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Research article

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Awareness of vaccination status and its predictors among working people in Switzerland

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Abstract

Background: Adult vaccination status may be difficult to obtain, often requiring providers to rely on individual patient recall. To determine vaccination status awareness and the sociodemographic predictors of awareness for tetanus, hepatitis A and B, tick born encephalitis (TBE) and influenza vaccination.

Methods: Multivariate analyses were used to evaluate a questionnaire survey of 10 321 employees (4070 women and 6251 men aged 15–72 years) of two companies in Switzerland.

Results: Among 10 321 respondents, 75.5% reported knowing their tetanus vaccination status, 64.1% hepatitis A, 61.1% hepatitis B, 64.3% TBE and 71.9% influenza. Between 1 in 4 and 1 in 3 employees were not aware of their vaccination status. Differences in awareness for the five vaccinations considered correlated with gender and language. These differences persisted in multivariate analyses.

Conclusion: Women employees, German-speaking employees and employees who paid more attention to their diet were more often aware of their vaccination status. A more reliable and readily accessible data source for vaccination status is needed in order to capitalize on opportunities to update vaccinations among Swiss employees.

Background

Thanks to efficacious vaccination campaigns, high hygienic standards and a high standard of living, diseases such as poliomyelitis, tetanus, diphtheria, pertussis, and congenital rubella syndrome are now rare in Switzerland [1]. However, the low incidence of these diseases combined with concerns over safety of vaccines have created much

controversy [2–9]. The Swiss Federal Office of Public Health (SFOPH) has launched several public awareness campaigns in recent years emphasising the importance of vaccination. Public awareness campaigns are likely to be particularly effective at increasing vaccination rates against diseases occurring seasonally, such as influenza or tick born encephalitis, that require annual vaccination

campaigns. Vaccines for other diseases, such as hepatitis A and B or tetanus, are not repeated annually. Therefore, vaccination status, including completion of a basic series and last booster dose, can be difficult to obtain. Consequently, health care providers administering vaccinations where medical records are lacking must rely on individual patient recall.

Validation studies of self-reported vaccination status showed that patient self-report was a highly sensitive and moderately specific measure of vaccination status [10,11]. One study showed that patient self-report of vaccinations not requiring annual boosters, such as pneumococcal vaccination, had lower specificity than that of vaccinations given annually, such as influenza [11]. More specifically, the study found that although relatively few false-negative cases would have been missed through self-report for both vaccinations (0–2% for influenza vaccination and 3–10% for pneumococcal vaccination, respectively), depending on the population studied, (i.e. veterans administration versus managed care organization), false-positive cases would have been much more frequent. 21–29% of reported influenza vaccinations and 46–47% of reported pneumococcal vaccinations would have been false positive, leading to many missed opportunities to vaccinate [11].

Because people either misplace or neglect to carry their vaccination cards with them, and increasing mobility necessitating periodic changes in health care provider for vaccinations, reliance on self-report will continue to occur, unless new strategies, such as national registries, become standard. But for the time being, such national registries have been shown to have low acceptance [12].

Many vaccine-preventable diseases occur among adults and cause mortality in Europe as well as in the US [13–17]. Vaccination screening and administration at the workplace have been shown to be an effective way to deliver comprehensive immunization services to employees [18].

In order to determine the awareness of vaccination status among Swiss employees, we analyzed data on immunization status from the "Check Bus" Project [19], along with demographic, psychological and behavioral predictors of vaccination status awareness.

Review of the studied vaccinations

Tetanus

All men aged 18 to 20 years without a valid tetanus vaccination at the beginning of their compulsory military service in Switzerland are inoculated. The tetanus vaccination was first available in 1938 (Wiedenmann, M., August 2000, Berna, personal communication), and in 1963, the

first written recommendation was made (Roost, H.-P., August 2000, SFOPH, personal communication). Currently, tetanus vaccination is recommended for every infant, three times in infancy and three times in childhood. Subsequent routine doses are administered every 10 years unless an injury necessitates an earlier booster. In 1998, 93.3% of Swiss children had completed the tetanus immunization series (three doses) [20]. There were, however, very few tetanus cases registered: between 1 and 5 cases per year from 1988 to 1998 [21], and 4 cases in the year ending August 22, 2000, annual incidence: 0.06/100'000 population [22]. By comparison, in 1996 there were 17 reported cases in Germany, annual incidence: 0.2/1'000'000 population [23] and 8 in the United Kingdom, annual incidence: 0.1/1'000'000 population [3].

