



Tetanus seroepidemiology and factors influencing immunity status among farmers of advanced age

Serkan Öncü^{a,*}, Mete Önde^b, Selcen Öncü^c, Filiz Ergin^b, Barçın Öztürk^a

^a Adnan Menderes University Medical Faculty, Department of Infectious Diseases and Clinical Microbiology, Aydin 09100, Turkey

^b Adnan Menderes University Medical Faculty, Department of Public Health, Aydin, Turkey

^c Adnan Menderes University Medical Faculty, Department of Medical Education, Aydin, Turkey

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ABSTRACT

Objectives: Tetanus, which is a vaccine preventable disease, remains a significant health concern. The mortality is especially high in elderly and farming is a significant risk factor for the disease. This study evaluates the serological immunity of tetanus and the related factors, in a farmer population.

Methods: This cross-sectional study was carried out in a village located in the western part of Turkey. Volunteer farmers over the age of 50 were included in the study. The study group was determined by the systematic sampling method. IgG class tetanus antibody was measured in sera of each participant. A structured questionnaire evaluating the demographic characteristics was completed by the investigators.

Results: A total of 293 participants (55.3% female, 44.7% male) were recruited from March 2010 to June 2010. A serum protective tetanus antitoxin level (>0.1 IU/ml) was detected in 99 out of 293 (33.9%) of participants. According to univariate analysis; advancing age, female gender, lower education, low monthly income, presence of chronic disease, absent or incomplete vaccination history or being unvaccinated in the last ten years were risk factors for insufficient tetanus immunity. After multiple logistic regression analysis, up-to-date vaccination, gender and age were the only factors that remained independently associated with immune status ($p < 0.001$).

Conclusion: Farmers of advancing age are a population at risk for tetanus due to their work environment and their absent or incomplete immunization to the disease. Low rates of immunity detected highlight the importance to explore strategies in order to improve immunization status in this risky population.

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1. Introduction

Tetanus remains a significant health concern in developing countries with predominantly agricultural economy [1]. It afflicts approximately one million people per year, with a mortality of 20–50% [2]. The risk and the mortality rate of the disease are greater in individuals above the age of 50 due to the waning immunity [3,4]. The leading predis-

posing factor for infection with *Clostridium tetani* is acute injury, primarily puncture wounds and lacerations. These types of injuries are common on farms where physical labor is performed outside, often in unsanitary conditions [5]. Despite its high mortality rate, tetanus is a completely preventable disease [6]. It is generally accepted that immunity against tetanus cannot be acquired naturally. Therefore, control of this disease depends on consistent immunization programs in infancy, followed by appropriate boosters in childhood and adulthood [7].

The tetanus vaccination history in Turkey started at mid 1960s but it was not until 1985 to become systematically

* Corresponding author. Tel.: +90 530 777 61 88.

E-mail address: serkanoncu@hotmail.com (S. Öncü).

in order. At present, after a primary series of three doses of tetanus toxoid, a booster dose is administered to infants at the age of 18 months. Other booster doses include one in the 7th year (first class of primary school), one in the 12th year (5th class of primary school) and another in the 15th year of life (first class of high school). Additionally, women receive tetanus toxoid during pregnancy and men are vaccinated during their military service. Although a 10 year interval booster doses are recommended by health authorities, it is not a mandatory implementation. This study was conducted to evaluate the prevalence and risk factors influencing tetanus immunity status in aging farmers, a population at high risk for injury and poor outcomes for both illnesses and injuries.

2. Material and methods

2.1. Study design and population

This cross-sectional study was carried out between the dates of March 2010 and June 2010 in a village of Aydın city (a western city of Turkey), in which most of the villagers are farmers. Older age farmers (age > 50) without communication and perception problem (dementia, schizophrenia, etc.) were included in the present study. The number of individuals above the age of 50 was 1133 in the village. On the assumption that 40% of the elderly in this age group will have protective levels of antitoxin, the required sample size was calculated as 369 at a confidence interval of 95% and with a deviation of 5%. A reserve sample size of 20 individuals was included because of probable problems in laboratory processes or individuals' refusal to participate in the study. The study group was determined by the systematic sampling method from health center records of the village. Face to face interviews were conducted with the study group and then called to visit the health station in order to get blood samples. When individuals were not found at home at first time, a second home visit was made. Of the targeted 369 individuals 293 were reached (response rate 79.4%). A structured questionnaire that assessed demographic and socio-economic characteristics was completed by the investigators for all participants. The questionnaire included age, sex, educational status, health insurance, monthly income, deal with stock raising, presence of a chronic disease, pregnancy record, past injury and tetanus vaccination history. The vaccination history was also abstracted from the health records. Primary vaccination or booster dose within last ten years was accepted as up-to-date vaccination. The level of basic tetanus information was also evaluated in the questionnaire. This study was approved by the local ethical committee (Protocol No: 2009/00351).

