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Determinants of tetanus and seasonal influenza vaccine uptake in adults living in Germany

Merle M. Böhmer^{a,d,*}, Dietmar Walter^{a,d}, Gérard Krause^b, Stephan Müters^c, Antje Gößwald^c,
Ole Wichmann^a

^a Immunization Unit, Robert Koch Institute, Berlin, Germany

^b Department for Infectious Disease Epidemiology, Robert Koch Institute, Berlin, Germany

^c Department of Epidemiology and Health Reporting, Robert Koch Institute, Berlin, Germany

^d Charité – University Medicine Berlin, Berlin, Germany

* Corresponding author:

Merle M. Böhmer

Immunization Unit,

Department for Infectious Disease Epidemiology,

Robert Koch Institute,

DGZ-Ring 1, 13086 Berlin, Germany

E-mail address: BoehmerM@rki.de

Abstract

The primary objective of this study was to assess determinants of vaccine uptake in adults living in Germany exemplified by one standard vaccination (tetanus) and one vaccination targeting specific risk-groups (seasonal influenza). Data from 21,262 telephone household-interviews representative of the adult population in Germany were collected in 2009 and analyzed. A total 73.1% of the adult population had a sufficient tetanus vaccination status according to national recommendations (i.e. last tetanus shot ≤ 10 years ago). Influenza vaccination coverage in the target population (i.e. persons ≥ 60 years, chronically ill, healthcare workers) was 44.1%. Persons who received professional vaccination advice within the past five years were more frequently vaccinated against tetanus and influenza than persons without ($p < 0.001$). Private physicians were identified as the most important source for vaccination advice. Having a statutory health insurance, last physician contact < 1 year ago, and living in the eastern part of Germany were independently associated with higher tetanus and influenza vaccine uptake. Low socio-economic status, two-sided migration background, and the feeling of being insufficiently informed on the benefits of vaccination were independently associated with low uptake of tetanus but not influenza vaccines. Our results show that tetanus vaccination coverage in the general adult population and influenza vaccination coverage in the target population are unsatisfactorily low in Germany. Since physicians' advice has a major impact on the vaccination decision, physician reminder systems could provide a method to increase vaccination coverage in adults. For tetanus, information activities should target population groups with an increased risk of being undervaccinated.

Keywords: *vaccination, determinants, coverage, tetanus, influenza, Germany*

Introduction

With the success of vaccines in reducing the burden of various diseases, the threat posed by these diseases is less imminent and the benefits of vaccination programs are becoming less obvious to the public. To achieve high vaccination coverage in the target population for which a particular vaccination is recommended poses a challenge to public health authorities. Reliable data on the incidence and trends of vaccine-preventable diseases as well as on vaccination coverage in the target populations are needed to evaluate and, if necessary, to adjust vaccination programs by implementing appropriate strategies. In this context, the assessment of the impact of socio-economic, regional, informational and other health-relevant factors on vaccination coverage is important to identify potential barriers to high vaccine uptake.

In Germany, the Standing Committee on Vaccination (STIKO) develops and endorses vaccination recommendations on a national level.¹ The sixteen federal states in Germany are responsible for the implementation of vaccination programs. Vaccines for adults are usually administered by general practitioners and in some companies also by occupational physicians. There are two different health insurance schemes in Germany: the statutory health insurance (SHI) and the private health insurance (PHI) scheme. Approximately 90% of the German population is covered by a SHI.² STIKO-recommended vaccinations are free of charge for both, persons who are covered by SHI and by PHI. However, persons with PHI need to pay for the vaccine and its administration out-of-pocket, and reimbursement of these expenses takes place after the bills are submitted to the insurance company. In contrast, persons with SHI are not involved in any payments of the physician or the vaccines.

Tetanus and influenza are two diseases that can effectively be prevented by vaccination. In Germany, tetanus booster vaccination is recommended by STIKO to be given to all adults every ten years.¹ Between 2001 and 2009, there were up to 32 reported cases of

tetanus each year, which occurred mainly among elderly persons.^{3,4} However, the disease is notifiable only in 6 of the 16 federal states. Estimates of annual tetanus case numbers are therefore based on notification data from the respective states⁵ as well as on case reports⁴ and national hospital discharge statistics.³ Influenza vaccination is recommended for defined target groups who have either an increased risk for severe influenza disease (e.g. person with chronic underlying diseases, pregnant women, and persons ≥ 60 years of age) or who are likely to transmit the virus to vulnerable groups (e.g. health care workers).¹ Depending on the intensity of influenza-activity there are between zero and approximately 30,000 estimated excess deaths attributable to influenza in Germany each year.⁶

Germany has no central immunization registry. Data on vaccination coverage of children is systematically collected only at school entry when the children are between 5 and 6 years of age.⁷ Information on vaccination coverage in adolescents and adults have mainly been available from a few smaller telephone surveys⁸⁻¹¹, from health insurance companies¹² and household surveys (Microcensus 2003)¹³, and are largely insufficient.

