DIPHTHERIA INCIDENCE IN ANBAR GOVERNORATE, WEST OF IRAQ DURING THE PERIOD 2009-2019

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ABSTRACT : Diphtheria is an infectious illness that occur due to Corynebacterium diphtheriae, characterized by the appearance of gray to white patch in the throat with the appearance of a barking cough like in croup as a result of obstruction of the airway with partial swelling of the neck as a result of enlarged lymph nodes and complications may include myocarditis, nerve inflammation and kidneys problems with bleeding due to low blood platelets. There is no current research study on the prevalence of diphtheria infection in recent years in Anbar Governorate, although many cases have been recorded, despite following a regular program of vaccination against diphtheria. A descriptive research aimed to find out the annual diphtheria incidence according to person, years and place in Anbar governorate, West of Iraq.

A descriptive cross-sectional research using Diphtheria patients' electronic archives that registered immediately in Anbar Governorate hospitals and Anbar Health Office in a period from 2009-2019. Numerous data had been collected as diphtheria cases by age, Years of incidence & gender. Diphtheria incidence was calculated by dividing the number of annual Diphtheria cases by population size multiplied by 100,000 of population. SPSS software version 24 was used for data analysis. The data had been explored through using descriptive investigation and displayed in charts & tables. Forty two diphtheria cases were recorded in Anbar governorate during the period from 2009-2019, 24 (57.1%) and 18 (42.9%) of females and males respectively, with mean age 13.4 ± 4 years, as the incidence rate during the years 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 and 2019 was (0.14, 0.18, 0.32, 0.44, 0.55, 0.00, 0.00, 0.23, 0.36, 0.28 and 0.05) / 100,000 of population respectively with a low annual incidence ratio 0.23/ 100,000. No statistical difference between males & females (p value = 0.943). Annual incidence of Diphtheria during a period from 2009-2019 confirmed 1 peak in 2013 & no Diphtheria cases was recorded during a period 2014-2015, Majority of them had been in 5 -14 years old age group. Diphtheria incidence had been decreased during the last three years mainly in all age groups in the Anbar governorate during last year's due to using DTP) vaccine.

Key words : Incidence, diphtheria, years, gender, age group, descriptive study, Anbar, Iraq.

INTRODUCTION

Diphtheria is acute contagious illness occur due to three *Corynebacterium* species, *Corynebacterium diphtheria*, *Corynebacterium ulcerans* and *Corynebacterium pseudotuberculosis* that is mainly spread though airborne droplets between persons (Pangalo *et al*, 2020). These bacteria usually localize in a noasopharynx. clinical symptoms of this disease include fever more than 38 in addition to a greyish white pseudo-membrane that is difficult to release with an easy hemorrhage in each of faring, larynx & tonsils. Diphtheria incubation period is 2-5 days (Both *et al*, 2015).

Exogenous toxins produced by these Corynebacterium species can result in inhibition of proteins creation from the host cells with destruction of place infection tissues, which may cause the development of a membrane. Besides, some complication may be appears as a results of infection and Exogenous toxins production which include myocarditis, nerve inflammation kidneys problems and thrombocytopenia with proteinuria and occasionally paralysis may be occur (Husada *et al*, 2017).

Diphtheria was main reason for death of children in the pre-Diphtheria vaccine era (Zakikhany and Efstratiou, 2012). Developed countries incidence quickly decreased

through using the diphtheria-tetanus-pertussis (DTP) vaccine after World War II (Clarke *et al*, 2019). The total number of diphtheria cases recorded in 2017 was higher than the number of cases recorded in 2004, despite the DTP vaccination campaign that covered 80% of the world's population, taking into account the decrease in the incidence of the disease in age groups less than 15 years, which indicates the effectiveness of the vaccine in these groups (Zakikhany and Efstratiou, 2012; Clarke *et al*, 2019). Few reports were published about diphtheria outbreaks and sporadically, however, cases of this disease were reported in Yemen, Bangladesh and Venezuela during the period 2016-2019 (Clarke *et al*, 2019).

