



Surveillance

Seroepidemiology of tetanus in Korean adults and adolescents in 2012



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ABSTRACT

This seroepidemiologic study was performed to evaluate the immune status against tetanus in Korean adolescents and adults and to provide evidence to develop strategies for tetanus prevention. Between July 2012 and December 2012, serum samples were collected from adults and adolescents 11 years of age and older, and serum anti-tetanus IgG titers were determined using a commercial ELISA kit. Subjects were divided into six age groups: 11–20 years, 21–30 years, 31–40 years, 41–50 years, 51–60 years, and ≥ 61 years. The mean anti-tetanus IgG titers and tetanus seroprevalence of the age groups were compared. A total of 1193 adults and adolescents were enrolled. Mean anti-tetanus IgG titer and tetanus seroprevalence of all subjects were 1.20 ± 3.58 IU/mL and 56.4%, respectively. The mean anti-tetanus IgG titer decreased with an increase in age ($p < 0.001$). Tetanus seroprevalence increased from 92.0% in the 11–20 year age group to 95.7% in the 21–30 year age group, and then decreased with a further increase in age ($p < 0.001$). These results reflected an appropriate Td booster vaccine coverage at 11–12 years of age. However, the tetanus seroprevalence of adults older than 41 years was as low as the levels in previous studies: therefore, adults should be more encouraged to acquire decennial Td booster vaccinations recommended by the National Immunization Program.

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1. Introduction

In Korea, the National Immunization Program (NIP) began to recommend diphtheria-tetanus-whole-cell pertussis (DTWp) vaccinations in 1954 [1], and it consisted of three doses of primary vaccination between 2 and 6 months of age and two doses of booster vaccination at 12 months and 5 years of age [2]. The diphtheria-tetanus-acellular pertussis (DTaP) vaccine has replaced the DTWp vaccine since 1989 [1], and three doses of primary vaccination at 2, 4 and 6 months of age and two doses of booster vaccination at 15–18 months and 4–6 years of age are currently recommended [3]. Because life-long immunity cannot be acquired by natural tetanus infection or immunization, periodic re-vaccination is necessary for tetanus prevention [4]. For that reason, decennial tetanus–diphtheria (Td) vaccinations beginning

at 11–12 years of age have been recommended in Korea since 2005 [1]. In Korea, the vaccination rate of the primary DTaP vaccination administered at 2, 4 and 6 months of age is greater than 90%, whereas the coverage rate of the first booster DTaP vaccination at 15–18 months of age is only 65.7% [5]. Because national policy mandates certification of the second booster DTaP vaccination for entrance into elementary school, the second booster vaccination at 4–6 years of age is expected to be administered to almost all children. However, there are no current reports regarding the vaccine coverage rate for the second booster vaccination and the following decennial Td vaccinations for adults and adolescents. Since 2000, eight to nineteen patients with tetanus have been reported annually in Korea, and the number of patients has not decreased: 14 patients in 2010, 19 patients in 2011, and 17 patients in 2012 [6]. Specifically, 94.4% of the patients diagnosed with tetanus were older than 40 years and none of the patients were younger than 10 years [6]. In addition, Shin et al. reported 17 adults diagnosed with tetanus in a single hospital during a 21 month period in Korea [7], and this suggests that the real incidence of tetanus could be higher than reported. Therefore, it is important to

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determine the immune status against tetanus in adults and to develop a preventive plan for these patients. This seroepidemiologic tetanus study is the third survey after 2000 and 2008 [8,9], and was conducted to evaluate the seroepidemiologic status of tetanus after the introduction of the Td vaccination in 2005 and to guide future vaccination strategies for tetanus prevention.

2. Material and methods

2.1. Serum collection and study design

Residual serum samples were collected from adults and adolescents 11 years of age and older, who visited the Health Promotion Centers of Seoul St. Mary's Hospital, Seoul and St. Vincent Hospital, Gyeonggi province, in the Republic of Korea for a health check-up between July 2012 and December 2012. All subjects were divided into six age groups (11–20 years old, 21–30 years old, 31–40 years old, 41–50 years old, 51–60 years old, ≥ 61 years old), and each age group included at least 150 subjects in accordance with instructions from the Korea Centers for Disease Control and Prevention (KCDC). This study was approved by the Institutional Review Board (IRB) of Seoul St. Mary's Hospital with an exemption from receiving informed consent (Approval No.: KC12TNSIO283).