Hepatitis B

In 1980, the hepatitis B vaccine was introduced in Switzerland for people at high risk, e.g. health care and dentistry workers, laboratory workers and drug addicts (Wiedenmann, M., August 2000, Berna). Since 1997 hepatitis B has been part of the national immunization program for children between 11 and 15 years of age. Vaccination of newborns is only recommended for groups at risk, e.g. babies with HB-antigen positive mothers [24].

Hepatitis A

In 1992, the active hepatitis A vaccine was introduced in Switzerland. The annual mortality rate for hepatitis A is very low (0.96/1'000'000 population) [25]. The vaccine is mostly administered to people travelling to potentially endemic countries with poor hygiene [26]. Since 1995, the 250 – 500 new cases of infections per year in Switzerland [21] were mostly travellers returning from endemic areas and drug-addicts [27].

Tick Born Encephalitis (TBE)

TBE is an endemic disease contracted through bites from infected ticks in well-known areas (mostly in German-speaking areas of Switzerland). With 68 incident cases in 1998, 112 cases in 1999, 93 cases for 2000 and 107 cases in 2001 [28,29] and an average overall incidence of 0.46/1'000'000 population per year, it is a rather rare, but present disease [30]. An active vaccine has been commercially available since 1979 [31]. This vaccine, which is administered as a three dose regimen, is mainly given to people at high risk, i.e. people who regularly spend time in forests in an endemic area, be it for work, or leisure [30].

Influenza

According to Swiss vaccine recommendations, [32] influenza vaccinations should be performed annually between mid-October and mid-November. The vaccine remains effective for 4–6 months [32]. Current Swiss

recommendations for influenza vaccination (2001/2002) include persons older than 65, children and adults with chronic conditions such as heart or lung diseases, as well as those who need regular medical treatment or hospitalizations [33]. For these high-risk groups, the costs are borne by health insurance. While for others, who are also at increased risk or who may risk transmitting the influenza virus to individuals at high risk, such as clinical staff personnel and close contacts of individuals at high risk, insurance has no obligation to bear the costs [33]. Case-fatality rates for influenza begin to rise at the age of 45 years and are highest in people with multiple chronic medical conditions [34].

The annual national vaccination campaigns put on by the Swiss government have not been as successful as some had hoped. In 1996, only 3.3% of all employees had been vaccinated. In that same year, the overall vaccination rate of the Swiss population, using units of sold vaccines, was estimated to be around 6%. It increased to approximately 14% in 2000 [35]. This vaccination rate is comparable with other European countries. Spain, France, the Netherlands and Italy reached immunization rates of more than 15% in 1997, while Germany, Great Britain and Belgium have rates ranging from 10–15% [35,36].

Methods

The national information and prevention campaign "Check Bus", which took place from August 1996 to August 1998, invited all employees of two nationwide companies (a large Swiss bank and an industrial company) to participate. Participants completed a self-administered questionnaire containing, among others, questions concerning their vaccination status. The questionnaire was available in the three Swiss national languages: German, French and Italian. Participants were asked to present their vaccination certificates. Methods have been described in detail elsewhere [19].

We assessed the status of the following vaccinations: tetanus, hepatitis A and B, tick-borne encephalitis (TBE) and influenza. Influenza vaccination rates were only analyzed for the years 1996 and 1997 as the vaccination period begins in October and the "Check Bus" Project ended in August 1998.