Necessary recommendations were issued by the World Health Organization regarding diphtheria vaccination in 2017 (WHO, 2017). Three doses of the diphtheria vaccine represent the primary series that is given in childhood. In addition, according to the recommendations, three doses of diphtheria toxoid are added to the age groups of 12-23 months, 4-7 years and 9-15 years, respectively (Pangalo *et al*, 2020; Clarke *et al*, 2019). Current research had been scheme to know Diphtheria incidence in Anbar governorate, Iraq throughout a period 2009-2019 among children, adolescents and young adults during these period.

MATERIALS AND METHODS

A descriptive cross-sectional study using Diphtheria patients electronic archives that registered immediately in Anbar Governorate hospitals, Pediatrician private clinics and Anbar Health Office in a period from 2009-2019. Numerous data had been registered as diphtheria cases by age, Years of incidence & gender. Diphtheria incidence was calculated by dividing the number of annual Diphtheria cases by population size multiplied by 100,000 of population.

Electronic database saved include diagnosis by recognition of speciûc IgM against Diphtheria in serum & diagnosis had been confirmed by as a minimum two consultants doctors in medicine & pediatric depending on WHO standard criteria (WHO, 2017; WHO, 2019). Anbar Governorate population under the risk of diphtheria infection was obtained from the Statistics Department of the Iraqi Ministry of Planning for the years 2009-2019, as well as the ethical approval obtained from the Medical Ethics Committee for Medical Colleges, Anbar of University.

Statistical analysis

Numerous data had been collected during this research as diphtheria cases by age, gender & years. Diphtheria-annual-incidence rate had been calculated through dividing newly diagnosed Diphtheria total cases number for every year by Diphtheria population at risk in the Anbar area & the results had been multiplied by 100,000. All Anbar area population in overall age groups considered at risk of Diphtheria development.

SPSS 24 Software program had been applied in analysis of statistical variable as males to females percentage, age groups & annual incidence of diphtheria patients to determine the presence of statistically significant differences in these variables based on the Chi-square test when P <0.05. In addition to showing graphs and tables for these variables.

RESULTS

Forty two diphtheria cases were recorded in Anbar governorate during the period of study, 24 (57.1%) and 18 (42.9%) of females and males respectively, with mean age 13.4 ± 4 years. No statistical difference between males & females (p-value = 0.943). Diphtheria cases mean age was somewhat higher in females link with males, 13.1 ± 2 & 16.2 ± 6 years respectively as illustrated in Table 1.

The diphtheria incidence rate during the years 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 and 2019 was (0.14, 0.18, 0.32, 0.44, 0.55, 0.00, 0.00, 0.23, 0.36, 0.28 and 0.05) / 100,000 of population respectively with a low annual incidence ratio 0.23/ 100,000. Annual Diphtheria incidence ratio from 2009-2019 confirmed one peak in 2013 & No diphtheria cases was recorded during a period 2014-2015 due to the displacement of greatest Anbar governorate population due to terrorist operations consequence to other Governorates, Majority of Diphtheria cases were in 5 -14 years old age group as shown in Table 2, Fig. 1.

Table 1 : Distribution of Diphtheria in a years 2009 - 2019 by gender in Governorate, Iraq.

