 (42.41 to 50.07)	15.59 (13.87 to 17.49)	35.56 (31.15 to 40.24)	14.21 (12.92 to 15.60)	35.79 (32.27 to 39.46))
Apprenticeship	15.49 (14.41 to 16.62)	46.26 (42.41 to 50.07)	13.89 (12.96 to 14.87)	38.74 (36.08 to 41.46)	13.96 (13.03 to 14.94)	34.27 (31.78 to 36.85)
Secondary	12.01 (10.00 to 14.37)	44.29 (36.07 to 52.84)	13.97 (12.11 to 16.06)	43.84 (37.70 to 50.17)	15.02 (13.40 to 16.80)	42.00 (37.10 to 47.05)

Continued

Table 1 Continued

Characteristic	2007		2012		2017	
% (95% CI)	All	≥65 years old	All	≥65 years old	All	≥65 years old
Tertiary	16.37 (15.61 to 17.16)	55.89 (50.85 to 60.80)	13.37 (12.32 to 14.49)	39.48 (35.62 to 43.46)	14.56 (13.57 to 15.62)	36.56 (33.32 to 39.92)
Smoking						
Never smoked	16.55 (15.46 to 17.70)	47.31 (44.40 to 50.23)	13.94 (13.02 to 14.90)	37.19 (34.50 to 39.97)	13.94 (13.15 to 14.78)	35.14 (32.85 to 37.51)
Former smoker	22.50 (20.79 to 24.31)	50.32 (46.56 to 54.08)	20.21 (18.71 to 21.80)	41.55 (38.31 to 44.86)	20.32 (18.97 to 21.74)	39.43 (36.64 to 42.29)
Current smoker	10.89 (9.71 to 12.19)	43.20 (37.63 to 48.93)	9.58 (8.63 to 10.62)	36.34 (31.30 to 41.71)	10.31 (9.36 to 11.35)	31.98 (27.82 to 36.44)
Self-reported health status						
Very good	10.97 (9.50 to 12.63)	34.51 (29.18 to 40.25)	8.50 (7.73 to 9.34)	28.40 (24.81 to 32.30)	10.05 (9.27 to 10.88)	26.57 (23.68 to 29.69)
Good	14.76 (13.88 to 15.67)	45.57 (42.89 to 48.29)	14.22 (13.26 to 15.24)	37.56 (34.77 to 40.43)	14.43 (13.58 to 15.32)	35.35 (33.02 to 37.75)
Moderate	33.13 (3.10 to 36.31)	58.16 (53.28 to 62.90)	25.87 (23.68 to 28.19)	46.48 (42.57 to 50.44)	26.84 (22.74 to 29.04)	47.52 (43.74 to 51.32)
Bad	38.55 (31.45 to 46.17)	65.80 (54.60 to 75.48)	33.83 (28.60 to 39.50)	54.16 (44.07 to 63.91)	26.55 (22.23 to 31.37)	51.35 (42.28 to 60.33)
Very bad	44.33 (27.56 to 62.49)	73.69 (37.76 to 92.82)	29.13 (17.36 to 44.58)	41.73 (21.00 to 65.86)	28.91 (19.51 to 40.56)	43.91 (25.87 to 63.71)
Hospital stay insurance						
Basic	14.04 (13.15 to 14.99)	44.87 (42.07 to 47.70)	12.30 (11.53 to 13.12)	35.39 (32.83 to 38.05)	12.38 (11.72 to 13.07)	32.75 (30.68 to 34.88)
Semiprivate	21.39 (19.58 to 23.33)	51.23 (47.02 to 55.43)	19.74 (18.16 to 21.41)	41.38 (37.82 to 45.03)	20.26 (18.78 to 21.83)	39.99 (36.80 to 43.27)
Private	28.34 (25.47 to 31.40)	55.06 (49.58 to 60.43)	27.15 (24.34 to 30.15)	50.55 (45.37 to 55.72)	26.77 (23.99 to 29.76)	46.29 (41.20 to 51.46)
Other	23.45 (15.11 to 34.52)	62.63 (35.66 to 83.52)	9.65 (6.25 to 14.52)	25.21 (12.25 to 45.87)	13.46 (9.11 to 19.44)	21.46 (10.86 to 37.99)
Use of any complementary medicine therapy†						
Yes	16.68 (15.35 to 18.10)	45.55 (41.93 to 49.21)	11.22 (10.19 to 12 to 35)	30.55 (27.09 to 34.24)	11.70 (10.74 to 12.73)	30.32 (27.20 to 33.62)
No	16.23 (15.32 to 17.19)	48.95 (46.31 to 51.60)	15.01 (14.24 to 15.81)	40.73 (38.48 to 43.01)	15.45 (14.74 to 16.17)	38.05 (36.14 to 40.00)
Chronic diseases‡						
Any chronic disease	43.40 (40.42 to 46.43)	60.81 (57.04 to 64.46)	37.10 (34.57 to 39.71)	48.93 (45.45 to 52.41)	31.61 (29.70 to 33.59)	48.92 (45.93 to 51.92)
Diabetes	41.51 (36.70 to 46.48)	59.95 (53.36 to 66.20)	37.58 (33.48 to 41.87)	49.58 (43.97 to 55.20)	33.24 (29.71 to 36.96)	51.65 (46.17 to 57.09)
Lung disease	42.27 (33.23 to 51.85)	65.88 (52.59 to 77.08)	42.13 (32.52 to 52.38)	50.43 (37.15 to 63.65)	21.60 (18.68 to 24.85)	49.85 (41.61 to 58.09)
Cerebrovascular disease	55.12 (41.54 to 67.97)	69.03 (51.79 to 82.21)	34.78 (24.61 to 46.57)	45.67 (31.05 to 61.09)	35.05 (22.56 to 50.00)	42.12 (25.50 to 60.75)
Cardiovascular disease	54.48 (50.42 to 58.48)	64.16 (59.64 to 68.44)	42.50 (38.96 to 46.12)	51.97 (47.51 to 56.39)	43.23 (40.12 to 46.40)	52.09 (48.33 to 55.82)
Cancer	29.76 (22.82 to 37.77)	53.84 (40.87 to 66.32)	31.46 (25.88 to 37.63)	46.35 (37.54 to 55.39)	35.65 (29.87 to 41.87)	43.11 (35.29 to 51.29)
Healthcare worker'§	17.56 (15.47 to 19.86)	–	15.15 (13.16 to 17.37)	–	18.42 (16.42 to 20.61)	–
Season of interview						
February- August	16.22 (15.31 to 17.16)	47.58 (44.91 to 50.26)	15.34 (14.53 to 16.20)	42.44 (40.02 to 44.90)	15.03 (14.34 to 15.74)	38.15 (36.19 to 40.14)
September- December	16.69 (15.33 to 18.14)	48.22 (44.70 to 51.76)	12.08 (11.10 to 13.14)	31.93 (28.81 to 35.22)	12.75 (11.74 to 13.83)	31.41 (28.44 to 34.54)

