

Knowledge, Attitudes and Practices of Agricultural Workers towards Tetanus Vaccine: a Field Report

M. Riccò¹, B. Razio², C. Panato², L. Poletti², C. Signorelli^{3,4}

Key words: Agricultural worker, Bacterial Vaccines, Occupational health, Tetanus, Tetanus toxoid, Vaccination

Parole chiave: Operatore agricolo, Vaccini batterici, Medicina del lavoro, Tetano, Tossoido tetanico, Vaccinazioni

Abstract

Background. Agricultural Workers are both more exposed to tetanus and at higher risk to be inadequately immunized than other usual recipients of the same vaccine

Study design. Our cross-sectional questionnaire-based study aimed to evaluate tetanus vaccination status, knowledge, attitudes and practices in Agricultural Workers in North-Eastern Italy.

Methods. Bivariate and multivariate logistic regression analyses were used to identify, from individual and work-related characteristics, factors significantly associated with appropriate vaccination status.

Results. Among 707 participants, 58.4% had an up-to-date immunization status. In 33.1%, last booster was performed by an Emergency Department. The main reason for inadequate immunization was having forgotten the recommended periodic booster (146/707; 20.7%). Attitude towards tetanus vaccination was somehow favourable in 79.5% of participants, and 72.7% correctly identified tetanus vaccination as mandatory for Agricultural Workers. A lower degree of false beliefs and better knowledge of official recommendations were significant predictors of vaccine propensity. The main predictor for an appropriate vaccination status was interaction with a healthcare provider, in general (adjusted Odds Ratio, adjOR 2.516 95%CI 1.707-3.710), and specifically regarding vaccine counseling, (adjOR 6.275 3.184-12.367 and adjOR 9.739 95%CI 3.933-24.111 for general practitioners and occupational physicians, respectively).

Conclusions. Our study enlightens the key role of healthcare providers in recalling and promoting vaccination policies, as well in increasing the general awareness of Agricultural Workers regarding vaccines and official recommendations.

Introduction

In 2010, the European Union Farm Structure Survey indicated that around 25 million people were engaged in the agricultural sector, representing 4.6%

of total employment (1). Even though epidemiological studies indicate that agricultural workers (AWs) are healthier and live longer than most other occupational groups (2-6), global estimates describe agriculture among the most hazardous

1) Occupational Health and Safety Unit, Department of Prevention, Provincial Agency for Health Services of the Autonomous Province of Trento, Italy

2) First cycle degree in Environment and Workplace Prevention Techniques, University of Trento, Italy

3) Department of Biomedical, Biotechnological and Translational Sciences, University of Parma, Italy

4) School of Medicine, University Vita-Salute San Raffaele IRCCS, Milan, Italy

occupational setting (7), associated to extensive exposure to risk factors such as strenuous physical exertion, climate, UV radiations, but also chemicals (e.g. pesticides), and biological agents (8, 9). AWs are also characterized by a high injury rate (8, 10), whose incidence and severity significantly increase in older age groups (4, 11): the exposure to soil and animal wastes, and the high rate of acute injuries, primarily puncture wounds and lacerations (12, 13), collectively explain their high risk of contracting tetanus (12-14).

Tetanus is a severe but fully preventable infectious disease and, since 1963, Italian law stipulates that tetanus vaccination (TeV) is compulsory for all newborns and for workers engaged in activities considered to be at high risk, including AWs (12, 13). However, several serologic surveys have pointed out that between 40% and 30% of Italian population has an inadequate protection (12, 13, 15, 16), and since 2006 Italy reports the highest number of cases in Europe, with an annual notification rate of 0.9-1.0 cases/1,000,000 (16, 17). As most of notified cases are the consequence of injuries occurred in countryside, farms or gardens, inadequate protection in the AWs may be even greater (12-14). The assessment of *knowledge* (i.e. the awareness of official recommendations), *attitudes* (i.e. propensity towards vaccinations) and *practices* (i.e. actual uptake of vaccinations), or KAP, is acknowledged as necessary in order to a better planning of vaccine campaigns in target populations (18-20), but few studies have specifically inquired AWs, in particular in Western Europe (12-14, 16).

Our primary objective was therefore to investigate the adherence to the TeV schedule of AWs from a highly developed agricultural settings (Autonomous Province of Trento, APT; North-Eastern Italy) (13, 16). Our secondary objective was then to investigate KAP of AWs towards TeV: as TeV in Italy is mandatory for AWs, but national

Constitution otherwise recognizes the right to avoid forced medical treatment (with few exceptions not including vaccinations), inquiring the reasons for an inappropriate or absent vaccination is an unavoidable step toward a better design of policies and informative programs (12-16).

Material and Methods

1. Study design and target population.

The present investigation was a questionnaire-based cross-sectional study. The target population included AWs from the APT, and the sampling was performed through convenience, involving all consecutive participants to qualification courses held between January and June 2016 and focusing on the occupational use of pesticides. The following excluding criteria were applied: an inadequate ability to understand the Italian language, and age < 18 years. A total of 915 consecutive AWs were eventually eligible to participate.

APT is located in the Italy's North East, covers a total area of 6,214 km² (2,399 sq. mi) and has a population of 537,416 habitants (2015 census). The nature of its territory is overwhelming mountainous (70% stands over 1,000 m/asl, and 20% is over 2,000 m/asl): ultimately, the area devoted to agriculture only accounts for 22% of the total provincial surface, but highly profitable cultivations (i.e. apples, vineyards) have sustained the regional economic development. According to labour force statistics, the agricultural sector in APT directly accounts for around 20,000 employees (dependent and self-employed) in 16,446 agricultural farms, including 11,958 agricultural enterprises, usually of small extent (89% are smaller than 5 hectares and 56% smaller than 1 hectare). These figures, however, do not include "hobby farmers" and part-time employees, whose number may largely exceed full-time employees (21).