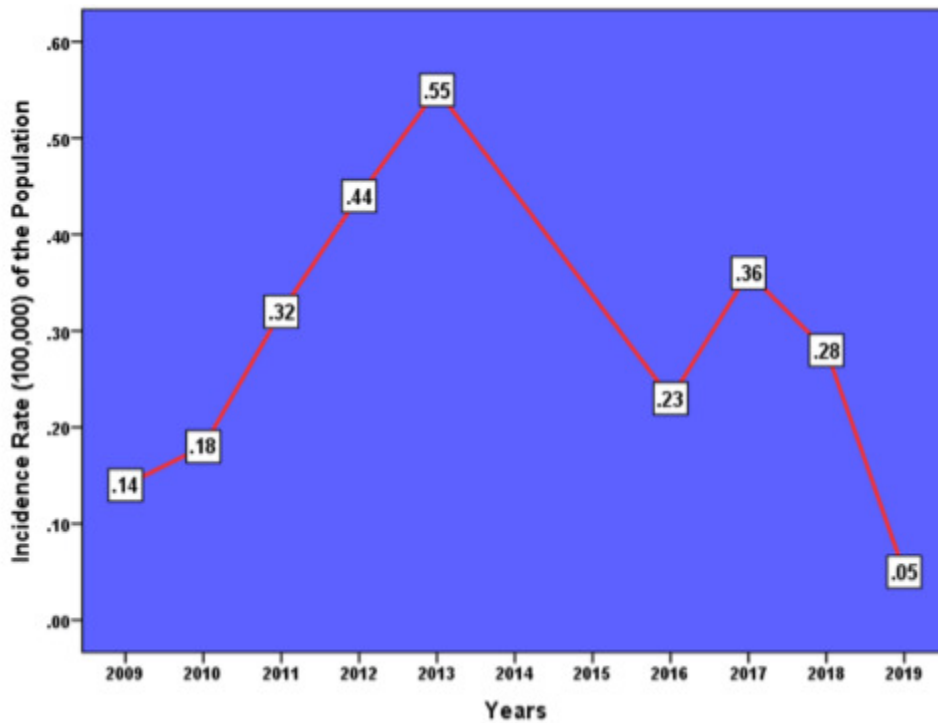| Year	Gender		Total (%)	P. value
	Male (%)	Female (%)		
2009	1 (50.0%)	1 (50.0%)	2 (100.0%)	
2010	1(33.3%)	2(66.7%)	3 (100.0%)	
2011	2 (40.0%)	3 (60.0%)	5 (100.0%)	
2012	3 (42.9%)	4 (57.1%)	7 (100.0%)	
2013	5 (55.6%)	4 (44.4%)	9 (100.0%)	0.943
2016	1 (25.0%)	3 (75.0%)	4 (100.0%)	
2017	2 (33.3%)	4 (66.7%)	6 (100.0%)	
2018	2 (40.0%)	3 (60.0%)	5 (100.0%)	
2019	1 (100.0%)	0 (0.0%)	1 (100.0%)	
Total	18 (42.9%)	24 (57.1%)	42 (100.0%)	

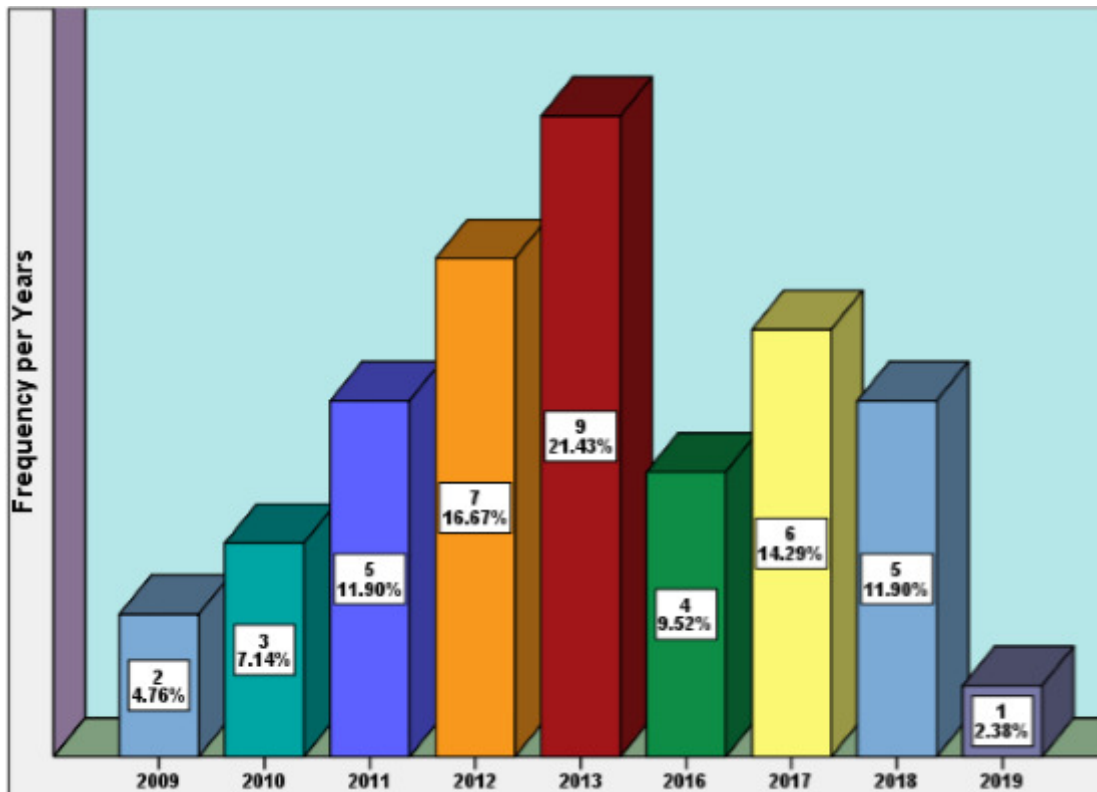**Fig. 1 :** Annual incidence of diphtheria per 100,000 during 2009-2019 in Al-Anbar governorate, Iraq.