*Current pregnancy in women 15–49 years.
†Use of any alternative therapy in the past 12 months (including acupuncture, traditional Chinese medicine, homeopathy, and osteopathy).
‡Current chronic diseases versus no disease (reference); lung diseases: asthma bronchiale, chronic bronchitis and emphysema; diabetes: use of any diabetic drug; cardiovascular disease: use of any heart medication; all other diseases: self-reported.
§Any profession in the healthcare system (in the 2007 survey, the veterinary professions were also included in this category) versus any other profession (reference).
BMI, body mass index.

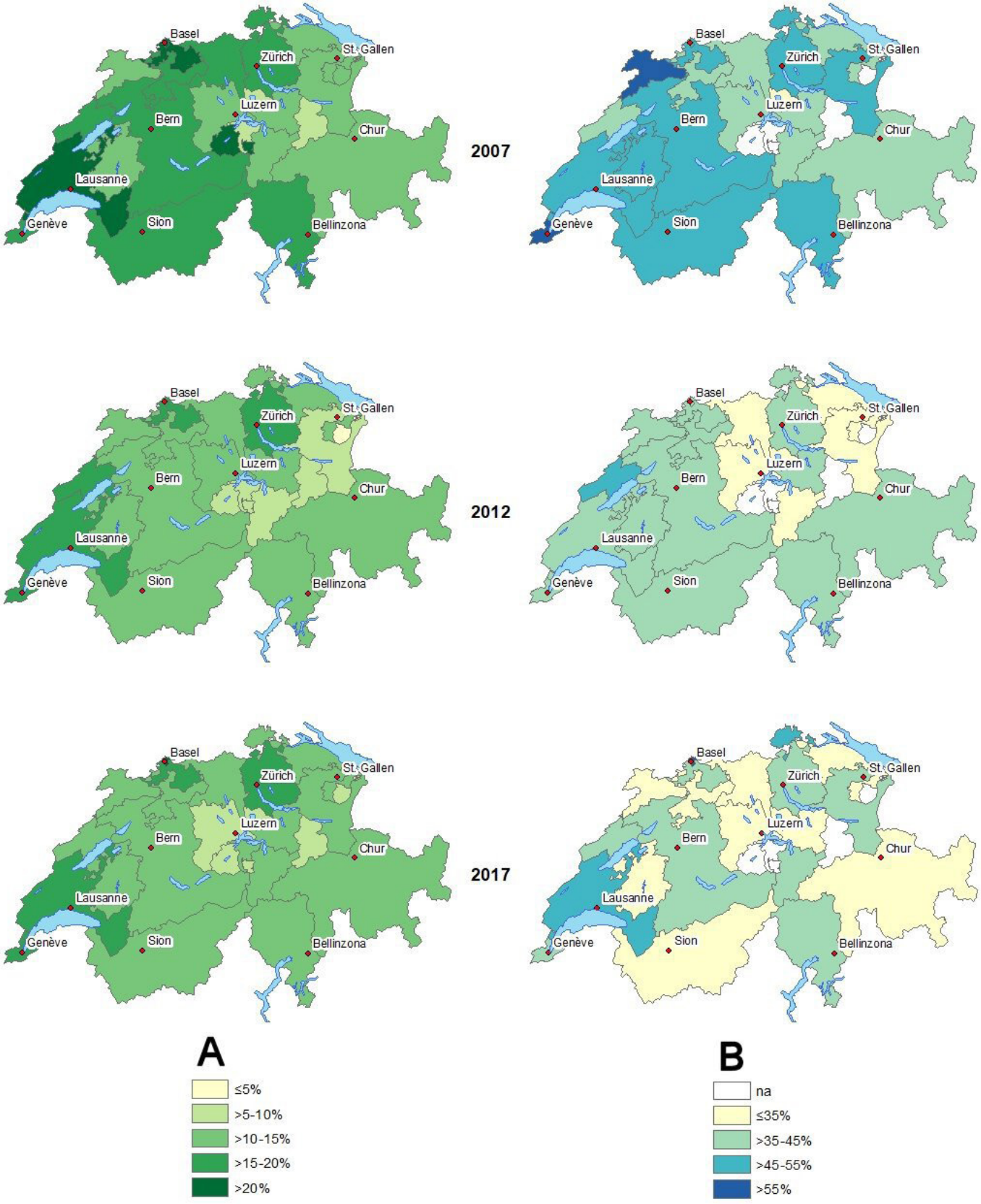

Figure 1 Geographical distribution (by canton) of people reporting influenza vaccination in the last 12 months in Switzerland, 2007 to 2017. (A) Overall; (B) people aged ≥65 years. na, not applicable (no. of respondents <100).

Table 2 Factors associated with the temporal change (between 2007, 2012 and 2017) in self-reported influenza vaccination status in the last 12 months in Switzerland, 2007 to 2012 and 2012 to 2017, overall among people aged ≥65 years

	2007–2012				2012–2017			
	All		≥65 years		All		≥65 years	
	Adjusted OR (95% CI)	P value*	Adjusted OR (95% CI)	P value*	Adjusted OR (95% CI)	P value*	Adjusted OR (95% CI)	P value*
Age groups, years		0.007		0.05		0.051		0.534
15–19	0.51 (0.27–0.99)	–	–		1.59 (0.92–2.74)		–	
