

Original Article

Incidence of Pertussis in Anbar Province, West of Iraq, during 2009-2019

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Received 5 October 2021; Accepted 21 October 2021
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Abstract

Pertussis (whooping cough also called 100-day cough) is an extremely infectious bacterial illness caused by *Bordetella pertussis*. *B. pertussis* spreads by coughs and sneezes of sick patients. The present study aimed to investigate the pertussis incidence, and thereafter, decide whether it is necessary to import a vaccine for this disease in Anbar province, Iraq. This descriptive cross-sectional study was performed by using the electronic archives of Pertussis patients in Anbar Governorate hospitals during a period of 10 years from 2009 to 2019. The incidence rate of pertussis has been calculated by dividing the annual cases number of infections by the size of the population at risk multiplied by 100,000. From 608 patients with pertussis registered at Anbar province hospitals, 315 (51.8%) and 293 (48.2%) of them were males and females, respectively, with an average age of 11.1±3 years old. The incidence rates of pertussis in 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019 were 0.014, 2.770, 1.427, 1.375, 3.421, 0.228, 0.00, 0.00, 21.321, 4.242, 0.604 in 100,000 people per year. The annual incidence ratio was 13.620/100,000 people per year. There was no statistically significant difference between males and females (P -value = 0.130). There was one peak in the annual incidence rate of pertussis from 2009-2019 which happened in 2017. Lack of pertussis incidence during 2015-2016 was due to population displacement. Incidence of pertussis was more prevalent in the age group of 1-4 years old, compared to the 1-year-old group. The incidence of pertussis decreased sharply during the last 2 years in Anbar province.

Keywords: Pertussis, incidence, Iraq

1. Introduction

Pertussis (whooping cough or name as one hundred day cough) is an extremely transmissible bacterial illness. It mainly affects children and adolescents, and its most important symptom is a severe cough accompanied by a high-pitched cough. Characteristically, paroxysmal cough is accompanied by both deep inhalations as well as fainting and sometimes vomiting after each cough (1, 2).

Some cases of the subconjunctival hemorrhage, broken ribs, enuresis, rupture of the pleura, pneumothorax, and hernia have been reported as complications of violent

coughing or whooping voice. While the disease in children younger than 1 year old is less severe (weak coughing or no coughing at all), episodes of breathlessness are the most common among them (1, 2). Pertussis occurs as the result of *B. pertussis* (a gram-negative aerobic bacteria). It is transmitted certainly through coughs and sneezes of sick patients. Pertussis can be transmissible from the beginning of signs until after 3 weeks of sneezing and coughing fits (3).

It is estimated that 16.3 million people were infected with whooping cough in 2015, especially in developing countries. It affects all ages, but it is concentrated in

children and adolescents (4, 5). It caused the death of 58,700 and 138,000 people in 2015 and 1990, respectively (5). Following the discovery that *B. pertussis* is responsible for whooping cough in 1906, a suitable vaccine for this bacteria was produced in the 1940s (6). The emergence of the pertussis vaccine caused a sharp decrease in the trend of pertussis incidence to around 1,000 in 1976 (7).

Whooping cough vaccines are effective at preventing this illness (8) and are recommended for routine use by World Health Organization and the US-Centers for Disease Control and Prevention (9). The pertussis vaccine saved more than half a million people in 2002. Pertussis vaccine (4) is usually suggested initially for children in the age range of 6-8 weeks with four doses to be administered in the first 2 years of life (10). Other doses of pertussis vaccine are frequently suggested for younger teenagers and adults, despite a decrease in the severity of pertussis incidence in older ages.

The current study aimed to determine the incidence rate of pertussis in Anbar province, Iraq during 2009-2019 to find out if it is necessary to import a vaccine for this disease.

2. Materials and Methods

In this descriptive cross-sectional study, the electrical files of patients with pertussis who were registered immediately at Anbar province hospitals were examined. The data of all the newly diagnosed pertussis cases were retrieved from public and private hospitals along with pediatrician private clinics. The electronic database saved in Al-Anbar Health Office during 2009-2019 includes demographic variables with sero-diagnosis by recognition of "Pertussis-specific IgM" in a serum sample. Pertussis diagnosis was confirmed by at least two specialized practitioners in internal medicine and pediatric according to the standard criteria of the World Health Organization (11).