With the implementation of the 'German Health Update' Survey (GEDA) in 2008/2009 as a part of the national health monitoring, a tool is now available in Germany for the detailed assessment of vaccination coverage in all age-groups above 18 years. GEDA is a large, population-representative telephone-survey. Here we present results from GEDA 2009 with focus on one standard vaccination for adults (tetanus) and one vaccination targeting specific risk groups (influenza). While target-group specific influenza vaccination coverage based on GEDA 2009-data was subject of a previous publication¹⁴, this paper focuses in detail on factors influencing tetanus and seasonal influenza vaccine uptake. The objectives of this study were i) to assess the proportion of adults who were vaccinated against tetanus and seasonal influenza according to national recommendations, and ii) to identify factors

potentially associated with vaccine uptake in the target populations thereby generating evidence for more targeted vaccination programmes.

Results

Sample characteristics. In total, 21,262 persons were interviewed via telephone during the study period of GEDA 2009 (July 2008-June 2009). Response Rate 3 as defined by the American Association for Public Opinion Research (AAPOR) was 29.1% and the cooperation rate at respondent level was 51.2%.^{14, 15} An overview of the study sample and the adult population in Germany (data of the German Federal Statistical Office, 2008) is given in Table 1. The median age in the study sample was 48.0 years (range 18-100 years). All data presented in the following sections are weighted data.

Tetanus vaccination coverage. Information on tetanus vaccination status (last tetanus shot $>$ or ≤ 10 years ago) was available for 20,470 respondents (96.3% of the study population). A total 73.1% (95% confidence interval (CI) 72.3-74.0) had a sufficient tetanus vaccination coverage according to the national recommendation (last tetanus shot ≤ 10 years ago). Tetanus vaccination coverage decreased with age and was lowest in persons ≥ 70 years (Figure 1). Among 20,840 respondents (98.0% of the study population) with information available, 95.4% (95%CI 95.0-95.9) stated to have received a tetanus shot at least once in their life.

The most frequently reported reason for receiving the last tetanus shot was that it was necessary due to the recommended immunization schedule (61.5%; 95%CI 60.6-62.4). A total 31.4% (95%CI 30.6-32.3) reported to have received their last tetanus vaccination as part of an injury treatment, and 7.1% (95%CI 6.7-7.5) of the interviewed persons received it during a pre-travel health consultation. Respondents belonging to the first group were significantly more frequently vaccinated as compared to those belonging to the second (tetanus vaccination coverage 82.9% vs. 68.6%; $p < 0.001$) or third group (78.0%; $p < 0.001$). The majority of interviewed persons (72.2%; 95%CI 71.3-73.0) reported to have received their last tetanus vaccination at their family doctor; 7.8% (95%CI 7.3-8.3) received it at some other private

physician, 14.2% (95%CI 13.5-14.9) received it at a hospital emergency unit after injury, and 2.6 (95%CI 2.3-2.9) received it at the local public health service.

Seasonal influenza vaccination coverage. Influenza vaccination status (vaccinated or unvaccinated for the last influenza season) was available for 21,190 interviewed persons (99.7%). Of those 10,640 (50.2%; 95%CI: 48.9-50.7) belonged to at least one of the recommended target groups for influenza vaccination. Influenza vaccination coverage was 44.1% (95%CI 42.7-45.4) in persons belonging to the target population and 17.0% (95%CI 16.2-17.9) in the non-target population. In contrast to tetanus vaccination, influenza vaccination coverage increased with age and was highest in persons ≥ 70 years (Figure 1). Among the different target groups, vaccination coverage was highest in persons ≥ 60 years (56.3%; 95%CI 54.5-58.1) and lowest in healthcare workers (HCW) (22.2%; 95%CI 19.7-25.0). The proportion vaccinated was 44.5% (95%CI 42.8-46.1) among persons with underlying chronic diseases.