20–29	1.02 (0.65–1.60)	–	–		1.19 (0.84–1.69)		–	
30–39	0.67 (0.49–0.92)	–	–		1.32 (0.98–1.77)		–	
40–49	0.74 (0.58–0.96)	–	–		1.16 (0.92–1.46)		–	
50–64	0.85 (0.72–1.00)	–	–		0.97 (0.83–1.13)		–	
65–75	0.55 (0.47–0.65)	–	0.56 (0.48–0.66)		0.87 (0.75–1.01)		0.89 (0.77–1.03)	
>75	0.73 (0.60–0.89)	–	0.72 (0.59–0.88)		0.94 (0.79–1.13)		0.95 (0.80–1.14)	
Sex	–	0.68	–	0.68	–	0.30	–	0.73
Pregnancy †‡		0.02		–		0.45	–	–
No	0.68 (0.52–0.90)		–		1.38 (1.11–1.72)		–	
Yes	4.43 (0.96–20.42)		–		0.94 (0.36–2.47)		–	
Setting (urban/rural)	–	0.94	–	0.77	–	0.40	–	0.77
Self-reported health status	–	0.58	–	0.27	–	0.20	–	0.92
Citizenship (Swiss/non-Swiss)	–	0.81	–	0.80	–	0.94	–	0.52
Education level		0.04		0.09		0.39	–	0.76
Primary	0.59 (0.48–0.74)		–	–	0.92 (0.75–1.13)		–	
Apprenticeship	0.73 (0.64–0.83)		–	–	0.96 (0.85–1.09)		–	
Secondary	1.03 (0.76–1.41)		–	–	1.02 (0.81–1.30)		–	
Tertiary	0.71 (0.60–0.84)		–	–	1.11 (0.96–1.27)		–	
Hospital stay insurance (general, semi-private/ private)	–	0.16	–	0.26	–	0.78	–	0.99
Language region (German, French, Italian)	–	0.45	–	0.048	–	0.92	–	0.66
Any chronic disease §		0.04		0.18		0.64		0.23
No	0.75 (0.68–0.84)		0.68 (0.58–0.79)		1.02 (0.93–1.12)		0.87 (0.75–1.01)	
Yes	0.60 (0.50–0.72)		0.56 (0.45–0.70)		0.97 (0.83–1.15)		1.01 (0.83–1.23)	
Smoking (never, former, current smoker)	–	0.44	–	0.75	–	0.92	–	0.75
Use of any complementary medicine therapy	–	0.14	–	0.11	–	0.40	–	0.69

