

# Display *Pertussis* in Pregnant Women in East Azerbaijan of Iran, Need to Improve Vaccination Strategies



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## Abstract

**Introduction:** Pertussis, a respiratory infection caused by the bacteria *Bordetella pertussis*, can affect persons of any age, but it is particularly virulent and life-threatening in infants. Rates of pertussis infection have been increasing in recent years.

**Methods:** In this study, levels of IgG-PT and IgA-PT antibodies was analyzed in 349 serum samples obtained from pregnant women in east Azerbaijan (Tabriz city) using ELISA.

**Results:** Based on the results of ELISA, 56.2% of the serum samples had a protective level of IgG.

The result was 21(6%) for IgA from the total 349 serum samples. About the relation between protective levels of antibody titers with age, occupation, history of coughing, education level, and pregnancy stage, there was a significant correlation between the protective levels of antibodies and the history of cough. The results due to IgG level indicate a drop in the immune level affected by the vaccine and the need to strengthen immunity in the study area. The level of IgA antibodies may indicate the rate of new infections in the studied population.

**Conclusion:** An outbreak among adults is a warning and risk factor for the development and spread of infection in newborns.

**Keywords:** Immunoglobulin Levels; *Bordetella Pertussis*; Pregnant Women; Iran

## Introduction

Pertussis is one of the vaccine-based preventable infectious diseases, worldwide. Before the onset of vaccination, the disease was a major contributor to mortality in infants and children [1]. Despite the high coverage of vaccination in different societies, recurrence of Pertussis has been reported in developed and either developing countries [2]. The agent for pertussis: *Bordetella Pertussis*, tend to be a human-specific pathogen that lacks animal reservoir and should inevitably spin among the human population. The disease is seen in children as a whooping cough, but it is often characterized by atypical and only with long cough in adults [3,4]. Recently, the decline in immunity due to the drop in antibody levels in adults increased the prevalence of the disease among adolescents and adults. Although, the disease does not have a clinical status in these hosts, such individuals are considered as the reservoir for the pathogen to be transmitted to the infants and young children [5].

On the other hand, passive immunity can occur through the transfer of antibodies made in maternal blood to the fetus through the placenta. This type of immunity can protect the infant for sev-

eral months after birth; drop in the level of immunity in mothers will reduce the transmission of maternal protective antibodies to infants and leave them sensitive until they receive the vaccine. However, this type of immunization cannot assure the immunization of the infants [6]. Securing mothers against diseases which are preventable by vaccines is essential to protect infants from 3 to 6 months, so the best way to protect infants during this period is to ensure that they receive enough maternal antibodies [7]. Low immunity levels in infants against *B. pertussis* is a sign of deficiency in maternal antibody, so immunization of booster in mothers during pregnancy can protect newborn babies a few months after birth [8]. Experts believe that to be immunized against Pertussis, adolescents and adults also require a boosting vaccine to reduce the infection and prevent further spread of the disease.

We have seen an increase in the incidence of the disease, which suggests that this is one of the world's most recurrent diseases [9]. According to reports from the Center for Disease Control in Iran, the rate of disease has increased in recent years despite 98% vac-

cine coverage [10,8]. Although several studies have been done on this disease and the level of safety in mothers, none of them included our study area. The study aimed to examine the prevalence of Pertussisanti bodies among pregnant women during pregnancy referring to Tabriz private laboratories, Northwest of Iran and one of the largest cities.

**Material and Method**

Ethics Statement: Informed consent was obtained from all study participants, and the Ethical Committee of the Islamic Azad University, Ahar, Iran approved the study. Serum samples: Samples in this study were serum samples of apparently healthy pregnant women referred to laboratories in Tabriz. They were selected, randomly. Samples were collected from April to September 2016 for 6 months. Information about age, occupation, history of coughing, education level, and pregnancy stage were obtained from each patient. Sample size was calculated based on previous studies. Serum samples were stored in a freezer at 80 °C . The serum sample of women with diabetes and a history of antibiotic use for several days prior to sampling were excluded from the study. Also samples that had hemolysis and serum samples with detectable chylomicrons were excluded.