First, we analyzed the following groups of variables for statistical significance in bivariate tests using Chi-square for each vaccine: Demographics (age, gender, marital status, language), psychological factors (general well-being, emotional well-being, stress), and behavioral factors (medication use, alcohol use, smoking status, physical activity and dietary attitudes). Age was categorized into the following groups: <24, 25–34, 35–44, 45–54 and 55+ years. We divided marital status into the categories single,

married, divorced and widowed. Language represented the language for which the questionnaire was requested and included German, French and Italian. To assess general well-being, the following question was asked: "How is your current state of health?" The respondents had the choice among four answers, ranging from "poor" to "excellent". Emotional well-being was a composite measure of four questions on feeling down or depressed, calm and balanced, tense and nervous, and full of energy and optimism, that evaluated on how many days of the last week respondents felt that way. The four choices were almost every day, on 3–4 days, on 1–2 days and never. The respondents' summary scores were calculated and classified into four groups: poor, moderate, good, and excellent.

Stress was assessed by asking six questions on conditions at work that could be perceived as stressful, such as long working hours, conflicting private life and work, and work under time pressure. Answers were given on a six point Likert scale, summary scores were calculated and following groups defined: never, sometimes, frequent, constant. Medication use assessed the frequency of four common medications, sleeping pills, painkillers, tranquilizers and laxatives. The answers on a five point Likert scale were summed up to a single score and then divided into the groups never, sometimes, frequently and constantly. Alcohol use was largely a measure of frequency and asked the "usual" consumption of alcoholic beverages per week. Answers ranged from never / abstinent to 3 times daily or more often and were categorised into never/seldom, once/several times a week, once/ several times a day.

Smoking status was divided into current smoker (ever smoked regularly during more than 6 months and currently smoking), ex-smoker (ever smoked regularly during more than 6 months, but not currently smoking) and non-smoker (never smoked regularly for more than 6 months and not currently smoking). We accepted the possibility that some of the participants would not fall into any of the three categories by choosing a relatively long duration of regular smoking in favour of exclusion of experimenters and occasional smokers. Like alcohol use, physical activity assessed mainly the frequency by asking how many days per week the participant was involved in any leisure activity through which he or she would sweat ("e.g. brisk walking, running, bicycling, etc."), ranging from never to 7x per week. Finally, dietary attitude was assessed by asking about any particular attention participants paid to twelve components, such as sweets, salt, fat, alcohol, diversity of food, regular meals, vegetarian diet, etc. A summary score was calculated from dichotomous answers on each component and then categorised into following groups: paid strict attention, paid attention, paid little attention, paid no attention.

Table 1: Bivariate Analyses

	Age	Gender	Language	Marital Status	Hierarchy at Work	Stress at Work	General Well-being	Emotional Well-being	Smoking	Alcohol Use	Medication Use	Dietary Attitudes	Physical Activity
Tetanus	<0.001	<0.001	<0.001	<0.001	0.986	<0.001	<0.001	<0.001	<0.001	<0.001	0.006	<0.001	<0.001
Hepatitis B	0.445	<0.001	<0.001	0.376	0.222	0.003	0.058	0.032	<0.001	<0.001	0.725	<0.001	0.294
Hepatitis A	0.128	<0.001	<0.001	0.017	0.528	<0.001	0.002	0.028	<0.001	<0.001	0.745	<0.001	0.115
Tick born Encephalitis	0.980	<0.001	<0.001	0.457	0.041	0.002	0.008	0.186	<0.001	<0.001	0.345	<0.001	0.157
Influenza	<0.001	<0.001	<0.001	0.529	0.094	0.005	0.092	0.648	<0.001	0.002	0.111	<0.001	0.472

all categorical (Chi-squared test)

Variables with statistically significant differences in bivariate tests (Chi-squared test) at $p < 0.05$ were entered into logistic regression models using SPSS 10. A two-tailed significance level was set at $p < 0.01$ for the multivariate tests.