Estimates derived from regression models adjusted for year of survey, age group, sex, body mass index group, setting, citizenship, language region, education level, smoking, self-reported health status, hospital stay insurance, any chronic diseases and use of any complementary medicine therapy. An interaction with the year of survey and the variable of interest was included.
*P values from interaction tests.
†Current pregnancy in women aged 15–49 years.
‡Estimate from a separate model which included the variable pregnancy instead of sex to avoid collinearity.
§Diabetes, lung disease, cerebrovascular disease, cardiovascular disease, cancer.

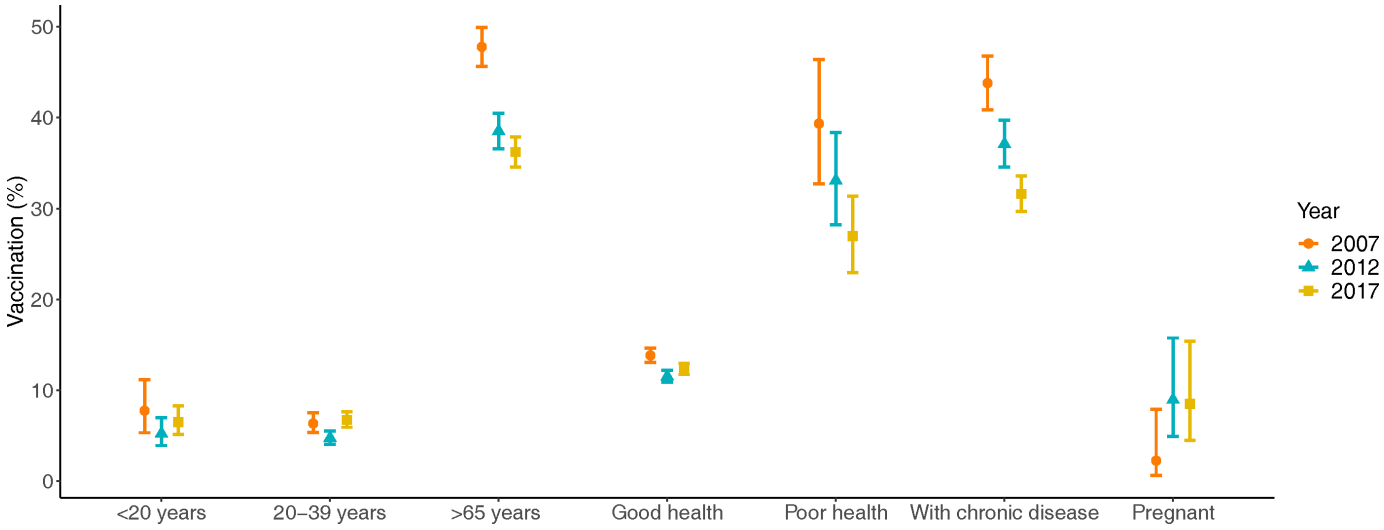

Figure 2 Temporal trends of selected groups of people reporting influenza vaccination in the last 12 months in Switzerland, comparing 2007 to 2017. Percent of people reporting having been vaccinated and the 95% CIs are presented. Good health: self-reported health status good and very good; poor health: self-reported health status bad and very bad; with chronic disease: any chronic illness.

Influenza vaccination status in different population groups

In all three surveys, self-reported influenza vaccination in the last 12 months was highest in the age group ≥65 years, and also higher in urban settings, among Swiss citizens, former smokers and in persons with supplemental health insurance (table 1). In all three surveys, the proportion of self-reported influenza vaccination was higher in the French-speaking and Italian-speaking region compared with the German region. Persons with chronic diseases were more frequently vaccinated for influenza, with uptake ranging from around 20% to 57% depending on age group and type of chronic disease. A lower proportion of self-reported vaccination was observed in ages 15 years to 50 years (range 4%–9%), current smokers, and person who reported their health status as very good. The regional differences in the vaccination status in the last 12 months in the overall population and the ≥65 age group are shown in figure 1A, B.

Individual and health system factors associated with the influenza vaccination status

In all three surveys, influenza vaccination in the last 12 months was positively associated with age 65 years or older, living in French-speaking and urban areas, having a tertiary education, history of smoking, bad self-reported health status, private/semiprivate hospital stay insurance, being a healthcare worker and having any underlying chronic disease. Use of any complementary medicine therapy was negatively associated with influenza vaccination (aOR 0.72, 95% CI 0.67 to 0.80). We found no association with sex, body mass index or non-Swiss citizenship (table 3). Similar findings were observed when analysing only participants' ≥65 years old. Online supplemental table 1 shows unadjusted and aORs of the associations between self-reported vaccination for influenza in the last 12 months and sociodemographic characteristics and health-related factors.