2. Instruments. The instrument used was a specifically designed structured questionnaire including a total of 22 items divided into four areas of inquiry:

(1) *Information about the interviewee.* Retrieved data included: gender, age, educational level, birthplace (i.e. Italian-born people, IBP vs. Foreign-born people, FBP), occupational status (i.e. working as professional farmer, either as self-employee or as employee, or as “*hobby farmer*”), main sources for information about health topics (i.e. TV/radio/newspapers, internet, friends, parents, school, healthcare professionals).

(2) *Knowledge about vaccines.* Firstly, participants were asked whether they acknowledged TeV as mandatory for AWs. Subjects then received a general knowledge test (18, 20), containing a total of 16 true-false statements such as “*vaccinations increase the occurrence of allergies*” (false), covering some typical misconceptions on vaccination and vaccination policies and derived from an extensive review of the literature about KAP towards TeV (12-18, 20-31). A cumulative General Knowledge Score (GKS) was then calculated as follows: when the AWs correctly answered, +1 was added to a sum score, whereas a wrong indication or a missing answer added 0 to the sum score.

(3) *Attitudes.* Participants were asked to explain why they would get vaccinations (i.e. “*to avoid getting vaccine preventable diseases (VPDs)*”, “*to avoid transmitting VPDs*”, “*to avoid complications of VPDs*”, “*to avoid VPDs in subjects who cannot be vaccinated*”) or rather would refuse a vaccine or hesitate towards vaccinations (i.e. “*to avoid shots/medications*”, “*uselessness*”, “*fear of side effects*”, “*religious/ethical reasons*”). Specific propensity towards TeV was then assessed through a 5 points Likert scale (i.e. strongly disagree; disagree; neutral; agree; and strongly agree), and a TeV Propensity Score (PS) was calculated by awarding a score of +1 for a specific

propensity rated as “strongly disagree”, +2 for “disagree”, and so on.

Risk perception is a significant component of the attitude, and it has been defined as a function of the perceived probability of an event and its expected consequences, being assessed as the mathematical product of subjective probability and disease severity (18, 20, 22). Consequently, participants were asked about their perceived probability of (a) tetanus infection in AWs (E^{inf}), (b) vaccine-related adverse effects (E^{vac}), and how severe they perceived (c) natural infection (C^{inf}), and (d) vaccine-related adverse effects (C^{vac}). All components of risk perception were assessed through a fully labelled 5-point scale (“almost zero”, “low or rather low”, “moderate”, “high or rather high”, “very high”), and cumulative Risk Perception Score (RPS) was obtained through the formula:

$$\text{Risk perception} = E^{inf} * C^{inf} - E^{vac} * C^{vac}$$

(4) *Practices.* Participants were initially asked whether they had received or not any medical assessment in the previous 5 years, and whether it had been performed by the general practitioner (GP), an occupational physician (OPh), or any other healthcare provider (HP).

Participants were then asked about their tetanus immunization status, whether they had received previous recommendations regarding tetanus by a HP (GP or OPh), and in particular whether they had been thought about risks associated with the avoiding of vaccine boosters; potential side effects of vaccine boosters; potential risks of tetanus natural infection; potential benefits associated with vaccination. The setting of the last vaccination shot was eventually recalled (either as a programmed/elective or an emergency shot performed after a penetrating injury), including the professional who actually performed the last vaccination shot (i.e. GP, OPh, nurse or any

other HP from a Local Health Unit service, Emergency Department, Military Service). An up-to-date vaccination schedule was defined as a complete set of TeV plus one booster shot against tetanus within the last 10 years. Subjects with an inappropriate vaccine status were asked whether the booster dose was simply forgot, also not having enough time, or deliberately avoided (i.e. because of allergies towards vaccine components; disbelief that pediatric age doses guarantee lifetime protection; fear of shots, needles or of side effects; because of personal/religious beliefs). On the contrary, subjects referring an appropriate immunization status were asked why they performed last TeV shots, and in particular whether they knew that the vaccine was required at workplace, or it was suggested by a HP (either GP or OPh), or simply the participant wanted to be protected against tetanus.

The majority of survey items had been used in previous studies on KAP both in the general population (20) and in occupational settings (18,19), but were adapted to our specific target population and design. Test-retest reliability of questionnaire items was preventively assessed by having 10 AWs complete the questionnaire at two different points in time. A correlation coefficient was calculated to compare the two sets of responses: items having a coefficient >0.80 were interpreted as consistent, and were therefore included in the questionnaire used in this survey. All questions were self-reported, and not externally validated.

The delivering and gathering of questionnaire were performed by hand before the beginning of the courses, and questionnaires lacking basic information about the interviewee were excluded from the study.

3. Ethical considerations. Before they give their consent, subjects to be inquired were informed that participation in the present survey was voluntary, and that the

questionnaires would be gathered only from subjects expressing preliminary consent for study participation. Participants were guaranteed that they may withdraw from the survey in any time, by simply non delivering the questionnaire at the end of the course session, and that all collected information would be handled anonymously and confidentially. As the questionnaire was strictly anonymous, it is implausible that individual participants could be identified based on the presented material, and ultimately this study caused no plausible harm or stigma to participating individuals. Moreover, as the final examiners of professional courses were totally blind regarding the status of inquired subjects (i.e. whether they had participated or not in the survey), it is also highly unlikely that individual participants have been forced to give their consent. As the study design assured an adequate protection of study participants, and neither included clinical data about patients nor configured itself as a clinical trial, a preliminary evaluation by the Ethical Committee of the Provincial Agency for Health Services (APSS) was not required.

