

Immunity to diphtheria and tetanus among blood donors in Arak, central province of Iran

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ABSTRACT

Background and Objectives: Tetanus and diphtheria are vaccine-preventable, infectious diseases with significant morbidity and mortality. Immunization by the diphtheria and tetanus toxoid (DT) has been applied in Iran for almost 50 years. However, there are very few data about the rate of immunity to these diseases in the adult population. The humoral immunity to tetanus and diphtheria among blood donors in Arak city, central province of Iran were investigated.

Patients and Methods: A total of 530 consecutive blood donor samples were collected from Blood Transfusion Organization, Central province of Iran. All samples were tested for diphtheria and tetanus IgG antibodies using enzyme-linked immunosorbent assay (ELISA).

Results: From 530 cases, 91.9% were male and 8.1% were female. 99.6% of cases had protective levels of diphtheria antibody. Protective levels of tetanus antibody were found in 96% of subjects. There was not any significant difference between diphtheria and tetanus antibodies levels and age and sex.

Conclusion: The obtained data showed that high proportion of the adult population in Arak have sufficient protection against diphtheria and tetanus. The high protective level of immunity to diphtheria and tetanus in Iran can be due to widespread use of booster vaccines in Iranian high schools and during the military services or for pregnant women in their 3rd trimester.

Keywords: Diphtheria, Tetanus, Antibody Level, Blood Donor

INTRODUCTION

Diphtheria and tetanus are still a great public health concerns in many developing countries. During the past two decades, in spite of the low incidence of diphtheria in developed countries, limited outbreaks have been reported in the United States and parts of

Europe (1, 2). So there is concern about outbreaks of these diseases especially in developing countries. After vaccination programs children are not threatened group by these diseases and recent cases are more common in the adult population (3).

In Iran the trivalent tetanus toxoid, whole cell pertussis and diphtheria toxoid (DPT) vaccine has been used for almost 50 years (4). The incidence of these two diseases was 0.015 and 0.045 in 100,000 populations respectively in 2007 (5). Near to 100% vaccination coverage was reported in Iran based on Eastern Mediterranean Regional Office (EMRO) data in 1997 (6).

Vaccination against diphtheria and tetanus has resulted in a fast decrease in morbidity and mortality

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Table 1. Diphtheria and Tetanus antibodies positivity among blood donors in different age groups.

Age Groups (Year)	Diphtheria antibody (N /Percent)		Tetanus antibody (N / Percent)	
	Positive	Negative	Positive	Negative
≤20	25(4.7%)	0(0%)	25 (4.7%)	0(0%)
21-30	170 (32.1%)	0(0%)	165(31.2%)	5(0.9%)
31-40	155 (29.2%)	1(0.2%)	150(28.3%)	6(1.1%)
41-50	108 (20.4%)	1(0.2%)	105 (19.8%)	4 (0.8%)
>50	69(13%)	1(0.2%)	65 (12.3%)	5 (0.9%)

due to these diseases (7). For both vaccines, According to the current Iranian National Immunization program a primary series of 4 doses is recommended, with a booster dose at 4 to 6 years of age. A primary series of 3 doses is required if the vaccine is first administered after 7 years of age. Boosters of DT vaccine for adult are recommended every 10 years (4).

It is generally agreed that when more than thirty percent of a population are non-immunized against diphtheria there is a chance of epidemic diphtheria occurring in that community (8). In order to achieve adequate levels of herd immunity and to prevent outbreaks, it is obligatory to analyze the immunity levels of the general population and to identify and vaccinate insufficiently protected groups (9).

There are few serological data concerning these two diseases immunity in the Iranian adult population. The aim of this study was to evaluate the immunity to diphtheria and tetanus in healthy blood donor in central Province (Arak), Iran.

Patients and Methods In this cross-sectional study, blood samples of 530 volunteer blood donors of Arak city were collected consecutively from Blood Transfusion Organization in September 2012. Informed consent was obtained from all cases. The study was approved by Ethics Committee in Pasteur Institute of Iran.

Plasma samples were tested for tetanus and diphtheria IgG antibodies using enzyme-linked immunosorbent assay (ELISA) test (IBL International, GmbH, Hamburg, Germany). The procedure was followed as indicated by the manufacturer. Tetanus and diphtheria antibody concentrations lower than 0.01 IU/ml were considered without protection; the levels between 0.01 and 0.09 IU/ml and levels greater than 0.1 IU/ml, were considered as basic immunity and full protection, respectively.

Statistical Analysis. The Chi-square, Fisher exact test, Anova, Tukey and t2- tests were used with the SPSS 16 Package program for statistical analysis (Chicago, IL, USA). Data are presented as mean ± SD or, when indicated, as an absolute number and percentage. A P-value of <0.05 was considered significant.