Factors associated with tetanus and seasonal influenza vaccine uptake. Results of univariate and multivariate analysis of factors potentially associated with tetanus and seasonal influenza vaccine uptake are presented in Table 2 and Table 3 respectively. Several factors were independently associated with both higher tetanus and influenza vaccine uptake including having a SHI, having received a professional vaccination advice within the past five years, physician contact in the last 12 months, and caring about personal health. Unlike influenza vaccination coverage, tetanus vaccination coverage decreased with increasing size of the city of residency and with age. Women were significantly less frequently vaccinated against tetanus but not influenza than men. Having a two-sided migration background decreased the odds of being vaccinated against tetanus by 40% when compared to persons without migration background.

Vaccination consultation and perceived information status. Receiving professional vaccination advice was independently associated with both, higher influenza and tetanus vaccine uptake (Tables 2 and 3). A total 56.0% (95%CI 55.2-56.9) of the interviewed persons reported to have received vaccination advice within the past five years. The most frequently reported source of vaccination advice was with 95.1% (95%CI 94.7-95.6) ‘general practitioners’. Health insurance companies (reported by 2.5% of interviewed persons who received consultation) and official health authorities (1.6%) played only a minor role as source of vaccination advice.

A total 87.9% (95% CI 87.2-88.4) of respondents had at least one physician contact in the last 12 months, 10.6% (95% CI 10.1-11.2) of respondents reported that their last physician contact was between 1 and 5 years ago, and 1.5% (95% CI 1.3-1.8) reported that it was longer than 5 years ago. Persons who had a physician contact in the last 12 months received significantly more often professional vaccination advice (58.1% reported such an advice) than persons whose last physician contact was between 1 to 5 years ago (42.9%; $p<0.001$) or more than 5 years ago (30.0%; $p<0.001$).

Of all interviewed persons 79.3% (95%CI 78.6-80.0) felt sufficiently informed about the benefits of vaccination in general, and 62.2% (95% CI 61.3-63.0) felt sufficiently informed about the risks of vaccination. Persons, who received professional vaccination advice, felt significantly more often sufficiently informed about the benefits (91.9% vs. 63.2%; $p<0.001$) and risks (74.1% vs. 46.8%; $p<0.001$) of vaccination than person without professional vaccination advice in the past 5 years.

Respondents with a two-sided migration background felt significantly less often sufficiently informed about the benefits and risks of vaccination (63.2% and 47.2%), and received significantly less often professional vaccination advice (45.2%) when compared to persons with a one-sided or no migration background (for all $p<0.001$). Similar observations were found for persons with a low socioeconomic status (74.2% and 56.2%; with 49.9%

having received advice) when compared to persons with a medium or high socio-economic status (for all variables $p < 0.001$).

Discussion

Due to the lack of an immunization registry in Germany, up-to-date country-level data on vaccination coverage in the general adult population and in specific vaccination target groups have to be assessed by surveys.^{7, 16} With GEDA a large data source consisting of more than 21.000 interviews representative of the adult population in Germany is now available since 2009. It is the only data source for tetanus vaccination coverage in the adult population living in Germany for more than a decade. We were able to demonstrate that tetanus and seasonal influenza vaccination coverage in the target populations are unsatisfactorily low in Germany. Moreover, our study revealed a lack of knowledge in the population regarding information about the benefits and risks of vaccination, demonstrated the importance of private physicians as the main source of vaccination advice, and identified several potential barriers to tetanus and influenza vaccine uptake.

In accordance with other studies,¹⁷⁻¹⁹ receiving vaccination consultation was shown to be a strong enabling factor for both high influenza and tetanus vaccine uptake in our study. Persons who received a professional advice did not only feel better informed about the benefits but also about the risks of vaccination in general. Since only 56% of the respondents of this study received a vaccination advice in the past five years but 98% had visited a physician in this period, it is important to ensure that every contact with a physician is used to check vaccination status. Private physicians stood out as the main source of vaccination information and consultation for the general adult population. Therefore it is crucial to provide HCWs – especially private physicians – with information about vaccines and the respective vaccine-preventable diseases that is based upon current scientific evidence.²⁰ Furthermore, HCWs should be enabled to adequately advice and inform patients regarding vaccination.

Differences in factors being associated with seasonal influenza and tetanus vaccine uptake have been identified. For influenza vaccination, higher coverage was identified in

older people, in individuals with underlying chronic diseases, and in persons without perceived good health status. In contrast, higher tetanus vaccination coverage was associated with younger age, and not with perceived health status or chronic underlying diseases. These differences can be explained by the fact that seasonal influenza vaccination is recommended for specific risk groups, mainly older persons and persons with chronic underlying diseases.