4. Data Analysis. Two independent researchers, one of whom read the responses from each questionnaire while the other reviewed the entered data and ensured the accuracy of data entry. The primary investigator examined unclear responses to determine the correct answer. Questionnaire lacking basic information about the interviewee were excluded from the study. We calculated the described GKS, PS and RPS, and all cumulative scores were normalized to percent values in order to more easily compare the scales (min 0.0%, max 100%). Continuous variables were expressed as mean \pm standard deviation and were preliminarily tested for normal distribution (D'Agostino & Pearson omnibus normality test): where the corresponding p value was < 0.10 , normality distribution was assumed

as rejected and variables were compared through Mann-Whitney or Kruskal-Wallis test for multiple independent samples. On the other hand, variables passing the normality check (D'Agostino & Pearson p value ≥ 0.10) were compared using the Student's t test or ANOVA, where appropriate. In the analysis involving cumulative scores and information sources, post-hoc Dunnett's test was applied and category "healthcare professionals" assumed as a reference.

Categorical variables were reported as per cent values and univariate confrontations between proportions were initially evaluated through Chi-squared test in order to examine correlates of self-assessed TeV status (appropriate vs. inappropriate) with demographic data regarding age (dichotomized as < 50 years vs. ≥ 50 years), sex, education (≤ 8 years vs. 9 years or more), birthplace, information sources, the recalling of TeV as a mandatory vaccination for AWs (correctly vs. incorrectly recalled), the attitude towards TeV (dichotomized as "strongly disagree", "disagree" and "neutral" vs. "agree" and "strongly agree"). Their associations were expressed as odds ratios (OR) with their 95% confidence intervals (95% CI). Association of self-assessed vaccination status with personal beliefs and HP associated factors was then assessed by binary logistic regression analysis as adjusted OR (adjOR) with the respective 95%CI. A regression analysis (SPSS 24, IBM Corp. Armonk, NY) was eventually modelled in order to assess the relative influence of GKS, RPS on the dependent variable PS. Both regression models included as covariates age, sex, seniority, education level, birthplace, and information sources. Significance level was < 0.05 .

Results

Demographic analysis. As shown in Table 1, the sample consisted of 707 AWs.

Table 1 - Baseline characteristics of the study population, including a total of 707 Agricultural Workers (AW) from the Autonomous Province of Trento (APT).

Variable	N	%
Age (years)		
< 30	105	14.9
30 – 39	140	19.8
40 – 49	160	22.6
50 – 59	160	22.6
60 – 69	110	15.6
> 70	32	4.5
Sex		
Males	607	85.9
Females	100	14.1
Occupational status		
Farmer (owner)	395	55.9
Hobby farmer	236	33.4
Farmer (employee)	76	10.7
Migration background		
No (Italian Born Peoples)	644	91.1
Yes (Foreign Born Peoples)	63	8.9
Education level		
Primary / Secondary School	194	27.4
High School	402	56.9
University	111	15.7
Main information source		
Health Professionals	462	65.3
Conventional media	104	14.7
New Media	67	9.5
Friends, relatives	59	8.3
Professional courses	15	2.1
Previous medical assessment		
Any in the previous 5 years	563	79.6
General Practitioner	506	71.6
Occupational Physician	332	47.0
None	144	20.4

The majority of participants was of Italian origin ($n = 644$, 91.1%) and male sex: 85.9% (600/707); 66.6% were "professional farmers", whereas around a third (33.4%) were "hobby farmers". Mean age was 46.6 years ± 14.1 , with males significantly older than females (47.4 years ± 14.0 , vs. 41.7 years ± 13.8 , $p < 0.001$). All the participants

had completed at least the primary education (5+3 years), and the majority of them (513/707, 72.6%) had achieved secondary education level (13 years) or higher. Around 65% of participant reported physicians as the main source of information regarding vaccinations, including both the GP (59.0%) and the OPh (6.4%), whereas 14.7% identified conventional media (i.e. radio, television, journals) and 9.5% new media as main information source.

Knowledge. TeV was correctly identified as mandatory for AWs by 72.7% of participants (n = 514), and after percent normalization GKS was estimated in $35.0\% \pm 24.4$ (actual range 0.0 to 94.0%). Regarding the single statements (Table 2), the majority of participants correctly recalled that tetanus infection may be associated with

soil contamination (370/707, 52.3%), and that tetanus may follow also minor wounds (406/707, 57.4%). On the contrary, 492/707 (69.6%) failed to identify the vaccine additives as not dangerous for human health, and the majority of participants erroneously acknowledged side effects of vaccines as not unusual (451/707, 63.8%), as usually hidden from public knowledge (477/707, 67.5%), and potentially developing also several years after vaccination shots (525/707, 75.7%). Moreover, the majority of participants claimed for causative associations of vaccines with auto-immune diseases (571/707, 80.2%), such as Multiple Sclerosis (521/707, 73.7%), and diabetes mellitus (485/707, 68.6%), but also with allergic disorders such as asthma and atopic dermatitis (509/707, 72.0%), and severe neurological

Table 2 - Knowledge test: response distribution of items proposed to the 707 Agricultural Workers from the Autonomous Province of Trento participating in the survey.