2.2. Laboratory methods

A 5-ml of blood was collected from each participant into dry tubes < remove-image >. After centrifugation, sera were separated and stored at -20°C until the time of study. IgG class tetanus antitoxin in the sera were measured by a commercial ELISA kit (Virotech, Rüsselheim, Germany). The procedure was performed fol-

lowing the manufacturer's instructions. Patient sera were diluted 1:100 in PBS dilution buffer and 100 μl samples were pipetted into microtiter wells previously coated with tetanus toxin. Standards (0.001 IU/ml, 0.002 IU/ml, 0.01 IU/ml, 0.02 IU/ml and 0.05 IU/ml IgG anti-tetanus antibodies) were tested at the same time as positive controls and dilution buffer alone was also tested as a negative control. Absorbance at 450/620 nm was read using a microtiter plate reader and results were expressed in units based on a standard curve drawn using control sera. The results were evaluated in the way previously defined by Schroder and Kuhlmann [8]. Briefly, antitoxin levels below 0.1 IU/ml were defined as "below protective level" and antitoxin levels above 0.1 IU/ml were defined as "at protective level".

2.3. Statistical analysis

SPSS 11.0 for Windows[®] software was used for statistical analysis of the data. Mean, standard deviation and percentages were used in the evaluation of descriptive statistics. In the analytical evaluation Chi-square test was used for the comparison of the data collected by counting, Student's *t*-test and analysis of variance with Bonferroni corrections were used in comparison of measuring data. Logistic regression analysis was done to determine the possible risky factors that could affect the seropositivity of tetanus. In this analysis, seropositivity or seronegativity of tetanus was taken as dependent variable and gender, age, educational status, monthly income, presence of chronic disease, standard of knowledge about tetanus, up to date vaccination were taken as independent variables. Data collected by measuring were showed as mean \pm standard deviation, data collected by counting were showed as number (%), the results of regression analysis were showed as relative risk (odds ratio-OR) and 95% confidence interval (CI). The $p < 0.05$ was accepted for significance. The Backward-Wald method was used as the regression model.

3. Results

A total of 293 volunteer subjects were included in the study. Of those, 162 (55.3%) were female and 131 (44.7%) were male with a mean age of 63.96 ± 9.05 . Approximately one-third ($n = 80$, 37.6%) were illiterate or had not attend even primary school. The majority of the subjects stated low ($n = 113$, 40.1%) or intermediate ($n = 157$, 53.5%) level monthly income. Thirty-five (11.9%) participants raised livestock besides agriculture. Most of the adults included in this study ($n = 251$, 85.7%) were covered by health insurance. More than half ($n = 182$, 62.1%) of the subjects had underlying chronic diseases. The majority of the female participants ($n = 284$, 97%) declared pregnancy history. Thirty-seven (12.6%) individuals reported having received medical care following injury in the past 10 years and the majority of them were male ($n = 29$, 78.3%). One fourth of the participants ($n = 74$, 25.3%), were able to describe the nature of the disease and the protective measures. According to the statements and health records, forty-nine (16.7%) of the subjects were up-to-date vaccinated. The

Table 1
 Characteristics of farmers in relation to tetanus immunity, n=293.