**Measurement of IgG and IgA by ELISA Method**

Specific IgG and IgA antibody ELISA kit produced against Toxin produced by B.pertussisused in this study was prepared by IBL Co.,

**Table 1:** Levels of IgG and IgA according to age, pregnancy stage, history of coughing, level of education and occupation (Tabriz, 2016).

P-value	IgA Level (ELISA Unit/ml)				P-value	IgG Level (ELISA Unit/ml)				Parameters	
	Non-Infection ≤ 12 IU/ml		Recent Infection > 12 IU/ml			Protective Level ≥ 24 IU/ml		Non-Protective Level <24 IU/ml			
	%	N	%	N		%	N	%	N		
0.1	4.9	1	4.6	32	0.551	4.9	17	4.6	16	16-20	Age Group (years)
	18.9	4	13.8	110		18.9	66	13.8	48	21-25	
	17.2	13	16.3	104		17.2	60	16.3	57	26-30	
	11.5	0	6.3	62		11.5	40	6.3	22	31-35	
	2.9	2	2.6	17		2.9	10	2.6	9	36-40	
	0.09	1	0.3	3		0.9	3	0.3	1	41-45	
0.01	0	0	7.4	26	0.015	3.2	8	5.2	18	01-Mar	Pregnancy Stage( Month)
	3.2	11	66.2	231		39.3	137	30.1	105	04-Jun	
	2.9	10	20.3	71		14.6	51	8.6	30	07-Sep	
0.0001	5.4	19	71.6	250	0.0001	23.7	114	39.5	138	Positive	History of Coughing
	0.6	2	22.3	78		23.5	82	4.3	15	Negative	
0.8	0	0	1.1	4	0.468	0.29	1	0.86	3	Illiterate	Level of Education
	0.3	1	6.3	22		4.58	16	2	7	Elementary	
	2.9	10	38.7	135		23.4	82	18	63	High school	
	0.9	3	8.3	29		4.8	17	4.3	15	Associate Degree	
	1.7	6	36.1	126		20.3	71	17.4	61	Bachelor Degree	
	0.3	1	3.4	12		2.6	9	1.1	4	Master Degree	

(Immuno-Biological Laboratories, Hamburg, Germany). Each antibody was assessed according to the manufacturer’s instructions; and the results were recorded by drawing the graph for each of the immunoglobulins according to the factory’s instruction.

**Statistical Analysis**

Statistical analysis was performed using chi-square test between groups and ANOVA analysis to examine the relation between age, occupation, educational level, history of coughing and pregnancy stage. All analyzes were performed using SPSS version 24 and results were considered significant with P-value <0.5.

**Results**

In this study, 349 serum samples were obtained from labs in Tabriz, whose pregnancy tests were reported positive. Data on the variables including age, occupation, history of coughing, education level and pregnancy stage are given in the following Table 1. Based on the results of ELISA, 196(56.2%) out of the 349 samples studied, had IgG with a protective level in the serum. The result was 21(6%) for IgA from the total 349 samples. About the relation between protective levels of antibody titers with age, occupation, history of coughing, education level, and pregnancy stage, there was a significant correlation between the protective levels of antibodies and the history of cough. Regarding other variables, the relation with the protective levels of antibodies was not significant (Table 1).