The last nationwide assessment of tetanus vaccination coverage among adults was conducted in 1998 and revealed with 63% a lower coverage as compared to our assessment (73.1%).²¹ Current tetanus vaccination coverage in Germany is comparable to tetanus coverage in other European countries and the US. A study based on patient data collected in a Spanish medical emergency service in 2007 revealed among adults a tetanus vaccination coverage of 71.6% (95% CI: 68.3–74.8).²² Based on data of the 2002 Health and Social Protection Survey, a tetanus vaccination coverage of 62.3% (95%CI 61.1-63.5) was estimated for adults living in France.²³ In the United States tetanus vaccine uptake was reported to be 61.6 % (95%CI: 60.6-62.5) in adults ≥ 18 years based on data of the National Health Interview Survey 2008.²⁴ In all three surveys a sufficient tetanus vaccination status was defined as having received the last tetanus shot ≤ 10 years ago. In our study we observed that tetanus vaccine uptake decreased with age. This observation was also made in other industrialized countries^{24,25} and is congruent to the fact that tetanus infections mainly occur among elderly persons in Germany.⁴ Thus, particularly older age-groups should be the target of individual tetanus vaccination catch-up activities.

Another important finding of our study was that persons with a SHI were significantly more likely to have a sufficient tetanus vaccination status than persons covered by PHI. The same observation was made for influenza vaccination among persons with an indication for this vaccination. A possible explanation for this finding, which remained stable in the multivariate analysis as an independent factor, might be that in Germany it is more complicated and time-consuming for someone with a PHI to receive the vaccination and to

get the expenses reimbursed. Persons with PHI need to pay for the vaccine out-of-pocket, and reimbursement takes place not until the bills are sent to the PHI. In addition, persons covered by SHI usually receive a vaccine dose from the physician's stock, whereas persons with PHI sometimes need a prescription from the physician first, then they need to go to the pharmacy to buy the vaccine, and finally they need to go back to the physician for the administration of the vaccine.

In our study, having a two-sided migration background was identified as a barrier to sufficient vaccination information and consultation as well as to tetanus vaccination. The latter observation is concordant with the findings of the 'German Health Interview and Examination Survey for Children and Adolescents' (KiGGS), which revealed significantly lower tetanus vaccination coverage (defined as a completed primary series of tetanus-preventing vaccinations) in adolescents aged 14-17 years when compared to those without migration background (~89% vs. ~97%).²⁶ In the same survey insufficient vaccination coverage in adolescents (11-17 years) with migration background was detected for the vaccinations against Diphtheria, *Haemophilus influenzae* and Poliomyelitis,²⁶ and in foreign born children (2-17 years) for the vaccination against measles.²⁷ However, it should be noted that the sub-population 'persons with a two-sided migration background' is very heterogeneous. Therefore, the reasons for low vaccine uptake in this specific population are likely to be diverse.

Since STIKO-recommended vaccinations are free of charge in Germany, we did not expect that low socioeconomic status would be a barrier to basic vaccinations. Our results from multivariate analyses showed, however, that persons with a low socioeconomic status were significantly less often vaccinated against tetanus and received less frequently professional vaccination advice when compared to persons with a medium or high socioeconomic status. This was, however, different for influenza vaccine uptake, which was 7 percentage points higher in persons with low when compared to persons with high

socioeconomic status (significant in bivariate but not multivariate analysis). Further research with focus on potential barriers to adult vaccination in different sub-groups of migrants as well as persons with low socioeconomic status is therefore necessary.

In our study significantly higher vaccination coverage was found in the eastern part of Germany for both vaccinations under investigation. Possible reasons for this observation have been discussed in detail in previous publications.^{8,9,14} In brief, mandatory vaccination practices in the former German Democratic Republic as well as differences in current implementation practices on the federal state level may contribute in general to a higher acceptance of vaccinations in the eastern federal states.

