

# Seroepidemiology of *Bordetella pertussis* infections in the twin cities of Pakistan

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## Abstract

**Background:** *Bordetella pertussis* is the cause of whooping cough occurring mainly in children. The prevalence of this disease has been reduced largely due to worldwide mass vaccination with DTP vaccine. However, the immunity produced by the vaccination wanes by the passage of time. Still this disease kills around 2-4 million children annually. Adults may be a source of infection for infants and children. Furthermore, *Bordetella pertussis* has also been found to be associated with cases of persistent cough in adults in many countries. **Aim:** The aim of this study was to study the exposure of the adult population to the *Bordetella pertussis* by detecting IgG antibodies. **Materials and Methods:** We performed Seroepidemiology of *Bordetella pertussis* infections in multiethnic twin cities of Pakistan (Rawalpindi and Islamabad) using a commercially available ELISA kit to have a picture of epidemiology of *Bordetella pertussis* in Pakistan. We targeted adults of age between 18-45 years (mean age 29.64 years). **Results:** The results of our study show a high percentage of seropositivity to *Bordetella pertussis* (89 percent), which indicates higher exposure to this organism and risk of infection to infants, children, adolescents and adults. **Conclusion:** A high percentage of seropositive individuals are alarming to health care professionals as well as policy makers. *Bordetella pertussis* infections may be associated with their atypical manifestation in Pakistan. Adult vaccination with DTP is recommended to reduce the risk of infection in infants and children through adult reservoirs.

**Keywords:** *Bordetella pertussis*, ELISA, DTP vaccine, Seroepidemiology.

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## Introduction

Pertussis or whooping cough is a highly contagious vaccine preventable disease caused by the bacterial species *Bordetella pertussis*. It is estimated that 200 000-400 000 cases of pertussis occur annually world wide [1, 2]. There are increasing reports of incidence of *B pertussis* infections in infants, school children, adolescents and adults [3, 4]. Some of the possible explanations for reemergence of pertussis disease in vaccinated children may be poor vaccine quality, improved diagnostic

facilities and the antigenic divergence in *B pertussis* strains than one used in the vaccine in those countries. This third reason has also been confirmed by the studies carried out in many countries including Finland, Netherlands and United Kingdom [5]. Pertussis caused by the *Bordetella* species other than *B pertussis* (e.g. *Bordetella parapertussis*) may be another reason [6-8]. The reports of pertussis from vaccinated population may be underestimated, because it is less typical in vaccinated children as compared to unvaccinated children [9].

In last two decades it has been found that *Bordetella pertussis* targets people of all age groups rather than infants and children only. However, the incidence of this disease is highest in children >6 months old who are not fully immunized. It is clear that childhood vaccination with DTP wanes with time and adolescent and adults are no more protected. Adults are not only a source of infection to other adults, but they are also a reservoir for children [10, 11]. It is estimated that a quarter of all adult prolonged cough cases are caused by *B pertussis*. The rate of pertussis infections in adolescents and adults is 370-1500 per 100 000 populations which suggests 0.8-3.3 millions cases of Pertussis in the United States [12]. The typical whoop is absent in many cases of adult pertussis which makes the diagnosis difficult [13].

Serological techniques such as ELISA have enabled us to detect presence of antibodies in the serum sample and an increased level which indicates the exposure of a person to *B pertussis* with typical or atypical manifestations [14, 10]. High sensitivity of ELISA using mixture of antigens as compared to utilizing single antigens such as pertussis toxin (PTX) or filamentous haemagglutinin (FH) was demonstrated by a study conducted by Hanlon *et al* [15].

The aim of the present study was to determine the level of IgG antibodies in the adult population that will indicate the exposure to *B pertussis* organism. The results of this study may be helpful in getting a picture of *B pertussis* incidence rate in this area as well as in designing policy regarding the adolescent and adult vaccination in future.

## Materials and Methods

### Study population

The study population consisted of adults of age group 18-45 years (mean age=29.6 years). They were further divided into three age groups *i.e.* 18-25 (mean age=22), 26-35(mean age 30.17) and 36-45(mean age=48.48) years and named group A, B and C respectively. We tried to take equal number of male and female participants for each age group. The number of participants for each group was 93, 64 and 62 for groups A, B and C respectively. Relevant information such as age, gender, ethnic background, vaccination status, history of persistent cough etc. was recorded for each participant. Informed verbal consent was taken and interested participants were briefed about the details of the study. None of the participants suffered from cough or any other respiratory tract disease at the time of sampling. This study was approved by the ethics committee of Comsats Institute of Information Technology Islamabad.

### Blood collection and serum extraction

5 ml of venous blood was drawn from our university students and staff, their family members and blood donors in Holy family hospital Rawalpindi. The collected blood was transported to Microbiology lab of Comsats Institute of Information Technology Islamabad. Serum was

extracted from the blood samples soon after arrival to the lab and stored at -20°C until used.

### ELISA

IgG level to *Bordetella pertussis* antigen was determined by using a commercially available ELISA kit from IBL Hamburg Germany following manufacturers' instructions. The kit uses a mixture of *B pertussis* antigens *i.e.* filamentous haemagglutinin (FHA) and pertussis toxin (PTX) and results are interpreted as positive, negative and equivocal. Participants bearing more than 24U/ml of IgG to *B pertussis* antigens were considered seropositive.

## Results

The results of our study show that 89.04% of the studied people were seropositive to *B pertussis*, while 6.48% and 6.48% fell into negative and equivocal category respectively. No significant relation of seropositivity to *B pertussis* to age and gender or ethnic background of the participants has been found. Of all 219 sera samples, seropositivity for each group of participants was 87.1% (n=81), 90.6 % (n=58) and 90.32 % (n=56) for groups A, B and C respectively. We could also not find any association between persistent cough in adults and seropositivity.