Statements	Correct answer	No. of Correct answers (%)
1. The additives used in the vaccines are not dangerous for humans	True	215 (30.4%)
2. Neurologic diseases such as Multiple Sclerosis may be induced by HBV vaccine	False	186 (26.3%)
3. Diabetes mellitus may be triggered by vaccination shoots	False	222 (31.4%)
4. Vaccinations increase the occurrence of auto-immune diseases (e.g. rheumatoid arthritis, some thyroid diseases etc.)	False	236 (28.0%)
5. Autism is more frequent in subjects vaccinated against measles	False	235 (33.2%)
6. Severe diseases of the CNS are a possible side effect of measles vaccine	False	189 (26.7%)
7. Vaccinations increase the risk for allergic disorders such as asthma and atopic dermatitis	False	198 (61.0%)
8. Tetanus infection may be associated with soil contamination of wounds	True	370 (52.3%)
9. Without massive vaccination programs, smallpox would still exist	True	388 (54.9%)
10. Tetanus illness may follow also minor wounds	True	406 (57.4%)
11. Children would be more resistant to infections if they were not always treated against all diseases	False	303 (42.9%)
12. Many vaccinations are administered too early. As results, the immune system has no possibility to fully develop by itself	False	263 (31.2%)
13. The immune system of children may be overwhelmed by a high number of vaccines	False	185 (26.2%)
14. Severe vaccine side effects are usually hidden from public knowledge	False	230 (22.5%)
15. Severe vaccine side effects are unusual	True	256 (36.2%)
16. Severe side effects may develop also several years after vaccination shots	False	182 (24.3%)

diseases such as autism (472/707, 66.8%), in particular after measles vaccine (518/707, 73.3%). Moreover, most of participants exhibited misconceptions regarding vaccine practices, as 444/707 (68.8%) believed that many vaccinations are administered too early, and 522/707 (73.8%) that the immune system may be overwhelmed by the high number of vaccines included in the vaccine schedules, as children would be more resistant to infections if they were not always treated against all diseases (404/707, 57.1%).

As shown in Table 3, GKS was significantly greater in participants with higher education level (36.7% \pm 23.6 in subjects having 9 years of more vs. 30.5% \pm 26.2 in participants having 8 years of formal education or less, $p < 0.001$), whereas not significantly better scores were identified in males (39.0% \pm 26.1 vs. 34.4% \pm 24.1 in females, $p = 0.099$), in FBP (37.8% \pm 25.6 vs. 34.7% \pm 24.3 for IBP, $p = 0.344$), in subjects ages 50 years or more (35.4% \pm 27.6 vs. 34.8% \pm 21.8 in people aged less than 50 years, $p = 0.763$). Focusing on information sources, subjects identifying healthcare professionals (37.3% \pm 25.0) as the main referents reported the better GKS, and difference was significant for participants relying on friends and relatives (24.7% \pm 21.5, $p = 0.001$) and new media (29.5% \pm 21.8, $p = 0.038$).

Attitudes. Most of participants were somehow in favor of TeV ($n = 562$, 79.5%), with a correspondent propensity score of 89.5% \pm 18.3 (actual range 20.0 to 100%), higher in IBP participants (90.5% \pm 17.3 vs. 79.4% \pm 24.4 in FBP, $p < 0.001$), and subjects older than 50 years (91.1% \pm 16.2 vs. 88.3% \pm 19.6 in participants younger than 50 years, $p = 0.033$), with no significant differences regarding sex (89.5% \pm 18.0 for males vs. 89.6% \pm 20.0 for females, $p = 0.942$), and the formal education level (90.4% \pm 16.4 in ≤ 8 years vs. 89.1% \pm 18.9 for 9 years or more, $p = 0.373$). Focusing on information

sources, higher PS were associated with referring to professional courses (94.7% \pm 9.2) and health professionals (90.8% \pm 16.8), followed by conventional media (89.2% \pm 16.9), friends or relatives (86.8% \pm 23.7), whereas new media were associated with a significantly lower score (82.1% \pm 23.4, $p = 0.001$).

RPS was estimated in 62.7% \pm 21.3 (actual range 20.0 to 80.0%), significantly higher in females (68.8% \pm 16.7) than in males (61.7% \pm 21.8, $p < 0.001$), in subjects with higher formal education level (65.6% \pm 19.1 for people having 9 years of formal education or more vs. 55.2% \pm 24.8 in in participants with 8 years or less, < 0.001), whereas not significantly higher scores were identified in subjects younger than 50 years (63.5% \pm 20.2 vs. 61.7% \pm 22.6 in participants aged 50 years and older, $p = 0.292$), and in IBP (63.1% \pm 21.0 vs. 58.4% \pm 23.9 in FBP, $p = 0.135$). Regarding the information sources, the highest score was identified in subjects referring to health professionals (64.4% \pm 20.7), and the difference with conventional media (61.7% \pm 21.4), new media (60.6% \pm 22.0), professional courses (58.7% \pm 25.6) was not significant. On the contrary, score associated with friends or relatives (54.9% \pm 22.2) was significantly lower than the referent category of healthcare professionals ($p = 0.005$).

Practices. Overall, 413 subjects presented with an appropriate tetanus immunization status (58.4%), whereas in 181 subjects (25.6%) last booster was performed 10 or more years before the sampling, and 113 were actually unable to recall the last vaccination shot.

The most frequent explanation associated with an incomplete vaccine status was “*forgetting*” the periodic booster (171/294, 58.2%), with 34 further cases (11.6%) avoiding vaccination as “*not having enough time*”. Among participants with inadequate vaccine protection, 36 subjects (12.2%) had refused the required boosters because

Table 3 - Knowledge Score (GKS), Propensity Score (PS), and Risk Perception Score (RPS) after per cent normalization by recalled demographic factors and main information source referred by study participants.