Our study has several limitations that need to be acknowledged. With 29.1% the response rate (Response Rate 3 as defined by AAPOR¹⁵) was comparatively low. However, it should be mentioned that the chosen method of calculating a response rate is a very conservative approach and that the response rate in our study is comparable to other studies using this approach (e.g. CDC-Behavioral Risk Factor Surveillance System Report²⁸). Considering the complex weighting procedures utilised in GEDA 2009 and the good cooperation rate (51.2%)¹⁴ it can be assumed that data quality in terms of generalizability to the general adult population is overall good (compare Table 1). Since vaccination status was self-reported by the respondents it could not be corroborated by any medical records. However, several previous studies have found that self-report of recent influenza vaccination has an adequate degree of validity.^{29,30} It is also likely that accuracy of self-reporting for having received a seasonal influenza shot for the last season differs from that for having received tetanus vaccination within the past 10 years. The estimates for tetanus vaccination coverage might therefore have been more prone to recall bias than those for influenza vaccination. Finally, persons with insufficient knowledge of the German language or persons who could not be interviewed via telephone were excluded from our study.

Methods

Study population and survey design. Details of the GEDA 2009 survey design have been described previously.¹⁴ In brief, GEDA 2009 is a national health telephone survey, representative of the adult population in Germany, which was conducted between July 2008 and June 2009. The study population (n=21,262) included persons 18 years of age or older who were living in a private household in Germany and who were able to be contacted by landline telephone. Persons aged ≤ 17 years and persons with an insufficient knowledge of the German language were excluded from the survey. The study protocol was approved by Germany's federal and regional data-protection commissioners. All data were collected and analyzed in an anonymous manner.

Response rates were calculated using Response Rate 3 as defined by the American Association for Public Opinion Research (AAPOR).¹⁵ Response Rate 3 is defined as the number of complete interviews divided by the number of interviews plus the number of non-interviews plus cases of unknown eligibility. Response Rate 3 uses an estimate for the proportion of cases of unknown eligibility that is potentially eligible. The cooperation rate at respondent level is defined as the proportion of all cases interviewed of all respondents ever contacted. This rate is calculated using only contacts with and refusals from known respondents.¹⁵

Definition of variables. All participants were asked whether they were vaccinated against seasonal influenza during the last season (Appendix). Since survey respondents were contacted over a 12-month period, the 'last' influenza season is either season 2007/08 or 2008/09 – depending on point of time of interview. Univariate and multivariate analysis of factors potentially influencing influenza vaccine uptake was performed using the complete dataset without consideration of season. Influenza vaccination coverage was calculated for persons for whom influenza vaccination is recommended in Germany. In accordance with the

STIKO 2008/09 recommendations¹, we classified persons into the influenza vaccination target group if they reported (1) to be ≥ 60 years of age, (2) to have underlying chronic diseases (chronic underlying respiratory, cardiovascular, liver or renal disease, cancer or diabetes), or (3) to work as a healthcare professional. Due to the study design, persons living in nursing or old people's homes, for which influenza vaccination is also recommended by STIKO, were included in the survey but not specifically asked if they live in such a home. Therefore, persons belonging to this target group were not identified and analyzed as a separate target group. Persons were regarded as vaccinated against tetanus if they reported to be vaccinated during the past 10 years. Persons were regarded as unvaccinated if they reported to have never received a tetanus vaccination or if the last tetanus shot was longer than 10 years ago. Persons were neither asked whether tetanus or influenza vaccination was offered to them nor if they actively declined a vaccination offer.

Socio-economic status levels were created as described by Lampert and Kroll on the basis of self-reported educational, income, and professional status of the interviewed person.³² The geographic region category 'Northwest/Middle' comprises the German federal states Schleswig-Holstein, Bremen, Lower Saxony, Hesse, Rhineland-Palatinate and Saarland (adult population: ~20 million), 'Midwest' comprises North Rhine-Westphalia (~15 million), 'East' comprises Mecklenburg-Vorpommern, Brandenburg, Berlin, Saxony-Anhalt, Thuringia and Saxony (~ 14 million), and 'South' comprises Baden-Württemberg and Bavaria (~ 19 million).

Interviewed persons were asked about the type of their health insurance (SHI, PHI, or other, which is defined as no health insurance, foreign health insurance, or unknown health insurance status) and potential migration background (none, one-sided when one parent and two-sided when both parents or the respondent were born abroad). Further questions included: Caring about personal health (yes/no); Self-assessment of general health status (good/not

good); Smoking behaviour (current or past smoker/non-smoker); Alcohol consumption (regular/ never or occasional). Finally, interviewees were asked questions related to vaccination: Received professional vaccination advice within the last five years (yes/no); source of vaccination advice (general practitioner, health insurance company, official health authorities, other); feeling sufficiently informed about the benefits of vaccination in general / feeling sufficiently informed about potential harms of vaccination in general (yes/no). Respondents were not explicitly asked to review their medical records before responding.