Fig. 2 : Anbar governorate Diphtheria frequency in a years 2009 - 2019.

Diphtheria cases greatest number were diagnosed in 2013 followed by 2013 then there was a regular reduction in the year 2018-2019 of Diphtheria in the Anbar governorate as illustrated in Fig. 2.

Diphtheria patients had been divided into 3 age groups; (1):1–4 years, (2): 5–14 years, and (3): 15–45 years for every year during a period 2009-2019. Results showed more than half of Diphtheria patients were registered in the 5-14 years old age group and fewer of them in the 15-45-year-old age group as shown in Table 3, Fig. 3. No statistically significant variance in Diphtheria incidence for different age groups (P. value: 0.998).
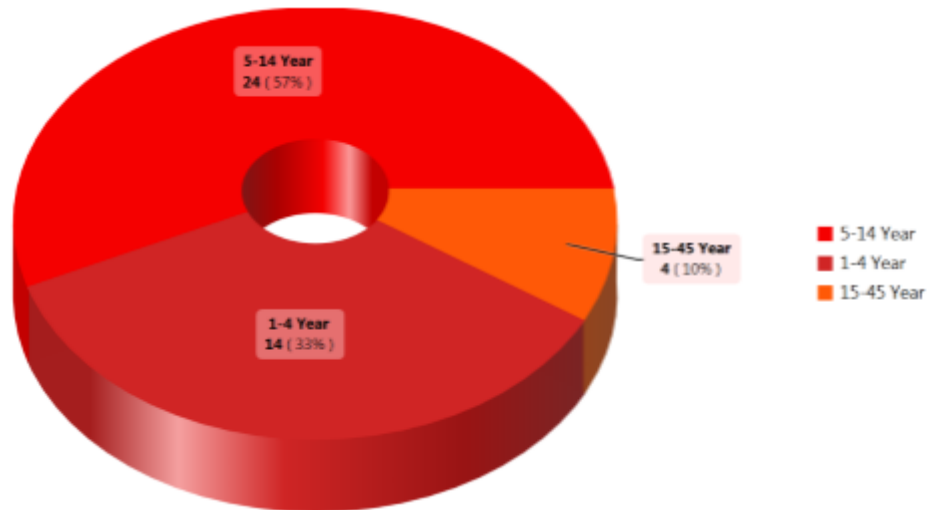
Fig. 3 : Diphtheria distribution in different age group in Anbar governorate, Iraq during 2009 to 2019.

Table 2 : Annual incidence of diphtheria per 100,000 during 2009–2019 in Al-Anbar governorate, Iraq.

Year	Pearson/year at risk	Patients number (%)	Total annual incidence per 100,000 person-year
2009	1478226	2 (4.8)	0.14
2010	1660123	3 (7.1)	0.18
2011	1562025	5 (11.9)	0.32
2012	1600000	7 (16.7)	0.44
2013	1636861	9 (21.4)	0.55
2014	1753968	00 (0.00)	0.00
2015	1750000	00 (0.00)	0.00
2016	1769230	4 (9.5)	0.23
2017	1665000	6 (14.3)	0.36
2018	1791390	5 (11.9)	0.28
2019	1818318	1 (2.4)	0.05
Total		42 (100.0)	Annual average of Diphtheria 0.23

DISCUSSION

Forty two confirmed cases of diphtheria were recorded in Anbar Governorate during 2009-2019 as illustrated in Table 1. This is the latest study that gives important details about confirmed diphtheria infections in Anbar governorate, which shows a significant reduction in diphtheria infections, this is certainly related to the remarkable progress in the health situation and following the health guidelines related to taking vaccines for this disease.