	n (%)	Seropositiven (%)	Seronegativen (%)	p
Sex				
Female	162 (55.3)	40 (24.7)	122 (75.3)	<0.001
Male	131 (44.7)	59 (45.0)	72 (55.0)	
Educational status				
Not attended any school	80 (37.6)	11 (13.8)	69 (86.2)	<0.001
Primary school or higher	213 (62.4)	88 (41.3)	125 (58.7)	
Monthly income				
Low	113 (40.1)	29 (25.7)	84 (74.3)	0.033
Intermediate-High	169 (59.9)	64 (37.9)	105 (62.1)	
Health insurance				
No	42 (14.3)	9 (21.4)	33 (78.6)	0.067
Yes	251 (85.7)	90 (35.9)	161 (64.1)	
Raising livestock				
No	258 (88.1)	83 (32.2)	175 (67.8)	0.112
Yes	35 (11.9)	16 (45.7)	19 (54.3)	
Underlying chronic disease				
No	111 (37.9)	49 (44.1)	62 (55.9)	0.003
Yes	182 (62.1)	50 (27.5)	132 (72.5)	
History of pregnancy				
No	9 (3)	1 (11.1)	8 (88.9)	0.688 ^a
Yes	284 (97)	38 (24.8)	115 (75.2)	
Attending medical center due to injury in the last 10 years				
No	256 (87.4)	75 (29.3)	181 (70.7)	<0.001
Yes	37 (12.6)	24 (64.9)	13 (35.1)	
To be informed of tetanus				
No	219 (74.7)	66 (30.1)	153 (69.9)	0.023
Yes	74 (25.3)	33 (44.6)	41 (55.4)	
History of tetanus vaccination				
No	196 (66.9)	51 (26)	145 (74)	<0.001
Yes	97 (33.1)	46 (47.4)	51 (52.6)	
Up to date vaccination ^b				
No	244 (83.3)	69 (28.3)	175 (71.7)	<0.001
Yes	49 (16.7)	30 (61.2)	19 (38.8)	

^a Fischer's exact test.
^b Primary vaccination or booster dose within last ten years.

descriptive properties of the study population are shown in Table 1. A protective level of antitoxin (>0.1 IU/ml) was detected in 99 (33.8%) of the individuals included in this study. According to univariate analysis; older age, female sex, lower education, low monthly income, presence of chronic disease, no vaccination history or being unvaccinated in the last ten years were risk factors for insufficient tetanus immunity (Table 1). Besides up to date vaccination, age and sex were significant variables after multivariate analysis (Table 2). Individuals with up-to-date vaccination were associated with higher seropositivity (n=30, 61.2%) (p<0.001). Seropositivity against tetanus in different age groups were as follows: 50–59 years (n=51, 51.5%), 60–69 years (n=40, 36.4%), 70 years and above (n=8, 9.5%) (Fig. 1). Tetanus seropositivity was found to

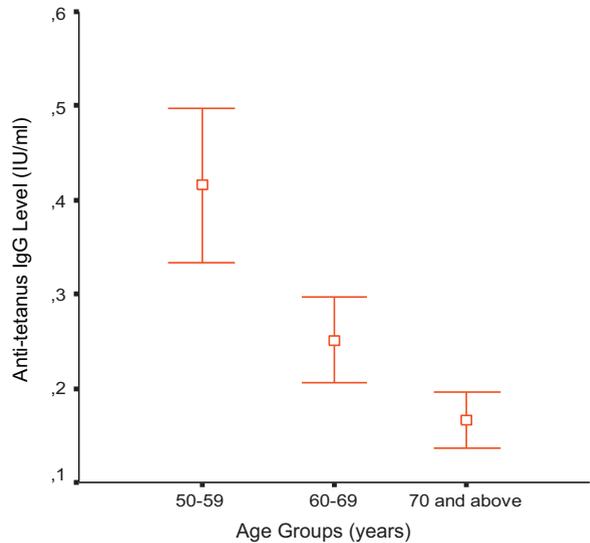


Figure represents mean and 95 % confidence interval of tetanus IgG levels according to age groups

Fig. 1. Anti-tetanus IgG levels according to age groups.

Table 2
 Multivariate logistic regression analysis of variables effecting tetanus seropositivity.

Variable	Regression coefficient	p	OR	95.0% CI
Constant	5.291	<0.001		
Age	-0.106	<0.001	0.883	0.868–0.932
Male Sex	0.883	0.003	2.419	1.355–4.317
Up to date vaccination ^a	1.054	0.005	2.868	1.380–5.961

^a Primary vaccination or booster dose within last ten years.

decline with increasing age (p<0.001). Male participants had significantly higher proportion of protective antibodies (n=59, 45%) when compared to females (n=40, 24.7%, p<0.001).