Statistical analysis. Data were analysed using PASW version 18.0 for Windows (SPSS Inc., Chicago, USA). Univariate analyses were performed to determine the association between vaccination uptake and demographic, socio-economic, health-relevant and informational factors. A p-value ≤ 0.05 was considered to indicate a statistically significant difference. Odds ratios (OR) and 95% confidence intervals (CI) were calculated as appropriate. Variables potentially associated with vaccine uptake (p-value < 0.2 in univariate analysis) were entered into a multivariate logistic regression model in a first step, followed by step-wise backward removal of variables with a p-value > 0.05 to produce a final model.

Conclusion. Despite an increase in tetanus and seasonal influenza vaccination coverage in German adults within the past ten years,^{11,21} our results indicate that tetanus vaccination coverage in the general adult population and influenza vaccination coverage in the target population is still unsatisfactorily low in Germany. Measures such as offering low-threshold vaccination services, implementing reminder systems for clients (potential vaccinees) and providers (physicians), and target group-oriented education strategies have been shown to improve vaccine uptake³¹ – especially when they are applied in combination – and should therefore be enhanced in Germany. As highlighted by the results of our study, private physicians should be a main target for enhanced activities related to vaccinations in Germany, since they are key figures in advising adults about vaccinations and informing them about the harms and benefits of the vaccines. In our study population, 88% had visited a physician in the past 12 months for any reason. Further research is necessary to evaluate communication channels for the efficient provision of vaccine-related information to private physicians and to assess their needs regarding vaccination-related information as well as patient recall and reminder systems.

Conflict of Interest

The authors have declared no conflict of interests.

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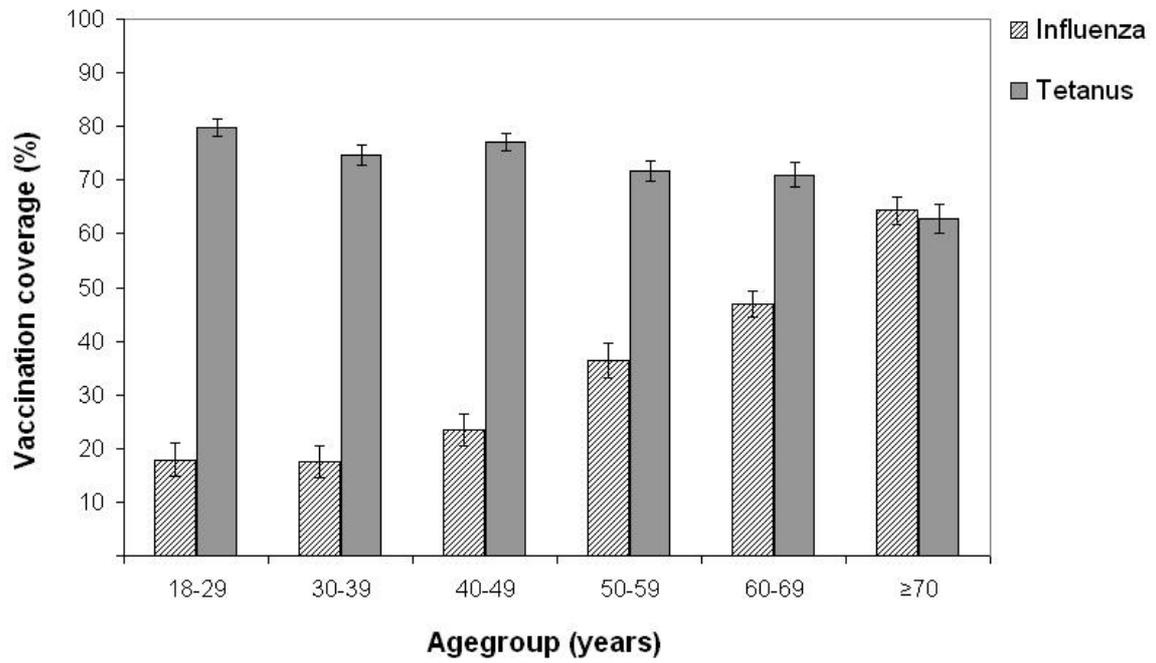
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Figure 1

Tetanus and seasonal influenza vaccination coverage in the general population by age group, Germany 2008/09



Tables

Table 1

Characteristics of persons aged ≥ 18 years in the study sample and the general population, Germany, 2008/09