Results

A total of 10 321 (41% of all employees) data sets were available for analysis. Respondents were 39.4% ($n = 4070$) female and 60.6% ($n = 6251$) male, corresponding with the gender distribution in the participating companies. Of the participants, 82.3% ($n = 8495$) were German-speaking, 13.8% ($n = 1419$) French-speaking and 3.9% ($n = 407$) Italian-speaking. At the time of questioning 83.9% ($n = 8657$) worked for the bank and 16.1% ($n = 1664$) for the industrial company. Of the participants, 67.2% ($n = 6938$) were staff, 23.1% ($n = 2382$) were cadre, 7.4% ($n = 767$) were supervisors, and 2.3% ($n = 234$) withheld this information.

Tetanus

Of the 10 063 participants who answered the questions on tetanus vaccination (258 or 2.5% did not), 75.5% (7599) knew their vaccination status (vaccinated 7446 or 74.0%, never vaccinated 153 or 1.5%) and 24.5% (2464) did not (the difference relative to 100% is due to missing answers). (Figure 1)

Bivariate analyses (Table 1) showed that age, gender, language, marital status, stress at work, emotional well-being, general well-being, smoking status, alcohol use, dietary attitude, physical activity (all $p < 0.001$) and medication use ($p = 0.006$) were all associated with awareness of tetanus vaccination status, while only employment hierarchy was not.

In the logistic regression model, four of the significant variables in the bivariate analyses remained independently associated with awareness of tetanus vaccination status: age, gender, language and smoking, while marital status, stress at work, general well-being, emotional well-being, alcohol use, medication use, dietary attitudes and physical activity did not.

Hepatitis B

Of the 9427 participants who answered the questions on hepatitis B vaccination (894 or 8.7% did not), 61.1% (5757) knew their vaccination status (vaccinated 299 or 3.2%, not vaccinated 5458 or 57.9%), while 38.9% (3670) did not. Bivariate analyses revealed gender, language, smoking status, alcohol use, dietary attitudes (all $p < 0.001$), stress ($p = 0.003$) and emotional well-being ($p = 0.032$) to be associated with awareness of hepatitis B vaccination status, while age, marital status, employment hierarchy, general well-being, medication use and physical activity were not.

In the logistic regression model, three variables were independently associated with awareness of hepatitis B vaccination status: gender, language and dietary attitudes.

Hepatitis A

Among 9383 respondents who answered the questions on hepatitis A vaccination (938 or 9.1% did not), 64.1% (6011) knew their vaccination status (vaccinated 1574 or 16.8%, not vaccinated 4437 or 47.3%), while 35.9% (3372) did not.

Bivariate analyses showed awareness of hepatitis A vaccination status to be associated with the following variables: gender, language, stress, smoking status, alcohol use, diet (all $p < 0.001$), general well-being ($p = 0.002$), emotional well-being ($p = 0.028$) and marital status ($p = 0.017$), while age, employment hierarchy, medication use and physical activity were not. In the logistic regression model, four variables were independently associated with awareness of hepatitis A vaccination status: gender, language, smoking status and dietary attitudes.

Tick-Borne Encephalitis

Among 9520 respondents who answered the questions on tick-borne encephalitis (801 or 7.8% did not), 64.3% (6122) knew their vaccination status (vaccinated 224 or 2.4%, not vaccinated 5898 or 62.0%), while 35.7% (3398) did not.