2.2. Anti-tetanus IgG enzyme-linked immunosorbent assay

Anti-tetanus IgG titers of the collected residual serum samples were determined using a commercial enzyme-linked immunosorbent assay (ELISA) kit (IBL International GmbH, Hamburg, Germany) according to the manufacturer's recommendations. Briefly, 100 μ L of serum was placed into each antigen-coated well, the well was covered with adhesive foil, and the serum was incubated for 60 min at room temperature. The incubated solution was removed, and the well was washed three times with 300 μ L of wash buffer. Next, 100 μ L of enzyme conjugate was added into the well, and was then incubated for 30 min at room temperature. The washing step was repeated three times. Then, 100 μ L of substrate solution was added into the well, and it was incubated for 20 min in the dark. After adding 100 μ L of stop solution, the constituents were mixed well with gentle shaking, and the blue color changed to a yellow color. The optical density of the solution was checked at 450 nm, and the anti-tetanus IgG titer was calculated by applying the checked optical density to a standard curve derived from standard solution testing provided by a manufacturer. Seropositivity was defined when the anti-tetanus IgG titer was higher than 0.1 IU/mL. All the laboratory procedures were performed in the Vaccine Bio Research Institute, College of Medicine, The Catholic University of Korea, Seoul, Republic of Korea.

2.3. Data and statistical analyses

Mean titers of anti-tetanus IgG according to sex and age groups were compared using a two-way analysis of variance (ANOVA) method, and Tukey's test was used as a post-hoc test. Seroprevalence of each age group and each sex was compared using a chi-square test. Statistical analysis was performed with SPSS Statistics 17.0 software (SPSS Inc., Chicago, IL, USA), and a significance was defined as a two-tailed *p*-value < 0.05.

3. Results

During the study period, residual serum samples were collected from a total of 1193 subjects consisting of 600 males and 593 females. Each age group included 181–213 subjects, and there were no significant differences in the sex distributions of each age group (Table 1).

3.1. Mean anti-tetanus IgG titer

The mean anti-tetanus IgG titer of all of the subjects was 1.20 ± 3.58 IU/mL. The mean anti-tetanus IgG titer decreased as age increased, from 3.64 ± 7.21 IU/mL in the 11–20 year age group to 0.14 ± 0.58 IU/mL in the ≥ 61 year age group (Table 1). There was no significant difference when the male and female patients were compared (*p* = 0.573), however, the mean anti-tetanus IgG titers of males were significantly higher in the 31–40 year (*p* = 0.011), 41–50 year (*p* = 0.048) and ≥ 61 year age groups (*p* = 0.001, Fig. 1).

3.2. Tetanus seroprevalence

The tetanus seroprevalence in all of the subjects was 56.4% (Table 1). Although, the seroprevalence generally tended to decrease with an increase in age, the seroprevalence of the 21–30 year age group was higher than that of the 11–20 year age group (Table 1). The seroprevalence of males was significantly higher than that of females when all of the subjects were compared (*p* = 0.001). There was a significantly higher seroprevalence in males in the 31–40 year (*p* = 0.015) and ≥ 61 year age groups (*p* = 0.037, Fig. 2).

4. Discussion

This study was the third seroepidemiologic survey on the immune status against tetanus in Korean adults and adolescents. The previous studies were performed in 2000 and 2008, and this study was conducted seven years after the Td booster vaccination for adults and adolescents was introduced.

Table 1
Mean anti-tetanus IgG titers and tetanus seroprevalence according to age groups.

Characteristics	Total (<i>n</i> = 1193)	11–20 years (<i>n</i> = 199)	21–30 years (<i>n</i> = 211)	31–40 years (<i>n</i> = 213)	41–50 years (<i>n</i> = 198)	51–60 years (<i>n</i> = 191)	≥ 61 years (<i>n</i> = 181)	<i>p</i> -value
Sex								0.973
Male	600 (50.3)	102 (51.3)	106 (50.2)	112 (52.6)	98 (49.5)	94 (49.2)	88 (48.6)	
Female	593 (49.7)	97 (48.7)	105 (49.8)	101 (47.4)	100 (50.5)	97 (50.8)	93 (51.4)	
Anti-tetanus IgG titer, (mean \pm SD) (IU/mL)								
Total	1.20 ± 3.58	3.64 ± 7.21	1.98 ± 3.31	0.81 ± 1.41	0.30 ± 1.10	0.15 ± 0.46	0.14 ± 0.58	<0.001
Male	1.29 ± 3.76	3.19 ± 7.73	2.46 ± 3.29	1.03 ± 1.39	0.40 ± 1.45	0.15 ± 0.42	0.22 ± 0.82	<0.001
Female	1.10 ± 3.38	4.10 ± 6.63	1.49 ± 3.28	0.57 ± 1.39	0.20 ± 0.56	0.14 ± 0.50	0.05 ± 0.05	<0.001
Seroprevalence, No (%)								
Total	673 (56.4)	183 (92.0)	202 (95.7)	154 (72.3)	66 (33.3)	33 (17.3)	35 (19.3)	<0.001
Male	366 (61.0)	94 (92.2)	102 (96.2)	89 (79.5)	38 (38.8)	20 (21.3)	23 (26.1)	<0.001
Female	307 (51.8)	89 (91.8)	100 (95.2)	65 (64.4)	28 (28.0)	13 (13.4)	12 (12.9)	<0.001

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