Variables	General Knowledge Score (GKS)			Propensity Score (PS)			Risk Perception Score (RPS)		
	N	%	Mean ± SD	P value	Mean ± SD	P value	Mean ± SD	P value	
Sex	607	85.9	34.4% ± 24.1	0.099	89.5% ± 18.0	0.942	61.7% ± 21.8	< 0.001	
Females	100	14.1	39.0% ± 26.2		89.6% ± 20.0		68.8% ± 16.7		
Age group	302	42.7	35.4% ± 27.5	0.763	91.1% ± 16.2	0.033	61.7% ± 22.6	0.292	
< 50 years	405	57.3	34.8% ± 21.8		88.3% ± 19.6		63.5% ± 20.2		
Migration background	644	91.1	34.7% ± 24.3	0.344	90.5% ± 17.3	0.001	63.1% ± 21.0	0.135	
No (Italian Born People)	63	8.9	37.8% ± 25.6		79.4% ± 24.4		58.4% ± 23.9		
Education level	194	27.4	30.5% ± 26.2	0.004	90.4% ± 16.4	0.373	55.2% ± 24.8	< 0.001	
≤ 8 years	513	72.6	36.7% ± 23.6		89.1% ± 18.9		65.6% ± 19.1		
9 years or more	462	65.3	37.3% ± 25.0	REF	90.8% ± 16.8	REF	64.4% ± 20.7	REF	
Main information source	104	14.7	35.3% ± 23.5	0.907	89.2% ± 16.9	0.892	61.7% ± 21.4	0.679	
Healthcare Professionals	67	9.5	29.5% ± 21.8	0.038	82.1% ± 23.4	0.001	60.6% ± 22.0	0.527	
Conventional media	15	2.1	35.7% ± 23.0	0.902	94.7% ± 9.2	0.679	58.7% ± 25.6	0.761	
New media	59	8.3	24.7% ± 21.8	0.001	86.8% ± 23.7	0.370	54.9% ± 22.2	0.005	
Professionals courses									
Friends, relatives									

Notes. Confrontation of demographic factors was performed through Student's t test for unpaired data, whereas confrontation of scores by information sources was performed through ANOVA and Dunnett's post-hoc test, the latter arbitrarily assuming Healthcare professionals as the referent ones.

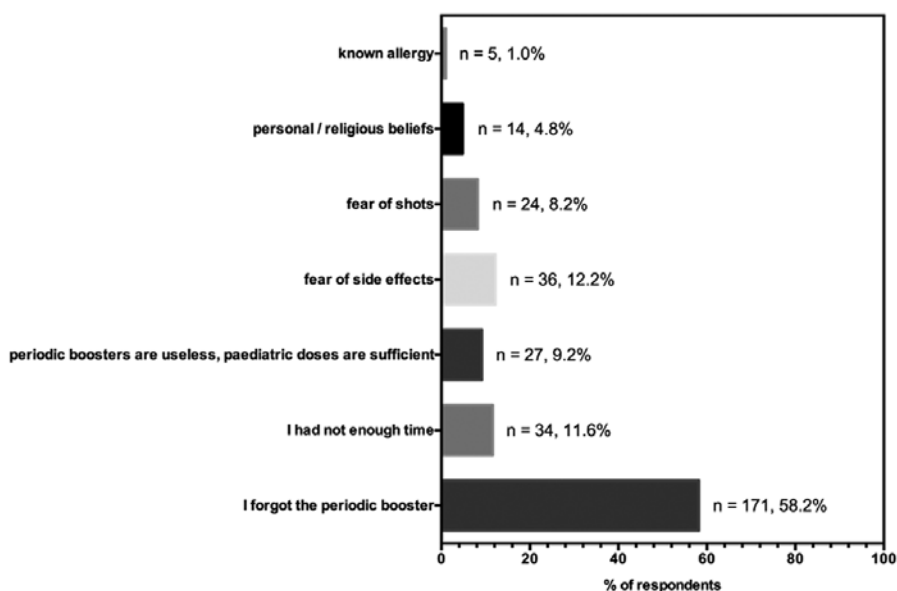


Figure 1 - Explanations referred by participants having an inappropriate vaccination status ($n = 293$) for having avoided the last vaccination shot. Appropriate vaccination status was determined as self-referral of one booster shot against tetanus within the last 10 years

of side effects, or fearing vaccination shots ($n = 24$, 8.2%), whereas 27 subjects (9.2%) did not perform vaccine booster assuming as “sufficient” the doses received in infancy and adolescence and 5 subjects (1.0%) for known allergy towards vaccine components. Eventually, 14 workers (4.8%) declared that they refused TeV for personal or religious beliefs (Figure 1).

The majority of sampled AWs having up-to-date immunization status had received last TeV shot in Emergency Departments following a previous penetrating injury ($n = 234$, 33.1%), whereas 25.3% had been previously vaccinated by professionals from Public Health Services, 22.1% by an OPh and 11.3 by the GP. Eventually, 7.2% were previously vaccinated at Conscription, whereas 1.0% ($n = 7$) were unable to recall the setting of the last vaccination shot.

Prevalence of up-to-date immunization status was similar in males and females (363/607 vs. 50/100; $p = 0.065$, OR 1.488

95% CI 0.973-2.274), in IBP and FBP (383/644 vs. 30/63; $p = 0.068$, OR 1.614 95% CI 0.961-2.712), in subjects having 8 years of formal education or less and more educated participants (117/194 vs. 296 vs. 513; $p = 0.530$, OR 1.114 95% CI 0.795-1.560), whereas a significantly increased prevalence of appropriate vaccination status was found in subjects older than 50 years (190/302 vs. 223/405 subjects younger than 50 years; $p = 0.036$, OR 1.385 95% CI 1.021-1.878) (Table 4). Assuming Health Professionals as the referent information source, Conventional Media (OR 0.294, 95% CI 0.188 – 0.460), New Media (OR 0.424, 95% CI 0.252 – 0.713) and Professional courses (OR 0.139, 95% CI 0.039 – 0.499) were associated with significantly lower vaccination rates, whereas participants referring friends and/or relatives as main information source had a conversely higher vaccination rate (OR 2.424, 95% CI 1.225-4.796).