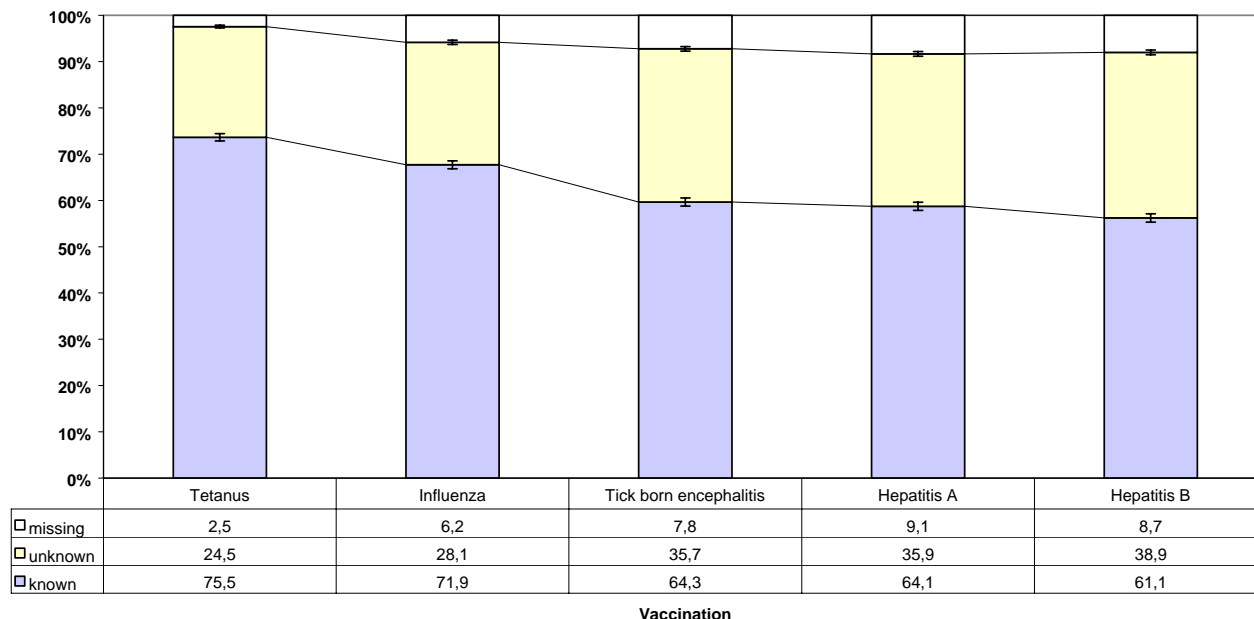


Figure 1
 Participants' awareness of vaccination status for the different vaccinations (χ^2 – Test $p < 0.001$). The 95% CI for each proportion value was below 1%.

Bivariate analyses showed awareness of TBE vaccination status to be associated with the following variables: gender, language, smoking status, alcohol use, diet (all $p < 0.001$), stress level (0.002), general well-being (0.008) and employment hierarchy (0.041), while not associated with age, marital status, emotional well-being, medication use and physical activity.

In the logistic regression model, five variables were independently associated with awareness of TBE vaccination status: gender, language, employment hierarchy, alcohol use and dietary attitudes.

Influenza

Among 9679 respondents who answered the questions on influenza (642 or 6.2% did not), 71.9% (6122) knew their vaccination status for 1996 and 1997 (vaccinated 308 or 3.2%, not vaccinated 6650 or 68.7%, 1996 vaccinated 204 or 2.1%, 1997 vaccinated 104 or 1.1%), while 28.1% (2718) did not.

Bivariate analyses showed awareness of 1996 and 1997 influenza vaccination status to be associated with the following variables: age, gender, language, smoking status, diet (all $p < 0.001$), stress (0.005), and alcohol use (0.002), while marital status, employment hierarchy, gen-

eral well-being, emotional well-being, medication use and physical activity were not.

In the logistic regression model, six variables were independently associated with awareness of influenza vaccination status in 1996 and 1997: age, gender, language, stress, smoking status, and dietary attitudes.

Table 2 shows the respondents awareness of vaccination status (number of individuals with vaccination status known/unknown) for the characteristic variables together with the results of the overall logistic regression for each vaccination.

Discussion

In this working population of two large firms in Switzerland, the proportion of known vaccination status (vaccinated or not vaccinated) for five different vaccinations varied between 61.1% for hepatitis B and 75.5% for tetanus (Figure 1).

The proportion of employees vaccinated against tetanus (74.0%) was almost identical with a previous study among primary care physicians and their employees in Switzerland, where 74.2% of the medical practice employees stated to have been vaccinated against tetanus [37].