DISCUSSION

Progress toward the WHO target of 75% vaccination coverage among high-risk groups has not only stalled in Switzerland, some of the gains made in earlier years were lost by 2017. Of particular concern is that the self-reported seasonal influenza vaccination rate among elderly persons declined from 47.8% in 2007 to 38.5% in 2012, and declined further to 36.2% in 2017. People at risk due to underlying chronic diseases reported coverage of influenza vaccination of 31.6% in 2017. Overall, after declining from 16.4% in 2007 to 14.1% in 2012, coverage in Switzerland was, with 14.4%, similar in 2017.

A decline in influenza vaccine coverage in recent years has been observed in other European countries. In the European Region of WHO, vaccine uptake in older people ranged from 0.03% to 76.3% over seven seasons (2008/2009–2014/2015). The median was 34.4%. In 2014/2015, only Scotland reached the WHO and European Council goal with an uptake of 75%. Among countries providing data for seasons 2008/2009 and 2014/2015, over half reported a drop in vaccination coverage among older people.[11] Among people with chronic diseases, coverage in the European Region ranged from 0.3% in Kyrgyzstan to 86.8% in Georgia in 2014/2015.[11]

From a historical perspective, vaccines have substantially reduced the burden for infectious disease (eg, polio, measles, mumps and rubella) or have been eradicated (small pox).[12] Vaccine safety have always been a concern. For example, measles vaccine was falsely linked to autism in the 1990s, which led to a dramatically drop in vaccine coverage in the UK and other countries. Misleading

Table 3 Associations of having been vaccinated for influenza in the last 12 months with sociodemographic characteristics and health-related factors (as compared with no vaccination) in Switzerland, 2007 to 2017, overall and among people ≥65 years old

	All		≥65 years old	
Characteristic	Adjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Year of survey		<0.001		<0.001
2007	1		1	
2012	0.74 (0.66 to 0.83)		0.60 (0.51 to 0.71)	
2017	0.72 (0.64 to 0.80)		0.57 (0.49 to 0.66)	
Age group, years		<0.001		<0.001
15–19	1.07 (0.67 to 1.71)		–	
20–29	1		–	
30–39	1.05 (0.77 to 1.44)		–	
40–49	1.32 (0.99 to 1.75)		–	
50–64	2.27 (1.74 to 2.96)		–	
65–75	6.26 (4.78 to 8.20)		1	
>75	12.94 (9.81.17.08)		2.04 (1.82 to 2.30)	<0.001
Sex		0.66		0.37
Male	1		1	
Female	0.97 (0.88 to 1.08)		1.06 (0.93 to 1.21)	
Pregnancy		0.67		–
Yes	0.91 (0.56 to 1.70)		–	
No	1		–	
BMI group		0.87		0.93
Underweight	1		1	
Normal	0.97 (0.74 to 1.28)		0.88 (0.58 to 1.34)	
Overweight	0.94 (0.72 to 1.25)		0.89 (0.59 to 1.36)	
Obese	0.99 (0.74 to 1.32)		0.91 (0.58 to 1.41)	
Language region		<0.001		0.01
German-speaking	1		1	
French-speaking	1.31(1.20 to 1.44)		1.22 (1.07 to 1.38)	
Italian-speaking	0.95 (0.82 to 1.12)		1.05 (0.86 to 1.29)	
Setting		<0.001		0.02
Urban	1.24 (1.12–1.38)		1.19 (1.03–1.37)	
Rural	1		1	
Citizenship		0.80		0.20
Swiss	1		1	
Non-Swiss	0.98 (0.85 to 1.13)		0.87 (0.70 to 1.08)	
Education level		<0.001		0.06
Primary	1		1	
Apprenticeship	1.00 (0.88 to 1.14)		1.05 (0.89 to 1.23)	
Secondary	1.11 (0.93 to 1.31)		1.14 (0.91 to 1.43)	
Tertiary	1.26 (1.09 to 1.46)		1.26 (1.04 to 1.53)	
Smoking		<0.001		0.009
Never smoked	1		1	
Former smoker	1.17 (1.05 to 1.28)		1.22 (1.07 to 1.39)	
Current smoker	0.91 (0.81 to 1.02)		1.01 (0.85 to 1.20)	
Self-reported health status		<0.001		<0.001