Table 4 - Association of self-assessed updated tetanus vaccination (TeV) status (i.e. a complete set of TeV plus one booster shot against tetanus within the last 10 years; n = 413, 58.4%) with main demographic factors of 707 farmworkers (FWs) from the Autonomous Province of Trento (APT).

	N# / 707 (%)	Updated self-assessed vaccination status N# / 413 (%)	P value	OR (95%CI)
Sex				
Males	607 (85.9%)	363 (87.9%)	0.065	1.488 (0.973-2.274)
Females	100 (14.1%)	50 (12.1%)		
Age group				
Age ≥ 50 years	302 (42.7%)	223 (54.0%)	0.036	1.385 (1.021-1.878)
Age < 50 years	405 (57.3%)	190 (46.0%)		
Migration background				
No (IBP)	644 (91.1%)	383 (92.7%)	0.069	1.614 (0.961-2.712)
Yes (FBP)	63 (8.9%)	30 (7.3%)		
Education level				
≤ 8 years	194 (27.4%)	117 (28.3%)	0.530	1.114 (0.795-1.560)
9 years or more	513 (72.6%)	296 (71.7%)		
Main information source				
Health Professionals	462 (65.3%)	297 (71.9%)	1.000	REF
Conventional media	104 (14.7%)	36 (8.7%)	< 0.001	0.294 (0.188-0.460)
New Media	67 (9.5%)	29 (7.0%)	0.001	0.424 (0.252-0.713)
Friends, relatives	59 (8.3%)	48 (11.6%)	0.011	2.424 (1.225-4.796)
Professional courses	15 (2.1%)	3 (0.7%)	0.002	0.139 (0.039-0.499)

Notes: IBP = Italian Born People; FBP = Foreign Born People OR = Odds Ratio; 95%CI = 95% Confidence Interval

As shown in Table 5, significantly higher vaccination rates were also identified in subjects who had correctly identified tetanus as a mandatory vaccination (adjOR 2.708, 95% CI 1.744 – 4.204), acknowledging that the use of vaccines may ultimately avoid communicable VPDs in subjects who cannot be otherwise vaccinated (adjOR 3.395, 95% CI 1.691 – 6.813), and who were previously taught by a HP about the potential side effects of side effects (adjOR 2.447, 95% CI 1.665 – 3.594).

Among the 707 participants, 79.6% reported ever having been medically examined by a health care provider in the previous 5 years, and 47.0% (332 out of 707) had at least one medical assessment by an OPh, and both behaviors were associated with increased vaccination rates (adjOR 2.516 95% CI 1.707-3.710 and adjOR

1.713 95% CI 1.256-2.335, respectively). Moreover, a total of 13.4% of the participants reported to have received vaccination advice in the past five years by the GP (adjOR 6.275, 95% CI 3.184 – 12.367), and 10.6% by the OPh (adjOR 9.739, 95% CI 3.933 – 24.111), and the advice of both professionals was identified as the stronger predictor for an appropriate vaccination status.

Predictors of vaccination propensity.

In a bivariate correlation analysis, GKS was positively associated with RPS ($r = 0.094$, $p = 0.012$), and PS ($r = 0.108$, $p = 0.004$), and also RPS and PS were significantly correlated ($r = 0.147$, $p < 0.001$), i.e. a better GKS was associated with higher propensity to receive TeV and to understand tetanus as a severe disease, and people with a better understanding of the risks associated with tetanus natural infection had also a better

Table 5 - Association of personal beliefs regarding vaccinations and the role of Healthcare providers (HP) with tetanus vaccination (TeV) status.

	N/707 (%)	T+ (N = 413)		T- (N = 294)		OR	95%CI	adjOR	95%CI
		N (%)	N (%)	N (%)	N (%)				
Correctly recalling of TeV as mandatory	514 (72.7%)	331 (80.1%)	183 (62.2%)	2.448	1.747 – 3.432	2.708	1.744 – 4.204		
Acknowledging Tetanus as a potentially severe disease	533 (75.4%)	317 (76.8%)	216 (73.5%)	1.192	0.844 – 1.684	0.907	0.575 – 1.432		
Somehow favorable attitude towards TeV	562 (79.5%)	332 (80.4%)	230 (78.2%)	1.141	0.789 – 1.649	0.925	0.581 – 1.473		
Previous medical assessment (any)	564 (79.8%)	351 (85.0%)	213 (72.4%)	2.153	1.484 – 3.123	2.516	1.707 – 3.710		
Previous medical assessment by an OPh	332 (47.0%)	215 (52.1%)	117 (39.8%)	1.643	1.213 – 2.224	1.713	1.256 – 2.335		
Vaccines avoid ...									
VPDs infection	530 (75.0%)	312 (75.5%)	218 (74.1%)	1.077	0.763 – 1.519	0.923	0.568 – 1.499		
VPDs transmission	166 (23.5%)	90 (21.8%)	76 (25.9%)	0.799	0.563 – 1.135	1.636	0.976 – 2.724		
VPDs complications	211 (29.8%)	129 (31.2%)	82 (27.9%)	1.174	0.845 – 1.632	1.186	0.775 – 1.815		
Communicable VPDs in subjects who cannot be vaccinated	68 (9.6%)	49 (11.9%)	19 (6.5%)	1.948	1.121 – 3.385	3.395	1.691 – 6.813		
Regarding TeV ...									
... it was suggested by GP	95 (13.4%)	80 (19.4%)	15 (5.1%)	4.468	2.517 – 7.933	6.275	3.184 – 12.367		
... it was suggested by an OPh	75 (10.6%)	68 (16.5%)	7 (2.4%)	8.081	3.654 – 17.870	9.739	3.933 – 24.111		
A HP taught me about ...									
... risks associated with the avoiding of vaccine boosters	62 (8.8%)	35 (8.5%)	27 (9.2%)	0.916	0.541 – 1.549	1.221	0.800 – 1.865		
... potential side effects of vaccine boosters	135 (19.1%)	98 (23.7%)	37 (12.6%)	2.161	1.431 – 3.264	2.447	1.665 – 3.594		
... potential risks of tetanus natural infection	105 (14.9%)	69 (16.7%)	36 (12.2%)	1.438	0.931 – 2.219	1.636	0.976 – 2.742		
... potential benefits associated with vaccination	298 (42.1%)	200 (48.4%)	98 (33.3%)	1.878	1.377 – 2.560	1.137	0.925 – 2.174		