Table 2: Logistic Regression

	Tetanus		Hepatitis B		Hepatitis A		Tick Born Encephalitis		Influenza	
	n	OR (CI)	n	OR (CI)	N	OR (CI)	N	OR (CI)	n	OR (CI)
Age										
-24	807/153	1.0	573/338	-	584/330	-	575/330	-	638/278	1.0
25-34	2520/600	0.84 (0.65, 1.00)	1781/1118	-	1912/986	-	1900/1052	-	2211/772	1.22 (1.04, 1.45)
35-44	2012/619	0.67 (0.53, 0.84)	1496/935	-	1510/869	-	1589/868	-	1859/660	1.24 (1.04, 1.47)
45-54	1647/760	0.48 (0.38, 0.61)	1373/915	-	1438/850	-	1478/828	-	1621/729	0.97 (0.81, 1.15)
55+	613/332	0.39 (0.30, 0.52)	534/364	-	567/337	-	580/320	-	632/279	0.99 (0.80, 1.23)
Gender										
Female	3071/885	1.0	2368/1293	1.0	2510/1177	1.0	2521/1198	1.0	2865/922	1.0
Male	4528/1579	0.84 (0.75, 0.95)	3389/2377	0.79 (0.72, 0.86)	3501/2195	0.77 (0.69, 0.85)	3601/2200	0.7 (0.65, 0.79)	4096/1796	0.73 (0.81, 1.23)
Language										
German	6405/1887	1.0	4889/2922	1.0	5048/2706	1.0	5319/2580	1.0	5831/2164	1.0
French	962/411	0.71 (0.62, 0.82)	605/615	0.61 (0.54, 0.69)	698/539	0.72 (0.63, 0.82)	544/679	0.39 (0.34, 0.45)	824/461	0.67 (0.66, 0.81)
Italian	232/166	0.41 (0.32, 0.51)	263/133	1.17 (0.94, 1.46)	265/127	1.15 (0.92, 0.14)	259/139	0.92 (0.74, 1.14)	306/93	
Hierarchy at Work										
Staff	5099/1663	-	3876/2483	-	4058/2301	-	4088/2338	1.0	4641/1875	-
Superiors	559/180	-	450/254	-	454/234	-	477/226	1.39 (1.16, 1.66)	534/182	-
Cadre	1756/575	-	1300/857	-	1365/769	-	1430/755	1.23 (1.10, 1.37)	1626/610	-
Stress at Work										
never	120/73	1.0	88/95	1.0	91/92	1.0	95/87	1.0	115/71	1.0
sometimes	1888/661	1.39 (0.94, 2.06)	1469/909	1.48 (1.05, 2.09)	1535/836	1.56 (1.10, 2.20)	1565/848	1.66 (1.21, 2.28)	1730/715	1.42 (1.04, 1.95)
frequent	5146/1578	1.61 (1.09, 2.37)	3869/2446	1.58 (1.13, 2.21)	4047/2240	1.67 (1.18, 2.34)	2249/4126	1.71 (1.25, 2.28)	4709/1773	1.61 (1.18, 2.20)
constant	445/152	1.70 (1.09, 2.63)	331/220	1.68 (1.15, 2.47)	338/204	1.72 (1.17, 2.54)	336/214	1.70 (1.19, 2.43)	407/159	1.66 (1.16, 2.43)
Smoking										
Non-Smoker	3981/1103	1.0	3013/1777	1.0	3153/1612	1.0	3186/1632	1.0	3616/1276	1.0
Smoker	2347/884	0.78 (0.69, 0.87)	1755/1250	0.88 (0.80, 0.97)	1822/1172	0.84 (0.76, 0.93)	1864/1180	0.87 (0.79, 0.96)	2124/971	0.80 (0.73, 0.89)
Ex-Smoker	1271/477	0.94 (0.81, 1.08)	989/643	0.93 (0.82, 1.05)	1036/588	0.95 (0.84, 1.08)	1072/586	0.97 (0.86, 1.10)	1221/471	0.98 (0.86, 1.12)
Alcohol Use										
never/ seldom	2666/813	1.0	2044/1224	1.0	2142/1131	1.0	2143/1156	1.0	2426/912	-
once/ several times a week	4308/1335	1.06 (0.95, 1.19)	2335/2041	1.04 (0.94, 1.14)	3374/1863	1.05 (0.95, 1.15)	3481/1857	1.10 (0.99, 1.21)	3927/1506	-
once/ several times a day	619/315	0.98 (0.81, 1.18)	472/404	0.84 (0.71, 0.98)	489/377	0.85 (0.72, 1.00)	492/384	0.83 (0.70, 0.98)	602/299	-
Dietary Attitudes										
paid strict attention	365/115	1.0	298/136	1.0	308/132	1.0	315/129	1.0	359/97	1.0