The absence of diphtheria infections in the current study during the period 2014-2015 (Table 2, Fig. 1) is related to the mass displacement of the governorate's population to other governorates or outside Iraq due to terrorist operations and military operations that occurred during this period, which made the Anbar Health Department and its health institutions unable to follow up cases of infection.

Table 3 : Distribution of Diphtheria in different age group in Anbar governorate, Iraq during 2009-2019.

Year	Age group			Total N (%)	P value
	1-4 Year N (%)	5-14 Year N (%)	15-45 Year N (%)		
2009	1 (50.0%)	1 (50.0%)	0 (0.0%)	2 (100.0%)	
2010	1 (33.3%)	2 (66.7%)	0 (0.0%)	3 (100.0%)	
2011	1 (20.0%)	3 (60.0%)	1 (20.0%)	5 (100.0%)	
2012	2 (28.6%)	4 (57.1%)	1 (14.3%)	7 (100.0%)	
2013	3 (33.3%)	5 (55.6%)	1 (11.1%)	9 (100.0%)	0.998
2016	2 (50.0%)	2 (50.0%)	0 (0.0%)	4 (100.0%)	
2017	2 (33.3%)	3 (50.0%)	1 (16.7%)	6 (100.0%)	
2018	2 (40.0%)	3 (60.0%)	0 (0.0%)	5 (100.0%)	
2019	0 (0.0%)	1 (100.0%)	0 (0.0%)	1 (100.0%)	
Total	14 (33.3%)	24 (57.1%)	4 (9.5%)	42 (100.0%)	

Diphtheria average annual incidence in the Anbar population during 2009-2019 was (0.23/ 100,000 persons) and this had been consistent with the results reported in neighboring nations as the kingdom of Saudi Arabia, Turkey, Iran & Kuwait (Clarke *et al*, 2019; Truelove *et al*, 2020). As well as similar to diphtheria infections in other countries of the Middle East and European as England, Poland, Italy, France, western Europe, Japan (Both *et al*, 2015; Czajka *et al*, 2018; Zakikhan and Efstratiou, 2012), this decrease of diphtheria infection in Iraq may be due to regular vaccination against this disease.

The result in the current study was similar to the result obtained in previous studies in Iraq that showed one hundred Diphtheria cases were cautiously identified as diphtheria during 6 months using direct smears in Mosul, Iraq (Zhao et al, 2019; Al-Talib et al,1986).

Diphtheria patients mean age during current research was 13.4 ± 4, in contrasts with diphtheria mean age offspring that registered in previous reports in the kingdom of Saudi Arabia, Egypt & Jordan that mainly appeared in 6-10 years old (Pantukosit *et al*, 2008; Khuri-Bulos *et al*, 1988). Diphtheria infection mainly was appeared in 5-14 age group during the years of study, these results were consistent with the results reported in Iran (Khuri-Bulos *et al*, 1988).

The current research showed that age group 5-14 is the main target age group diphtheria, where children in 5-9 years old age group were more susceptible to diphtheria infection (Azizi *et al*, 2012), as well as consistent with the previous report in the USA, where Diphtheria infection in age group under14 years of 85% of diphtheria patients (Galazka and Robertson, 1995), in contrasts with previous research that showed age group 4-16 is more susceptible to diphtheria infection in Belgium and this study disagreement with the other studies that showed diphtheria infection mainly appear in the 12-16 age group (Martini *et al*, 2019; Wagner *et al*, 2012).

Diphtheria incidence in males 18 (42.9%) and females 24 (57.1%) out of a total of 42 diphtheria cases during the study period that confirmed slightly elevation in infected females than males. No significant variance between males & females diphtheria patients, these results had been in agreement with the results reported in previous researches (Khuri-Bulos *et al*, 1988; Galazka and Dittmann, 2000). It also consistent with Swedish research that showed 55% of diphtheria patients were males, and consistent with the result of Al-Talib (1986) and Al-Talib *et al* (1986) in Iraq that showed elevation in diphtheria prevalence in males than in females. Other researches demonstrate a bias for diphtheria cases of

male, Current study was also consistent with German research that registered diphtheria infection in 45.2% of male patients (Fink and Klein, 2015; Völzke *et al*, 2006).

CONCLUSION

A significant decrease in the incidence of diphtheria has been recorded during the past two years in the Anbar governorate and for all age groups. This decrease may be associated with the regular use of diphtheria vaccines.

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