Notes. T+ = adequate TeV status; T- = inadequate TeV status; an adequate schedule was defined as a complete set of TeV plus one booster shot against tetanus within the last 10 years; GP = General Practitioner; OPh = Occupational Physician; VPD = Vaccine Preventable Disease.

attitude towards vaccination. In the linear regression analysis model, RPS ($B = 0.110$, 95% CI 0.047 to 0.173; $p = 0.001$) and GKS ($B = 0.082$, 95% CI 0.028 to 0.109; $p = 0.004$) were also identified as significant predictors of the PS.

Discussion

TeV is effective, inexpensive, and easy to perform, but it is essential that an adequate protection against tetanus be maintained over time (23). Although tetanus in developed countries has become a very rare disease (24-26), unsatisfying protective immunity rates have been repetitively associated with certain occupational groups, such as construction workers (19, 27) and AWs (12, 13, 28-31), ranging between 50% and <20% (28, 31-33). In our sample, around 58.4% of the sample had received the basic cycle plus an immunization booster within the recommended time frame: the prevalence of appropriate vaccination status was therefore seemingly similar to previous questionnaire-based reports from the general population (24-26) and slightly higher than in most of available occupational studies about AWs (12, 13, 28-31), in particular for older age groups. In this regard, it should be stressed that demographic parameters of our sample were similar to European agricultural labor force, as it included a relatively low share of workers younger than 40 years (34.8% vs. 33.0% of European estimates), and a high share of workers aged 65 and more (11.0 vs. 9.9%) (1, 34). We found a positive association between age > 50 years and the immunization status of the individuals (73.8% vs. 46.9% in younger subjects, $p = 0.036$), and these results are apparently in contradiction with the previously available evidence (23, 28, 35-37). Previous reports from North America and Western Europe, clearly showed that the elderly population is frequently inappropriately immunized

against tetanus, and tetanus seropositivity declines with increasing age (16, 33, 38). For instance, in 2016, the US Centers for Disease Control and Prevention (CDC), estimated that the proportion of adults who received vaccines including tetanus toxoid within the last 10 years was 62.6% for those 19-64 year-olds and only 57.7% for people over 65 years (36). Similarly French estimates suggest that booster for tetanus in subjects aged more than 65 years had been received by only 60.5% (39).

Other demographic factors such female sex, education level and migration background were similarly not associated with the immunization status, and our results may ultimately found an explanation through the assessment of KAP of the survey population (40-42).

First at all, our sample was characterized by a very high awareness that TeV is mandatory for AWs (72.7%), and such an attitude was identified as a significant predictor of an appropriate vaccination status (adjOR 2.708 95% CI 1.744-4.204).

Second, a positive attitude towards vaccination was extensively reported among the majority of participants, and this has been repetitively acknowledged as a factor significantly increasing the chance of having a valid vaccination status (43).

Third, although participants exhibited substantially unsatisfying knowledge of vaccines and vaccine related topics, the share of the study population acknowledging tetanus (a) as a severe illness (75.4%), (b) as potentially following even minor wounds (57.4%), and (c) correctly recalling risk factors for tetanus infection such as soil contamination of the wounds (52.3%) were somehow higher than previously reported (30, 31, 44). Actually, farmers are usually characterized as independent, self-reliant individuals, associated with significant informative and formative gaps, including preventive health practices (such as immunizations), and more specifically

occupational health and safety practices (31, 45). In particular, AWs are characterized by high risk tolerance and significant delays in seeking care after accidents (9): not coincidentally, most of reported tetanus cases in AWs or in farm settings are usually unable to recall the injury associated with *C tetani* infection (12, 14, 16, 46). Contrariwise, in our study a high share of participants remember that they had received last vaccination booster in Emergency Departments after a penetrating injury ($n = 234$, 33.1%), confirming the high risk perception of participants. Actually, the majority of AWs showing an inappropriate vaccination status simply forgot to request the recall shots rather than avoiding them because of limited trusts in vaccines and HPs (47).

High risk perception by study participants may in turn be explained as a consequence of the specific settings we assessed, as in APT the occupational health and safety practices are strictly regulated (40, 48-50). Not coincidentally, around 47.0% of study participants had received at least one consultation from an OPh in the previous 5 years, and HPs were cited as the usual source of information for the majority of participants. Again, identification of HPs as main information source and previous consultation with either GP or OPh, were both associated with higher vaccination rates. These results are consistent with previous reports suggesting that coupling information with clear HPs recommendation is likely to be most influential in determining tetanus immunization (24), ultimately underscoring the role of HPs and their influence in immunization decision making (44). In other words, HPs should be not only vigilant in evaluating the tetanus immunization status of their farm clients, but should be also available to interact with them, as their intervention may significantly increase the attitude towards vaccination (23).