Table 2: Logistic Regression (Continued)

paid attention	2246/678	0.97 (0.76, 1.24)	1787/968	0.88 (0.70, 1.10)	1840/870	0.96 (0.76, 1.20)	1910/878	0.91 (0.73, 1.14)	2112/732	0.79 (0.62, 1.00)
paid little attention	2709/808	0.88 (0.69, 1.13)	1995/1293	0.76 (0.61, 0.94)	2102/1190	0.81 (0.65, 1.02)	2152/1169	0.80 (0.64, 1.00)	2442/929	0.72 (0.57, 0.92)
paid no attention	2279/863	0.79 (0.61, 1.01)	1677/1273	0.70 (0.56, 0.87)	1761/1180	0.74 (0.59, 0.92)	1745/1222	0.70 (0.56, 0.88)	2048/960	0.65 (0.51, 0.83)

n = vaccination status known / unknown, OR = Odds Ratio (coding of dependent variable: unknown = 0, known = 1), CI = 95% Confidence Interval

The proportion of employees in our study population vaccinated against influenza in 1996 or 1997 (3.2%) corresponded with estimates by the Federal Office of Public Health among employees in 1996 where a vaccination rate of 3.3% was found. However, this similarity may be misleading, as a validation study for influenza vaccination rates has shown that between 20 – 30% of those indicating to have been vaccinated for Influenza actually had not been vaccinated, when checked against data in hospital records [11].

In the bivariate analyses, six independent variables show a significant association with awareness of vaccination status for all five immunizations: gender, language, stress, smoking, alcohol use and dietary behavior.

The results of the logistic regression analyses seem to discriminate mainly between two groups of independent variables. Two variables, gender and language, were associated with all five types of vaccination, while the rest of the independent variables were associated with four (dietary behavior), three (smoking status), two (age) or one type of vaccination (employment hierarchy and stress). Interestingly, alcohol use, which was associated with all five immunizations in bivariate analyses, was only independently associated with one of the five immunizations in regression analyses.

One important weakness of our study is the lack of data on non-participants as we were denied access to this information. This makes it impossible for us to compare participants with non-participants in order to detect any bias due to differential participation. Details concerning representativeness have been discussed in our methods paper [19].

The Check Bus Project was performed during a period of major restructuring in one of the two enterprises involved, which mostly concerned employees in the French-speaking part of Switzerland where the participation rate was consequently lower. This restructuring could have negatively influenced the participation rate. We did not send out reminders and the Check Bus visited the different

companies sites only once. In view of this the participation rate of 41% may be regarded as rather high.

Women, German-speaking people, to a lesser degree people who pay more attention to a healthy diet, and the non-smokers (as compared to the smokers, but not ex-smokers) seem to be more aware of their vaccination status.

Our results show that between 1 in 4 to 1 in 3 of healthy Swiss employees are unaware of their vaccination status, even for seasonally recommended vaccines. This indicates a need for a more reliable and readily accessible, i.e. electronic, central database where individual vaccination records are stored. More research into the acceptability of such a database among the population and health care providers of Switzerland is also needed.

Competing Interests

There are no competing interests

Authors' contributions

CL performed the statistical analyses and participated in the design of the manuscript. CN conceived the study, drafted the manuscript and participated in the statistical analyses, DG participated in the drafting of the manuscript and the study coordination, ND participated in the statistical analyses and the manuscript preparation, and JS participated in the manuscript preparation and study coordination.

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