Continued

Table 3 Continued

Characteristic	All		≥65 years old	
	Adjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Very good	1		1	
Good	1.16 (1.03 to 1.31)		1.30 (1.10 to 1.53)	
Moderate	1.56 (1.36 to 1.80)		1.65 (1.36 to 2.01)	
Bad	2.13 (1.70 to 2.65)		2.03 (1.46 to 2.81)	
Very bad	2.07 (1.26 to 3.40)		1.79 (0.92 to 3.45)	
Hospital stay insurance		<0.001		<0.001
Basic	1		1	
Semiprivate	1.43 (1.30 to 1.59)		1.42 (1.24 to 1.63)	
Private	1.78 (1.56 to 2.03)		1.86 (1.56 to 2.21)	
Other	1.28 (0.86 to 1.92)		0.89 (0.50 to 1.58)	
Use of any complementary medicine therapy*		<0.001		<0.001
Yes	0.72 (0.66 to 0.80)		0.65 (0.57 to 0.75)	
No	1		1	
Chronic diseases†				
Any chronic disease	1.84 (1.69 to 2.09)	<0.001	1.68 (1.51 to 1.88)	<0.001
Diabetes	1.54 (1.33 to 1.77)	<0.001	1.46 (1.23 to 1.73)	<0.001
Lung disease	1.81 (1.46 to 2.26)	<0.001	1.59 (1.16 to 2.18)	0.004
Cerebrovascular disease	1.12 (0.74 to 1.69)	0.59	0.91 (0.58 to 1.42)	0.68
Cardiovascular disease	1.50 (1.34 to 1.68)	<0.001	1.44 (1.26 to 1.64)	<0.001
Cancer	1.22 (0.97 to 1.55)	0.09	1.05 (0.80 to 1.38)	0.12
Healthcare worker'‡	1.92 (1.64 to 2.24)	<0.001	–	–

Model adjusted for all variables included in the table. Unadjusted ORs are shown in online supplemental table 2.
*Current pregnancy in women 15–49 years.
†Use of any alternative therapy in the past 12 months (including acupuncture, traditional Chinese medicine, homeopathy, and osteopathy).
‡Any current chronic disease versus no chronic disease (reference); lung diseases: asthma bronchiale, chronic bronchitis and emphysema versus no lung disease (reference); diabetes: use of any diabetic drug versus no diabetes (reference); cardiovascular disease: use of any heart medication versus no cardiovascular disease (reference); all other diseases: self-reported disease versus no disease (reference).
§Estimates from separate models which included the variable 'any chronic disease' instead of specific chronic diseases.
¶Any profession in the healthcare system (in the 2007 survey, the veterinary professions were also included in this category) versus any other profession (reference).
BMI, body mass index.

information about the safety of vaccines might have increased the vaccine hesitancy and reduced the coverage of some vaccines.[13]

The decline in coverage and an increase in vaccine hesitancy is of general concern. In the last years, several countries of the WHO European Region including Switzerland, had large outbreaks of vaccine-preventable diseases, including measles, rubella and influenza. Switzerland and other countries identified steps to improve vaccination coverage for vaccine-preventable infectious diseases.[14 15] The relationship between vaccination uptake, knowledge, attitudes and awareness is complex.[16] Reasons for people not getting vaccinated against influenza include underestimation of disease severity, fear of side effects and the cost of vaccines.[17–19] Often people are unaware that they should receive the vaccination.[17] For the seasonal influenza, the varying efficiency ranging from 30% to 60% depending on the season could play a role in the reduced coverage over time.[20 21] However, mathematical models of influenza and vaccination showed that the health burden associated with influenza is more sensitive to changes in vaccination coverage than to changes in vaccine efficacy.[21] Of note, the coverage of measles vaccination increased to almost 90% in young adults in Switzerland, probably due to the campaigns and a national measles strategy.[22] The experience with measles could serve as a model for public health actions influenza.

The advent of the novel COVID-19 SARS-CoV-2 has profoundly changed everyday life in Switzerland and elsewhere. It is unclear how the COVID-19 pandemic will affect attitudes toward vaccines. The director of the US Centers for Disease Control has warned that a possible second wave of COVID-19 could be worse than the first.[23] This has already been seen in the 'Spanish influenza' pandemic of 1918/1919. The Spanish influenza affected Switzerland in two waves. The first one occurred in July

1918, the second, more severe one, in October–November 1918.[24] However, even in the absence of a second wave, a resurgence of COVID-19 that coincides with the start of the influenza season could significantly stress healthcare systems. An effective and safe vaccine against COVID-19 is unlikely to become widely available in 2020. Therefore, low influenza vaccination rates at around half the 75% coverage recommended for high-risk groups constitute a hazard that merits prompt, focused attention by public health authorities.