The results are interpreted as positive, negative and equivocal. Last row in the Table indicates the overall results (Table 1).

Table 1 Details of the ELISA results for each group of the participants

Age group	No. of samples	Seropositive	Seronegative	Equivocal
18-25	93	81(87.1%)	6(6.45%)	6(6.45%)
26-35	64	58(90.6%)	5(8.62%)	1(1.56%)
36-45	62	56(90.32%)	1(1.61%)	5(8.06%)
18-45	219	195(89.04%)	12(5.48%)	12(5.48%)

## Discussion

This is the first report on Seroepidemiology of *B pertussis* in Pakistan which clearly shows higher level of seroprevalence in Pakistani population. As seen in Table 1, all studied age groups show higher level of IgG antibodies to *B pertussis antigens* (FHA and Ptx). As the immunity conferred by the childhood vaccination with DTP wanes with the passage of time, the higher level of IgG to *B pertussis* in adult population should be due to natural exposure to the organism. Adults are not only a source of *B pertussis* infections for children, but are susceptible to this infection themselves [16].

There have not been many reports of *B pertussis* infections from Pakistan which may be due to the failure of diagnosing from clinical picture and unavailability of laboratory diagnostic facilities in rural areas. At the same time there exists no adequate surveillance system for the monitoring of the infectious diseases like pertussis in Pakistan. Another possibility may be the shift of the typical pertussis to atypical form in children to which

physicians are unaware [9]. In any case, like in many other countries, pertussis seems to be an underreported disease in both children and adults in Pakistan. Clearly, DTP vaccination has reduced the burden of *B pertussis* in this region which can be understood by the fact that there is lower recorded morbidity and mortality rate as compared to the past. However, its incidence and the risks still need to be monitored.

The clinical manifestation of the adult pertussis differs in reports from different countries. It is reported to have typical paroxysmal cough in some cases, whereas it was difficult to diagnose as pertussis from symptoms alone due to non typical persistent cough [16]. There are reports of outbreak of pertussis with both typical as well as asymptomatic coughing.

## Conclusion

The results of the study are alarming and clearly indicate the exposure of the local population to *B pertussis*. We propose adult vaccination with DTP to prevent infants and children from getting this disease.

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## References

1. Vatansever U, Coeplue N, Oener N, Soenmez C, Karasilihoglu, Kurtoglu, et. al. Seroprevalence of *B pertussis* antibodies among healthy adolescent girls in Edirne. *Swiss Med Wkly* 2005; 135:531-536.
2. Fung KFC, Yeung WL, Wong TW, So KW, Cheng AFB. Pertussis-a reemerging infection? *J Infect* 2004; 48:145-148.
3. Van der Wielen M., Van Damme P, Van Herck K, Schlegel-Haueter S, Siegrist C A, Seroprevalence of *B pertussis* antibodies in Flanders, Belgium 2003. *Vaccine*; 21:2412-2417.
4. Gonik B, Puder K S, Gonik N and Kruger M. Seroprevalence of *Bordetella pertussis* antibodies in mothers and their newborn infants. *Infect Dis Obstet Gynecol* 2004; 13:59-61.
5. Van Loo IHM, Van der Heide GJ, Nagelkerke NJD, Verhoef J, Mooi F. Temporal trends in the population structure of *Bordetella pertussis* during 1949-1996 in a highly vaccinated population. *J Infect Dis* 1999; 179:915-923.
6. Fry NK, Neal S, Harrison TG, Miller E, Mathews R, George RC. Genotypic variation in the *B pertussis* virulence factors pertactin and pertussis toxin in historical and recent clinical isolates in the United Kingdom. *Infect. Immun* 2001; 69:520-528.
7. Gerlach G, Von Wintzingerode F, Middendorf B, and Gross R. Evolutionary trends in the genus *Bordetella*. *Microbes Infect* 2003; 3:61-63.
8. Hochwald O, Bamberger E, Srugo I. The return of Pertussis; who is responsible? What can be done? *IMAJ* 2006; 8:301-306.
9. Tozzi AE, Rava L, Marta L, Atti CDA, Salamasso. Clinical presentation of pertussis in unvaccinated and vaccinated children in first six years of life. *Pediatrics* 2003; 112:1069-1077.
10. Wilder-Smith A, Earnest A. Seroepidemiology of pertussis in adult population of Singapore. *Acad Med Singapore* 2006; 35:780-782.
11. Wright SW, Decker MP, Edwards KM. Incidence of Pertussis infection in healthcare workers. *Infect Control Hosp Epidemiol* 1999; 20:120-123.
12. Cherry JC. The epidemiology of *B pertussis*; a comparison of the epidemiology of the disease pertussis with the epidemiology of *B pertussis* infections. *Pediatrics* 2005; 115:1422-1427.
13. Hoey J. Pertussis in Adults. *CMAJ* 2003; 168:453-455.
14. Grimprel E, Begue P, Anjak I, Njamkepo E, Frankois P, Guiso N. Long term serum antibody responses after immunization with whole cell pertussis vaccine in France. *Clin Diagn Lab Immunol* 1996; 3:93-97.
15. Hanlon MG, Nambiar R, Kakakios AM, McIntyre P, Land M, Davine PL. Pertussis antibody levels in the infants immunized with an acellular pertussis component vaccine, measured using whole cell pertussis ELISA. *Immunol Cell Biol* 2000; 78:254-258.
16. Mattoo S, Cherry JD. Molecular pathogenesis, epidemiology, and clinical manifestations of respiratory infections due to *B pertussis* and other *Bordetella* subspecies. *Clin Microbiol Rev* 2005;18:326-382