0.1	4	14	68.5	239	0.614	40.1	140	32.4	113	Unemployed	Occupation
	2	7	25.5	89		16.1	56	11.5	40	Employed	
	6	21	94	238		56.2	196	43.8	153	-	Total

## Discussion

Decline in immunity has recently increased the prevalence of the disease, especially among adolescents and adults, and has become a major source of transmission of disease to infants and young children. On the other hand, although the normal routine of vaccination for children plays an important role in keeping children safe from infections of Pertussis, but passive immune transmission through antibodies made in maternal blood to the fetus through placenta, can protect the baby for several months after birth. However, due to the drop of immunity in mothers, infants face deficient antibodies received from passive immunity and are therefore susceptible to pertussis. During this period, youth and adults with infections can transmit the disease to infants who have not been vaccinated completely and do not have an acceptable level of protection against pertussis [7]. The prevalence of pertussis infection in each particular region should be evaluated before the implementation of preventive measures with pertussis whole cell vaccine. In this study, the prevalence of anti-pertussis antibodies among 349 pregnant women during pregnancy referring to laboratories in Tabriz was investigated. The results showed that the frequency of IgG antibodies was higher than 24IU/ml with 56.2% and frequency of IgA antibody was higher than 12IU/ml with 6%.

Since the IgG level is related to the vaccine and the history of previous infections, the results indicate a drop in the immune level affected by the vaccine and the need to strengthen immunity in the study area. The results of other studies in other parts of Iran continue to confirm this fact. A study in Hamedan, West of Iran, on 288 pregnant women, showed that only 35.8% had a positive response in serological results based on IgG evaluations against pertussis toxin [8]. In Tehran, Iran, on 303 pregnant women, showed that only 58.2% had a positive response in serological results based on IgG evaluations against pertussis toxin [9]. Of course, in another study previously performed by the same group in 2009 on female medical students, it was shown that 47.6% had antibodies against *Bordetella pertussis* [7,11]. A study was done by Zatsu et al. [12] in Russia in 2010 on 102 pregnant women. The results showed that the level of antibody against pertussis was negative in more than two thirds of pregnant women, that is, only 22.5% had the antibody titer needed for protection. A study done by Kristensen in France in 2006 on 18 mothers and umbilical cords showed that in 9 of the mothers (55.56%), the level of IgG against pertussis toxin was less than 25IU/ml [13]. These reports indicate a low level of immunity in a high percentage of mothers for transmitting passive immunity through their placenta to infants. Therefore, infants in the above regions, including our study area, are at risk for pertussis. Studies have shown the different protective levels against pertussis in adults about 35 to 90% [3]. In a study conducted by Izadi et al. [14] in 2010 on 424 healthy soldiers in Tehran, the results showed that 60.6% had antibodies against *Bordetella pertussis* toxin. In a

study by Saffari et al. [15] in 2010 in Sari, on 595 healthy individuals, it was found that in adults, the antibody level against *Bordetella pertussis* was 60 to 73%. The lack of a complete protective level in adults holds a percentage of them susceptible to acute pertussis. This can be a warning to take preventive measures at risk. Low immunity levels in infants against *Bordetella pertussis* are a sign of maternal antibody deficiency, so a boosting immunization for mothers during pregnancy can protect newborn babies in a few months after birth. Centers for Disease Control and Prevention have recommended mothers diphtheria and tetanus toxoid booster dose, as well as the use of a booster dose of a vaccine lacking proper pertussis cell right after delivery and before being discharged from the hospital to protect them and their babies from *B.pertussis* infection is recommended [8].

On the other hand, the level of IgA antibodies may indicate the rate of new infection among the population under study. Some studies in Iran and abroad indicate the high incidence in the adult population. This rate has been reported 95% in Edirne, Turkey, based on the level of IgG antibody and vaccination history [3]. In Iran, Saffari et al. [16] based on the IgG level and the presence of IgA, reported this rate as 5.7% and 1.55%, respectively. According to reports from the Center for Disease Control in Iran, the disease rate has increased. The outbreak has recently been reported to be high among Iranian children [16]. An outbreak among adults is a warning and is also a risk factor for the development and spread of infection in new borns [17]. Therefore, we suggest that to maintain immunity against pertussis, adolescents and adults need a booster vaccine to reduce the infection and prevent the spread of disease.

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