Characteristics	Study population GEDA 09*		General population, 2008**	
	<i>n</i>	% (95% CI)	<i>n</i>	%
Sex				
Male	10,310	48.5 (47.6-49.4)	33,165,264	48.5
Female	10,952	51.5 (50.6-52.4)	35,153,535	51.5
Age				
18-39 years	7,021	33.0 (32.2-33.8)	22,135,423	32.4
40-59 years	7,774	36.6 (35.7-37.4)	25,225,632	36.9
≥ 60 years	6,467	30.4 (29.5-31.3)	20,957,744	30.7
Geographic Region				
Northwest/Middle	6,263	29.5 (28.7-30.3)	20,126,061	29.5
Midwest	4,598	21.6 (20.9-22.4)	14,764,121	21.6
East	4,467	21.0 (20.3-21.7)	14,306,153	20.9
South	5,934	27.9 (27.1-28.7)	19,122,464	28.0
Target group for influenza vaccination				
Healthcare workers	996	4.7 (4.4-5.0)	3,060,000	4.5
Persons with underlying chronic conditions	6,959	32.7 (31.9-33.6)	unknown	
Whole target population	10,661	50.1 (49.3-51.0)	unknown	

* weighted data; ** data by the Federal Statistical Office of Germany³³

Table 2

Univariate and multivariate analysis of factors potentially associated with tetanus vaccination coverage in the general population

Variable	Vaccination coverage (%)	Univariate OR (95% CI)	Multivariate OR (95% CI)
Sex			
female	71.6	1 (ref)	1 (ref)
male	74.8	1.18 (1.11-1.25)**	1.20 (1.11-1.29)**
Age			
18-39	77.3	1 (ref)	1 (ref)
40-59	74.8	0.87 (0.80-0.94)**	0.82 (0.75-0.90)**
≥60	66.7	0.59 (0.54-0.63)**	0.46 (0.42-0.51)**
Geographic Region			
Northwest/Middle	71.8	1 (ref)	1 (ref)
Midwest	66.9	0.80 (0.73-0.87)**	0.90 (0.81-0.99)*
East	79.2	1.50 (1.37-1.64)**	1.37 (1.23-1.52)**
South	74.7	1.16 (1.07-1.26)**	1.07 (0.97-1.17)
Residency (population)			
<5,000	77.6	1 (ref)	1 (ref)
5,000-<20,000	74.4	0.84 (0.76-0.92)**	0.93 (0.84-1.04)
20,000-<100,000	73.3	0.79 (0.72-0.87)**	0.84 (0.76-0.93)*
≥100,000	69.4	0.66 (0.60-0.72)**	0.68 (0.62-0.75)**
Type of health insurance			
PHI	71.3	1 (ref)	1 (ref)
SHI	73.2	1.10 (1.00-1.21)	1.26 (1.12-1.41)**
other	77.4	1.37 (1.11-1.69)*	1.24 (0.97-1.60)
Received vaccination advice within past 5 years			
no	58.2	1 (ref)	1 (ref)
yes	84.8	4.00 (3.74-4.28)**	3.37 (3.12-3.64)**
Feel sufficiently informed about the benefits of vaccination			
no	58.6	1 (ref)	1 (ref)
yes	77.2	2.39 (2.22-2.56)**	1.52 (1.39-1.67)**
Feel sufficiently informed about the risks of vaccination			
no	66.1	1 (ref)	NS
yes	77.4	1.76 (1.65-1.87)**	
Last physician contact			
<1 year	74.7	1 (ref)	1 (ref)
≥1 year - <5 years	64.1	0.60 (0.55-0.66)**	0.68 (0.61-0.76)**
≥5 years	45.4	0.28 (0.23-0.35)**	0.29 (0.22-0.38)**
Socioeconomic Status			
low	67.4	1 (ref)	1 (ref)
medium	74.1	1.39 (1.29-1.50)**	1.17 (1.06-1.28)*
high	76.0	1.54 (1.39-1.69)**	1.18 (1.04-1.33)*
Migration background			
none	75.2	1 (ref)	1 (ref)
one-sided	75.7	1.03 (0.86-1.23)	1.00 (0.81-1.22)
two-sided	59.1	0.48 (0.44-0.52)**	0.60 (0.53-0.67)**
Caring about personal health			
no	70.5	1 (ref)	1 (ref)
yes	75.4	1.28 (1.20-1.36)**	1.19 (1.11-1.29)**
Smoking			
non-smoker	73.9	1 (ref)	1 (ref)
current or past smoker	72.5	0.93 (0.88-0.99)*	0.91 (0.85-0.99)*
Alcohol consumption			
never/occasional	72.2	1 (ref)	1 (ref)
regular	75.7	1.20 (1.12-1.29)**	1.17 (1.07-1.27)**
Underlying chronic disease			
no	73.3	1 (ref)	NS
yes	72.9	0.98 (0.92-1.04)	
Perceived general health status			
not good	69.5	1 (ref)	NS
good	74.7	1.30 (1.22-1.39)**	