A concerted effort to increase influenza vaccination coverage in 2020/2021, when the COVID-19 pandemic to continue to pose a threat to the public's health, is urgently needed. Influenza vaccination prevents deaths, morbidity, hospital admissions and other adverse health outcomes, in target populations such as older people, chronically ill people,[25–30] and also children[31] and pregnant women.[32] The continued promotion of infection control measures such as avoiding close contact with sick people, covering one's nose and mouth while coughing or sneezing, social distancing and hand hygiene will contribute to reducing the spread of both influenza and COVID-19.[3]

Our study has several limitations. Influenza vaccination status is self-reported in the Swiss Health Survey, and the reliability of the data unclear. For example, vaccination coverage could be lower if social desirability bias led to an overestimation of uptake. Conversely, incomplete recall of vaccinations could bias coverage downwards. Individuals younger than 15 years are excluded from the survey, but coverage in this age group might be even lower than in the 15–19 years old. A strength of our analysis is the fact that the survey is a nationwide and representative, and repeated every 5 years using the same methodology. Also, the analyses were weighted and adjusted for a range of potential confounders, which did not substantially change the results.

In conclusion, we need to increase influenza vaccination uptake, particularly in the elderly and chronically ill, who are also the risk groups most heavily affected by COVID-19. These efforts should include classic information campaigns, but novel approaches using social media should also be considered.[33 34] Recommendations by healthcare professionals are essential to improve influenza vaccination coverage, such as client reminder/recall and standing orders.[35] The preparation of influenza season 2020/2021 must start now to address the double burden of COVID-19 and seasonal influenza.

Patient and public involvement

The Swiss Health Survey is a nationwide, representative survey that is repeated every 5 years using the same methodology. The survey is conducted by the SFSO on behalf of the Swiss Government. The content of the survey is based on a holistic and dynamic health framework and contains questions on essential topics for the public and politics. The wording of the questions is regularly harmonised with the statistical offices of other countries in Europe.

Twitter Matthias Egger @eggersnsf

Acknowledgements We thank the Swiss Federal Statistical Office for providing the data of the Swiss Health Survey 2007 to 2017, and the people who participated in the surveys.

Contributors Conception and design: LF, MZ, ME. Data analysis: KZ, LF, CB, MZ. KZ, LF, ME wrote the first draft of the paper and revised it based on comments from all authors. All authors reviewed and approved the final version of the manuscript.

Funding There was no specific funding for this project. ME was supported by special project funding (grant 17481) from the Swiss National Science Foundation.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Data were collected anonymised and ethical approval was not required but we obtained permission to analyse and publish the data through a contract with the SFSO (Ref. 624.110-1).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. Data may be obtained upon request from the Swiss Federal Statistical Office (SFSO).

ORCID iDs
Kathrin Zürcher http://orcid.org/0000-0002-7915-3194
Marcel Zwahlen http://orcid.org/0000-0002-6772-6346
Claudia Berlin http://orcid.org/0000-0003-3505-348X
Matthias Egger http://orcid.org/0000-0001-7462-5132
Lukas Fenner http://orcid.org/0000-0003-3309-4835

REFERENCES

1 Nicholson KG, Wood JM, Zambon M. Influenza. *Lancet* 2003;362:1733–45.
2 Fauci AS, Touchette NA, Folkers GK. Emerging infectious diseases: a 10-year perspective from the National Institute of allergy and infectious diseases. *Emerg Infect Dis* 2005;11:519–25.
3 Federal Office of Public Health. National influenza vaccination website, 2020. Available: https://www.vaccinateagainsttheflu.ch/en-us/the-flu/how-dangerous-is-the-flu.html
4 Del Rio C, Malani PN. COVID-19-new insights on a rapidly changing epidemic. *JAMA* 2020;323:1339.
5 Thanh Le T, Andreadakis Z, Kumar A, *et al*. The COVID-19 vaccine development landscape. *Nat Rev Drug Discov* 2020;19:305–6.
6 World Health Organization ROfE. Evaluation of seasonal influenza vaccination policies and coverage in the WHO European region, 2020. Available: http://www.euro.who.int/__data/assets/pdf_file/0003/241644/Evaluation-of-seasonal-influenza-vaccination-policies-and-coverage-in-the-WHO-European-Region.pdf
7 Federal Office of Public Health. National influenza vaccination website: vaccine recommendations. Available: https://wwwvaccinateagainstthefluch/en-us/vaccination/impfempfehlungenhtml
8 Zürcher K, Zwahlen M, Berlin C, *et al*. Trends in influenza vaccination uptake in Switzerland: Swiss health survey 2007 and 2012. *Swiss Med Wkly* 2019;149:w14705.
9 Swiss Federal Statistical Office. Schweizerische Gesundheitsbefragung, 2020. Available: https://www.bfs.admin.ch/bfs/de/home/statistiken/gesundheit/erhebungen/sgb.html