4. Discussion

Despite widespread immunization of infants and children since the 1980s in Turkey, tetanus still occurs in this country. The Turkish Ministry of Health receives reports of about 50 domestic cases per year, but this number probably reflects the minority of cases. Mandatory vaccination program in younger ages, has shifted tetanus to older adults who are unvaccinated or inadequately vaccinated [9]. Currently, advancing age is a worldwide risk factor for tetanus and adults age 50 and over have twice the incidence of tetanus compared to their younger adult counterparts [10].

In this study, it was found that 33.9% of adults over 50 years of age had protective levels of antitoxin. The protective levels of immunity were more prominent at younger ages and also in male population. Worldwide studies evaluating the rate of protective tetanus immunity in older ages varied according to the study population. Despite some acceptable results were reported in a couple of studies [11–13], the rate of protective immunity was not at desired levels in the majority [14]. In a community based study in three different provinces in Turkey, the rate of protective immunity among the aged 50 and above was between 10 and 24% [15]. In another study evaluating the tetanus antibody prevalence in nursing home residents in Turkey, reported even lower protective rates with only 15.7% [16]. On the other hand, a study performed by Dundar et al. in Kocaeli region of Turkey showed much more higher rates of tetanus protection (>65%) in the older age group [17]. Although the Turkish Ministry of Health runs a mandatory childhood immunization schedule, there is no comprehensive tetanus vaccination program for adults. On the other hand, the vaccination is available in all primary health care centers and it is administered without the need of any health insurance or worth. In the face of this, the low immunity rates should be explained by some socio-demographic properties.

In this study, age was detected as a significant variable inversely affecting the immune status of the individuals. Since systematic immunization program against tetanus began approximately 25 years ago in our country, none of the individuals in the study population received primary vaccination at their childhood and early adulthood. As tetanus vaccination is not mandatory at late adulthood and elderly, it is not surprising to detect such low level of immunity rates which is more prominent with increasing age. Additionally, reduction of antibodies may be attributed to the shortened immunologic memory in this age group [18].

It is reported that farmers acquire tetanus at a higher rate than the rest of the population [19,20]. Since they work in an environment laden with responsible organism, farmers are one of the most risky populations for tetanus. Superficial and deep wounds, even abrasions from prickles and shrubs, can carry with them the deadly bacteria. Hence, the higher risk and fatality rates of tetanus in aging farmers increase the need for awareness in evaluating the immunization status. Despite the increased risk of disease, existing studies in the literature show that elderly agricultural workers usually have unsatisfied protective immunity rates [21–23]. Present study also displayed undesired lev-

els of tetanus immunity. This low rate of immunity in such a risky population is a significant public health concern. Thus, health care providers should be especially alert in evaluating the tetanus immunization status of their patients with older ages.

Male individuals in this study were found to be considerably more immune against tetanus than females. This result can be explained by the work conditions they are opposed. Male farmers in rural area are faced to arduous conditions. Consequently, serious injury due to agriculture is expected to be more common in male gender as in this study. Male dominance attending to a medical center due to an injury observed in this study supports this statement. Higher immunity detected in male sex is explained by the post injury vaccination in medical centers. Female gender as being less protected against tetanus is congruent with the literature and illustrates the need for increased attention to immunization for older women [10,24,25].

Monthly income, educational status and knowledge about tetanus were also significant variables affecting seropositivity. These features seem to be dependent to each other and at the end point it is related to the awareness about the disease. Most of the subjects with up to date vaccination were among those who attended the medical center for vaccination after an injury. As the individuals with these features compromise the majority of up to date vaccinated population, it is obvious that higher education and consequently awareness about the disease is one of the critical step in preventing the disease. Therefore, education and increasing the awareness about this deadly preventable disease in risky population should be one of the priorities of the public health workout.

The prevention of tetanus in rural areas could also benefit from the cooperation of health physician with other health personnel, such as veterinary or public health providers [26]. As proposed by Reed and Westneat health fairs, county agriculture field days, and co-sponsorship of a dedicated "Take your Tetanus" day at local agribusinesses may provide some opportunities for increasing immunization status of the farm community [5]. Although such measures may help to improve the immune status of farm population, the desired levels may not be approachable owing to the educational level of rural population. This stresses the need for the introduction of mandatory tetanus immunization scheme directed at the rural population with advanced age. This approach seems to be feasible with family practice which will be the near future health implementation in Turkey.

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