OR=Odds Ratio; CI=Confidence Interval; ref = reference category; PHI=private health insurance; SHI=statutory health insurance; NS=not significant; * p<0.05; ** p<0.001

Table 3

Univariate and multivariate analysis of factors potentially associated with influenza vaccination coverage in the recommended target population

Variable	Vaccination coverage (%)	Univariate OR (95% CI)	Multivariate OR (95% CI)
Sex			
female	44.5	1 (ref)	NS
male	43.5	0.96 (0.89-1.04)	
Age			
18-39	17.5	1 (ref)	1 (ref)
40-59	30.0	2.02 (1.73-2.35)**	2.02 (1.71-2.38)**
≥60	56.3	6.07 (5.29-6.95)**	6.55 (5.64-7.61)**
Geographic Region			
Northwest/Middle	40.2	1 (ref)	1 (ref)
Midwest	43.1	1.13 (1.01-1.25)*	1.20 (1.06-1.36)*
East	58.9	2.13 (1.91-2.38)**	2.00 (1.76-2.27)**
South	37.9	0.91 (0.82-1.01)	0.90 (0.80-1.01)
Residency (population)			
<5,000	45.1	1 (ref)	NS
5,000-<20,000	43.5	0.94 (0.84-1.05)	
20,000-<100,000	43.7	0.95 (0.85-1.06)	
≥100,000	44.0	0.96 (0.86-1.07)	
Type of health insurance			
PHI	37.2	1 (ref)	1 (ref)
SHI	45.1	1.39 (1.22-1.58)**	1.32 (1.14-1.53)**
other	31.8	0.79 (0.57-1.08)	1.03 (0.72-1.47)
Received vaccination advice within past 5 years			
no	29.3	1 (ref)	1 (ref)
yes	54.7	2.90 (2.67-3.15)**	3.05 (2.77-3.35)**
Feel sufficiently informed about the benefits of vaccination			
no	29.9	1 (ref)	NS
yes	47.1	2.09 (1.88-2.34)**	
Feel sufficiently informed about the risks of vaccination			
no	36.7	1 (ref)	1 (ref)
yes	47.5	1.56 (1.43-1.69)**	1.16 (1.05-1.29)*
Last physician contact			
<1 year	46.4	1 (ref)	1 (ref)
≥1 year - <5 years	19.6	0.28 (0.24-0.34)**	0.37 (0.30-0.44)**
≥5 years	26.7	0.42 (0.28-0.63)**	0.44 (0.27-0.70)*
Socioeconomic Status			
low	47.7	1 (ref)	NS
medium	43.7	0.85 (0.78-0.93)*	
high	40.3	0.74 (0.66-0.84)**	
Migration background			
none	45.0	1 (ref)	1 (ref)
one-sided	44.0	0.96 (0.78-1.19)	1.00 (0.78-1.28)
two-sided	35.9	0.69 (0.60-0.78)**	1.23 (1.05-1.44)*
Caring about personal health			
no	38.0	1 (ref)	1 (ref)
yes	48.4	1.53 (1.42-1.66)**	1.26 (1.15-1.38)**
Smoking			
non-smoker	48.6	1 (ref)	1 (ref)
current or past smoker	40.1	0.71 (0.66-0.76)**	0.91 (0.83-1.00)*
Alcohol consumption			
never/occasional	44.2	1 (ref)	NS
regular	43.2	0.96 (0.88-1.05)	
Underlying chronic disease			
no	35.9	1 (ref)	1 (ref)
yes	50.9	1.85 (1.71-2.00)**	1.37 (1.24-1.51)**
Perceived general health status			
not good	52.7	1 (ref)	1 (ref)
good	37.5	0.54 (0.50-0.58)**	0.72 (0.65-0.79)**

OR=Odds Ratio; CI=Confidence Interval; ref = reference category; PHI=private health insurance; SHI=statutory health insurance; NS=not significant; * p<0.05; ** p<0.001