10 Health FOoP. Health insurance, 2020. Available: https://www.bag.admin.ch/bag/en/home/versicherungen/krankenversicherung.html
11 Jorgensen P, Mereckiene J, Cotter S, *et al*. How close are countries of the WHO European Region to achieving the goal of vaccinating 75% of key risk groups against influenza? Results from national surveys on seasonal influenza vaccination programmes, 2008/2009 to 2014/2015. *Vaccine* 2018;36:442–52.
12 Andre FE, Booy R, Bock HL, *et al*. Vaccination greatly reduces disease, disability, death and inequity worldwide. *Bull World Health Organ* 2008;86:140–6.
13 Folb PI, Bernatowska E, Chen R, *et al*. A global perspective on vaccine safety and public health: the global Advisory Committee on vaccine safety. *Am J Public Health* 2004;94:1926–31.
14 The Lancet. Addressing decreasing vaccine coverage in the EU. *Lancet* 2018;391:1638.
15 European Union. EU manifesto on influenza vaccination. our response to the burden of influenza in Europe, 2020. Available: www.eufightingflu.com
16 Larson HJ, Jarrett C, Eckersberger E, *et al*. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007-2012. *Vaccine* 2014;32:2150–9.
17 Casalino E, Ghazali A, Bouzid D, *et al*. Patient's behaviors and missed opportunities for vaccination against seasonal epidemic influenza and evaluation of their impact on patient's influenza vaccine uptake. *PLoS One* 2018;13:e0193029.
18 Wendlandt R, Cowling BJ, Chen Y. Knowledge, attitudes and practices related to the influenza virus and vaccine among older adults in eastern China. *Vaccine* 2018;36:2673–82.
19 Wheelock A, Thomson A, Sevdalis N. Social and psychological factors underlying adult vaccination behavior: lessons from seasonal influenza vaccination in the US and the UK. *Expert Rev Vaccines* 2013;12:893–901.
20 Sullivan SG, Chilver MB, Carville KS, *et al*. Low interim influenza vaccine effectiveness, Australia, 1 May to 24 September 2017. *Euro Surveill* 2017;22.
21 Sah P, Medlock J, Fitzpatrick MC, *et al*. *Optimizing the impact of low-efficacy influenza vaccines. Proceedings of the National Academy of Sciences of the United States of America*, 2018.
22 Altpeter E, Wymann MN, Richard JL, *et al*. Marked increase in measles vaccination coverage among young adults in Switzerland: a campaign or cohort effect? *Int J Public Health* 2018.
23 Sun Lena H. CDC director warns second wave of coronavirus is likely to be even more devastating, 2020. Available: https://www.washingtonpost.com/health/2020/04/21/coronavirus-secondwave-cdcdirector/
24 Ammon CE. Spanish flu epidemic in 1918 in Geneva, Switzerland. *Euro Surveill* 2002;7:190–2.
25 Talbot HK, Zhu Y, Chen Q, *et al*. Effectiveness of influenza vaccine for preventing laboratory-confirmed influenza hospitalizations in adults, 2011-2012 influenza season. *Clin Infect Dis* 2013;56:1774–7.
26 Pereira M, Williams S, Restrick L, *et al*. Healthcare worker influenza vaccination and sickness absence - an ecological study. *Clin Med* 2017;17:484–9.
27 Phrommintikul A, Kuanprasert S, Wongcharoen W, *et al*. Influenza vaccination reduces cardiovascular events in patients with acute coronary syndrome. *Eur Heart J* 2011;32:1730–5.
28 Colquhoun AJ, Nicholson KG, Botha JL, *et al*. Effectiveness of influenza vaccine in reducing hospital admissions in people with diabetes. *Epidemiol Infect* 1997;119:335–41.
29 Liu W-C, Lin C-S, Yeh C-C, *et al*. Effect of influenza vaccination against postoperative pneumonia and mortality for geriatric patients receiving major surgery: a nationwide matched study. *J Infect Dis* 2018;217:816–26.
30 Arriola CS, Anderson EJ, Baumbach J, *et al*. Does influenza vaccination modify influenza severity? data on older adults hospitalized with influenza during the 2012-2013 season in the United States. *J Infect Dis* 2015;212:1200–8.
31 Ferdinands JM, Olsho LEW, Agan AA, *et al*. Effectiveness of influenza vaccine against life-threatening RT-PCR-confirmed influenza illness in US children, 2010-2012. *J Infect Dis* 2014;210:674–83.
32 Mosby LG, Rasmussen SA, Jamieson DJ. 2009 pandemic influenza A (H1N1) in pregnancy: a systematic review of the literature. *Am J Obstet Gynecol* 2011;205:10–18.
33 NHS Foundation Trust. The flu bee game web APP, 2020. Available: http://www.focusgames.com/case_studies/Flu%20Bee%20-%20Case%20Study%202018.pdf
34 Glanz JM, Wagner NM, Narwaney KJ, *et al*. Web-based social media intervention to increase vaccine acceptance: a randomized controlled trial. *Pediatrics* 2017;140 doi:10.1542/peds.2017-1117
35 Lu P-J, Srivastav A, Amaya A, *et al*. Association of provider recommendation and offer and influenza vaccination among adults aged ≥18 years - United States. *Vaccine* 2018;36:890–8.