Estimates of the population of Anbar were obtained from the statistics section of the Iraqi Ministry of Planning for 2019 and previous years for the study. From 608 Pertussis cases that were included in this

study, the incidence rates are expressed per 100,000. Ethical approval was achieved by Anbar medical college Ethics Committee, Iraq.

2.1. Statistical Examination

The annual incidence rate of pertussis was calculated by dividing the total number of newly diagnosed Pertussis cases in a given year by the population at risk of pertussis in Anbar Governorate this year and the result was multiplied by 100,000 as it was considered as the population of all ages at the risk of pertussis infection. The SPSS software (version 24) was used to analyze the qualitative data as the ratio of males to females, age group, and annual frequencies of pertussis patients to determine whether there was a statistical difference among these variables through the Chi-Square test. It should be mentioned that a p-value of less than 0.05 was considered statistically significant.

3. Results

There were 608 confirmed cases of pertussis registered in public and private hospitals that also include pediatrician private doctors in Anbar province during 2009-2019. Of the total 608 cases, 315 (51.8%) were males and 293 (48.2%) were females. A male to female ratio was 1.07:1.00, and no significant difference was recorded between males and females regarding the incidence of pertussis (p -value ≈ 0.130 as illustrated in Table 1). The mean age of registered cases of Pertussis was 11.1 ± 3 years old. Moreover, the mean age of recorded cases of pertussis was significantly higher in females (10.3 ± 4), compared to males (11.6 ± 2).

The incidence rates of pertussis in 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, and 2019 were 0.014, 2.770, 1.427, 1.375, 3.421, 0.228, 0.00, 0.00, 21.321, 4.242, 0.604 in 100,000 people per year, respectively. The annual incidence rate of pertussis was 13.620/100,000 people per year. The drift in annual pertussis incidence rates from 2009 to 2019 showed one peak in 2017. However, the incidence rates of pertussis were low during 2009-2014, and no pertussis cases were registered during 2015-2016 due to most of the population displacement from the Anbar province

to other provinces and outside of Iraq as a result of terrorist operations (Table 2, Figure 1).

The demographic data of the population was studied regarding the pertussis frequency during 10 years from 2009 to 2019 in Anbar province. The number of

cases according to years for all pertussis patients is presented graphically in Figure 2. The highest number of cases were registered in 2017, after which there was a sharp decrease in incidence rates of pertussis in recent years.

Table 1. Pertussis distribution during 2009-2019 based on gender in Anbar province, Iraq

Year	Gender		Total (%)	P-value
	Female (%)	Male (%)		
2009	7(46.7)	8(53.3)	15(100.0)	0.130
2010	19(41.3)	27(58.7)	46 (100.0)	
2011	11(47.8)	12(52.2)	23(100)	
2012	12(54.5))	10(45.5))	22(100)	
2013	30(53.6)	26(46.4)	56(100)	
2014	4(00.0)	0 (00.0)	4(00.0)	
2015	0 (00.0)	0 (00.0)	0 (00.0)	
2016	0(00.0)	0(00.0)	0(100)	
2017	159 (44.8)	196 (55.2)	355 (100)	
2018	46(60.5)	30(39.5)	76(100)	
2019	5 (45.5)	6 (54.5)	11 (100)	
Total	293 (48.2)	315 (51.8)	608 (100)	

Table 2. Pertusis annual incidence per 100,000 population during 2009-2019 in Anbar province, Iraq

Year	At-risk population	Number of patients (%)	Overall annual incidence per 100,000 people	p-value
2009	1478226	15(2.5)	0.014	0.000
2010	1660123	46(7.6)	2.770	
2011	1562025	23 (3.8)	1.427	
2012	1600000	22(3.6)	1.375	
2013	1636861	56(9.2)	3.421	
2014	1753968	4(0.7)	0.228	
2015	1750000	0(0.00)	0.00	
2016	1769230	0(0.00)	0.00	
2017	1665000	355 (58.4)	21.321	
2018	1791390	76 (12.5)	4.241	
2019	1818318	11 (1.8)	0.604	
Total		608 (100.0)	Annual average: 13.620	