Moreover, the study population was, by design, limitedly comparable with available surveys from Turkey and North America (23,

30-33, 51, 52), as it included a very high share of high educated subjects (72.6% with 9 or more years of formal education, and 15.7% referring university level degree): not only they exhibited higher knowledge and risk perception as assessed through cumulative score, but also evidence suggests that higher education would be in turns associated with higher referral to HPs following even minor wounds, eventually resulting in higher vaccination rates (5, 16, 23, 52, 53).

Despite its potential interest, some limitation of our study should be addressed. Firstly, we used self-reports to measure vaccination status in respondents, and therefore we are unable to rule out recall bias and social desirability bias. In other words, our results might be affected by an implicit misreporting, because of individuals' recall errors on the one hand, and subjects' answering to questions in a manner that will be viewed favorably rather than factually, on the other hand (54, 55). However, evidence hints that questionnaire-based self-reporting of TeV guarantees a relatively accurate measure of vaccination status (24): more specifically, asking patients whether they had a tetanus booster in the last 10 years is associated with high sensitivity (92.4%) and positive predictive value (potentially peaking to 98.8%) (47, 56).

Second, we addressed a sample of relatively small size, gathered through convenience sampling and a regional basis. The latter may represent a main issue, as Italy has been repetitively acknowledged as highly heterogeneous in terms of socioeconomically development and, education level; and also agricultural practices are deeply regionalized (57). Again, it should be stressed that the study population, i.e. AWs performing pesticide application, included only subjects having a relatively high qualification, both in term of personal education and in empirical experience with farming practices. Moreover, around a third of participants were "hobby farmers", and also most

“professional farmers” are often only part-time AWs: therefore, generalization of our results may be cautiously applied only to similarly highly developed agricultural settings (57).

Eventually, also the very same definition of appropriate vaccination status for decennial boosters may be questioned, as high serologic protection was otherwise found in subjects receiving a ventennial booster, and increasing evidence suggests that a high pre-booster antibody concentrations will increase the risk of adverse events after vaccination (41). In other words, not only a significant ratio of participants self-defining as “unvaccinated” may have received in the previous years a forgotten vaccination booster, but - for an even greater proportion - the booster would be eventually useless.

Conclusions

Our study provides evidence that, in highly developed agricultural settings, TeV rates may be slightly higher than previously reported. It also showed that propensity for vaccinations, and ultimately TeV rates, are significantly affected by factors such as risk perception and knowledge of issues about TeV and tetanus illness. A continuous interplay of AWs with HPs was similarly identified as a significant predictor of appropriate vaccination status, underscoring the importance of medical surveillance and medical counselling about preventive vaccinations. In summary, our results suggest that the prevention of tetanus in rural areas from high income countries could benefit from communication strategies having HPs as cornerstone, and that the good acceptance of TeV in such settings could be more largely exploited by extensive invitation policies. Collectively, such interventions may at least sustain or even improve the current vaccine uptake level also in a critical occupational group such as AWs.

Riassunto

Conoscenze, atteggiamenti e comportamenti degli operatori agricoli nei confronti del vaccino anti-tetanico: esiti di un'indagine conoscitiva

Premessa. Gli operatori agricoli sono caratterizzati da un alto rischio di entrare in contatto con la tossina tetanica e di presentare un inappropriato status vaccinale.

Disegno dello Studio. Il nostro studio trasversale, condotto tramite questionari, ha valutato lo status vaccinale, conoscenze, attitudini e comportamenti di operatori agricoli dall'Italia Nord-Orientale nei confronti della vaccinazione antitetanica.

Metodi. I dati raccolti sono stati sottoposti ad analisi bivariata e multivariata in modo da individuare fra i fattori individuali e correlati al lavoro, le condizioni significativamente associate con uno status vaccinale appropriato.

Risultati. Fra i 707 partecipanti, il 58,4% presentava uno status vaccinale appropriato. Nel 33,1%, l'ultimo richiamo era stato eseguito in un contest di Pronto Soccorso. La principale motivazione per un inappropriato status vaccinale era aver dimenticato il richiamo periodico (146/707; 20,7%). L'attitudine verso la vaccinazione antitetanica era complessivamente favorevole nel 79,5% dei partecipanti, e il 72,7% identificava correttamente il vaccino antitetanico come obbligatorio per gli operatori agricoli. Una più bassa frequenza di false credenze e una migliore conoscenza delle raccomandazioni ufficiali erano fattori predittivi della propensione vaccinale. Il principale predittore di un appropriato status vaccinale era la precedente interazione con un professionista sanitario, sia in generale (adjusted Odds Ratio, adjOR 2.516 95%CI 1.707-3.710), che specificamente riguardo le raccomandazioni vaccinali (adjOR 6.275 95% CI 3.184-12.367 e adjOR 9.739 95%CI 3.933-24.111 per un medico di medicina generale ed un medico del lavoro, rispettivamente).

Conclusioni. Il nostro studio sottolinea il ruolo critico dei professionisti sanitari nel richiamare e nel promuovere le politiche e le raccomandazioni vaccinali, così come nell'aumentare l'attenzione generale degli operatori agricoli nei confronti dei vaccini.

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Corresponding author: Matteo Riccò, MD Provincial Agency for Health Services (APSS) of the Autonomous Province of Trento, Department of Prevention. Operative Unit for Health and Safety in the Workplaces, Viale Verona SNC, C/O Big Center, Building A, 1st Floor, I-38123 Trento (TN), Italy
e-mail: matteo.ricco@apss.tn.it / mricco2000@gmail.com