RESULTS

A total of 530 volunteer blood donors with mean age of 36.3 ± 11.7 (18-71) years were enrolled in this study. 91.9% of them were male and 8.1% were female.

Cases were classified in to five age groups as follows: Group 1 (≤ 20 years; n = 25), Group 2 (21-30 years; n = 170), Group 3 (31-40 years; n = 156), Group 4 (41-50 years; n = 109) and Group 5 (>50 years; n = 70).

Overall, 99.4% of cases had sufficient immunity levels against diphtheria and 96% showed protective levels of tetanus antibody. The mean diphtheria and tetanus antibodies levels were 3.2 ± 2.3 and 1.1 ± 0.34 IU/ml, respectively.

There were no statistically significant differences between age and gender groups regarding diphtheria and tetanus antibodies levels (Tables 1- 3).

DISCUSSION

In this study the humoral immunity to tetanus and diphtheria among blood donors in Arak city were investigated. The study indicates that a high proportion of the adult population in Arak city have sufficient protection against diphtheria and tetanus.

Iranian Ministry of Health runs a childhood immunization program, and routine booster doses are recommended every 10 years to maintain protective immunity against diphtheria and tetanus.

Table 2. Diphtheria and Tetanus antibodies levels in different age groups.

Age groups (Year)	Diphtheria antibody (IU/ml)		Tetanus antibody (IU/ml)	
	N	Mean \pm SD	N	Mean \pm SD
≤ 20	25	1.2 \pm 0.39	25	4.1 \pm 2.4
21-30	17	1.1 \pm 0.32	17	3.4 \pm 2.4
31-40	156	1.1 \pm 0.34	156	3.01 \pm 2.2
41-50	109	1.1 \pm 0.31	109	3.1 \pm 2.3
> 50	70	1.04 \pm 0.37	70	2.6 \pm 2.3

SD: Standard Deviation

Booster injections in Iran are typically administered to adolescences at the age of 12-14 years. Besides it is administrated to males when they enter military services at the age of 19 -21 years and to females at 7th and 8th month of pregnancy.

Diphtheria antibody production, primarily of IgG type, can be induced by natural toxin during clinical or subclinical infection, carrier state, or by immunization with diphtheria toxoid (9, 10). Saffar *et al.* showed that 73% of mothers in Iran were protective to diphtheria (11). Eslamifar *et al.* found that 93.9% of HIV positive patients in Iran had protective antibody against diphtheria (7). A Study by Aue *et al.* showed that 66.4% of blood donors in Germany were not immune against diphtheria (3). Allerdist *et al.* also reported that 67.5% of Germans had non-protective antibody titers against diphtheria (12). In another study, in the US blood donors 83.4% had full protection (13). Our survey showed that 99.4% of cases had sufficient immunity levels against diphtheria which is near to other results from Iran (7,11).

The high protective level of immunity to diphtheria in Iran can be due to widespread use of booster vaccines in Iranian high schools and during the military service. There is no significant difference between age groups regarding the level or rate of Diphtheria antibody which is in contrast to observations from other studies (3, 10, 14). The immunity levels may be lower in individuals older than 70 years who are excluded from blood donation.

Our study showed that 96% of blood donors are adequately immunized against tetanus. Natural immunity to tetanus does not exist; it is not even conferred after infection; therefore, immunity can result only from previous vaccination (15).

Saffar *et al.* showed that %96 of pregnant women in Iran were immune to tetanus (11). Razzaghi *et al.* found that %57 of subjects in 50-60 years in Kashan had protective tetanus antibody levels (16). Results of a survey showed that 64%-80% of persons above the age of 60 years old had no protective levels of tetanus antibody, compared to 7% of adults between the ages of 18- 30 years old (17). Gergen *et al.* in USA showed that serological evidence of immunity declining from over 80% among persons aged 6–11 years to 27.8% among persons aged 70 years or older (18). Our results showed a high proportion of immunity to tetanus in the adult population of Arak city which is similar to the report of Saffar *et al.* (11).

Our study didn't show significant difference in immunologic protection against diphtheria or tetanus among men and women, which is consistent with some other studies (17), and in contrast to others (15, 19).

In conclusion, Our data showed that high proportion of the adult population in Arak city have sufficient protection against diphtheria and tetanus. The high protective level of immunity to diphtheria and tetanus in Iran can be due to widespread use of booster vaccines in Iranian high schools and during the

Table 3. Diphtheria and Tetanus antibodies positivity among blood do nors according to sex.

Sex	Diphtheria antibody (N/ Percent)		Tetanus antibody (N/Percent)	
	Positive	Negative	Positive	Negative
Male	484(91.3%)	3(0.6%)	472(89.1%)	15(2.8%)
Female	43(8.1%)	0(0%)	38(7.2%)	5(0.9%)

military service or for pregnant women in their 3rd trimester.

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