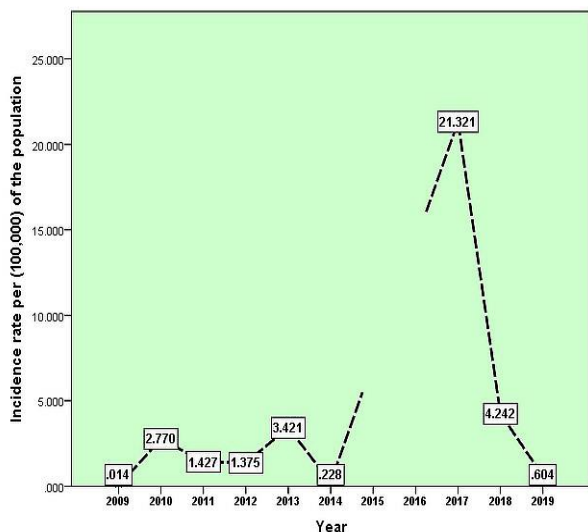


Figure 1. Annual incidence rate of pertussis per 100,000 people during 2009-2019 in Anbar province, Iraq

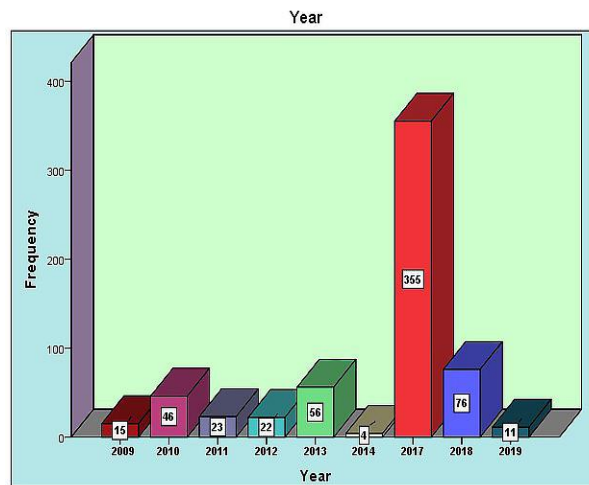


Figure 2. Frequency of pertussis over the years 2009 to 2019 in Anbar province, Iraq

Pertussis patients were categorized into 5 groups based on their ages: (1) less than one year, (2) 1-4 years old, (3) 5-14 years old, (4) 15-45 years and, (5) more than 45 years old. This categorization was performed for each year of study during 2009-2019. Half of the

pertussis patients were in the age range of 1-4 years old as presented in table 3 and figure 3. There was a statistically significant difference between different age groups of pertussis patients during each of the study years.

Table 3. Distribution of pertussis over years 2009 to 2019 based on age group in Anbar province, Iraq

Year	Age group					Total (%)	P-value
	less than one year (%)	1-4 Years (%)	5-14 Years (%)	15-45 Years (%)	More than 45 Years (%)		
2009	4 (26.7)	7 (46.7)	3 (20.0)	1 (6.7)	0 (0.0)	15 (100.0)	0.000
2010	12 (26.1)	22 (47.8)	11 (23.9)	1 (2.2)	0 (0.0)	46 (100.0)	
2011	6 (26.1)	14 (60.9)	2 (8.7)	1 (4.3)	0 (0.0)	23 (100.0)	
2012	5 (22.7)	13 (59.1)	3 (13.6)	0 (0.0)	1 (4.5)	22 (100.0)	
2013	16 (28.6)	26 (46.4)	10 (17.9)	3 (5.4)	1 (1.8)	56 (100.0)	
2014	1 (25.0)	3 (75.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (100.0)	
2017	91 (25.6)	195 (54.9)	64 (18.0)	4 (1.1)	1 (0.3)	355 (100.0)	
2018	20 (26.3)	31 (40.8)	19 (25.0)	5 (6.6)	1 (1.3)	76 (100.0)	
2019	3 (27.3)	5 (45.5)	2 (18.2)	1 (9.1)	0 (0.0)	11 (100.0)	
Total	158 (26.0)	316 (52.0)	114 (18.8)	16 (2.6)	4 (0.7)	608 (100.0)	

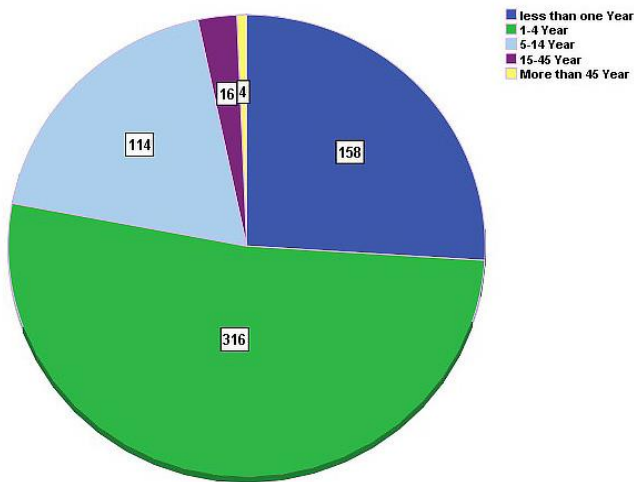


Figure 3. Distribution of pertussis during 2009-2019 based on age group in Anbar province, Iraq

4. Discussion

The total number of pertussis cases that were registered during a period of 10 years from 2009 to 2019 in Anbar province was 608 cases as summarized in Table 1. This is the **first quantitative study** that provides important evidence in detail on pertussis incidence in this area. The decrease in pertussis cases during the past two years (2018 and 2019) in Anbar Province may be due to the global decline of this disease during the same period (11).

There was zero pertussis incidence from 2014 to 2016 which was due to the migration and displacement of the Anbar population to other regions inside and outside Iraq as a result of the military operations. Therefore, the health institutions have lost the ability to register new cases of pertussis as shown in Table 2 and Figure 1.

The average annual incidence rate of pertussis in Anbar province during the current study (13.620/100,000 persons/year) was much higher than that of the same disease that was registered in neighboring countries, such as Saudi Arabia (12), Turkey (13) and Egypt (14) in addition to other countries, like Italy, France, Western Europe, and Japan (15). This may be due to the regular vaccination of the DTP vaccine in these countries. The sharp decrease in pertussis incidence rate during a period of 2 years (2018-2019) may be due to a regular vaccination with the DTP

vaccine. The result of the efficacy of vaccination against pertussis was in agreement with those of previous studies that showed regular annual vaccination was effective against pertussis and reduced the incidence of this disease (16, 17).

The mean age of patients with pertussis during the study period was 11.1 ± 3 , which was consistent with the mean age of infected patients with pertussis that was shown by previous studies in Saudi Arabia (12), Egypt (14), and Jordan (18). It was shown that the disease was concentrated in children within the age group of 1-4 years old.

The current research showed that age group 1-4 years old is the main target age group for pertussis patients as they constitute about half of all cases, followed by age groups of less than 1 year old and 5-14 years old. This result was in line with those of previous studies (19, 20) which showed that the age group of 1-4 years old is more susceptible to infection with pertussis in Tehran (21), where children within age groups of 0-8 or 5-10 years old were more susceptible to pertussis infection. The findings of this study were completely identical to those of a previous study performed in the USA (22) where it appeared that 90% of children with pertussis were within the age group of 1 year old. However, these results are in contrast with those of a previous study conducted in Belgium which indicated that the age group of 5-14 years old is more susceptible to pertussis, and also those of other studies which showed that the less than one year's age group was the target of pertussis (23).

The findings of the current study showed that the prevalence of pertussis in males and females were 315 (51.8%) and 293 (48.2%), respectively, in 608 cases during the period of study. This confirmed equal distribution of pertussis in males and females which is in contrast with the results of a previous study that showed pertussis illness happened more commonly in males with a ratio of about 2:1 (24) as well as a Sweden study that showed 62% of pertussis patients were male (25). In a previous study in Iraq, it was found that the

incidence rate of pertussis was higher in males, compared to females. Other studies showed a bias for male cases of pertussis (26, 27), whereas the current study was different from a previous study conducted in Germany which showed that only 33.1% of pertussis patients were male (28). Results of the present study regarding gender distribution of pertussis patients may be due to the small sample size.

The conservative nature of Iraqi society makes females less social; therefore, they were less infected with pertussis through respiratory droplets. In addition to mixing and socializing, other male activities, such as traveling, social differences, and other important activities increase the risk of pertussis infection in males. The current study showed a noticeable decrease in the incidence rate of pertussis during the last 3 years, especially age range of 1-4 years old. Therefore, it is not necessary to vaccinate children with the pertussis vaccine.

Authors' Contribution

Study concept and design: A. M. A.

Acquisition of data: E. M. A.

Analysis and interpretation of data: M. A. K.

Drafting of the manuscript: E. M. A.

Critical revision of the manuscript for important intellectual content: E. M. A.

Statistical analysis: H. A. O.

Administrative, technical, and material support: E. M. A.

Ethics

All the procedures were approved by the Ethics Committee at the University of Anbar, Al Anbar, Iraq.

Conflict of Interest

The authors declare that they have no conflict of interest.

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