ORIGINAL ARTICLE

Evaluation of Mumps Vaccine Effectiveness in Vaccinated Children in Thi-Qar Province, Iraq

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Key words:
Mumps virus IgG, Mumps vaccine, MMR vaccine

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ABSTRACT

Background: *Outbreaks of mumps continue to take place in a number of regions across the globe, with Iraq being one of the countries that occasionally experiences epidemics.* ***Objectives****: This study aimed to evaluate whether the Mumps vaccination is efficacious in children who have been vaccinated.* ***Methodology:*** *The case-control study included 176 children (117 vaccinated and 59 unvaccinated), aged less than thirteen years. The ELISA technique was used to detect the presence of mumps virus IgG in them sera.* ***Results:*** *The seroprevalence of mumps IgG in the vaccinated group was positive in 110 (94.0%) of 117 children. While in the unvaccinated group it was positive in 45 (76.3%) of the 59 children. This study found a significant difference between both groups (X2 = 11.754, p value < 0.001) using the chi-square test. According to sex, there was a significant difference between males and females in the vaccinated groups (p value = 0.037) by using the t-test, but there was no significant difference by sex using the chi-square (X2 = 0.542, p value < 0.462) in the same group. Our study also did not find any significant difference according to the number of vaccine doses (p value = 0.246), but there was a significant difference in results according to age group (p value = 0.049).* ***Conclusions:*** *The current study concluded that the mumps vaccine is potently effective for Iraqi-vaccinated children in Thi-Qar province. The outbreaks in other places in Iraq may be attributed to weak vaccine coverage in areas suffering from battles and the displacement of citizens.*

INTRODUCTION

Mumps virus (MuV) is an acute contagious disease belong to family Paramyxoviridae that causes non-suppurative salivary gland enlargement. Children's mumps cases are usually mild, while complications often develop meningitis and orchitis in adults[1]. MuV is transmitted via the respiratory route by the inhalation of contaminated droplets[2]. After MuV infections, the majority of individuals are asymptomatic or exhibit only minor respiratory symptoms or fever; normally take 12 to 25 days for incubation to occur, and parotitis commonly develops 16 to 18 days following exposure[3]. The only known natural host of MuV is humans[1]. The mumps virus has a stable antigen at least 12 SH gene genotypes exist. Current global epidemics are more common with genotype G[3]. The testes and ovaries may be impacted, particularly after puberty. Orchitis (typically unilateral) affects 20-50% of males who are infected with the mumps virus. Sterility is an uncommon side effect. About 5% of women get mumps oophoritis[1].

Public health concerns have arisen from mumps prevention and control. According to a previous report, 70% of patients with a documented vaccination history had received two doses of measles, mumps, and rubella (MMR) vaccine prior to sickness[4], Measles and rubella cases are far less common among people who have received two doses of the MMR vaccine than instances of the mumps, indicating that some factors may affect the efficacy of the mumps vaccine[5].

Several significant mumps outbreaks have also been documented in wealthy nations in recent years[3]. Despite safe and effective immunizations, mumps is still an important health problem around the world countries, and the virus continues to produce outbreaks worldwide[6]. Globally, unvaccinated regions have mumps epidemics every five years[7]. Over the last ten years (2013–2022), WHO has documented a total of 3,928,759 mumps cases[8].

In Iraq A 2020 study in Anbar province found that mumps frequency had grown, particularly in children aged 5–14[9]. From 2001 to 2016, Iraq saw two large mumps outbreaks. The first outbreak occurred in 2004, and the second, greater period lasted from 2015 to 2016. Following the epidemic in 2016, 13 of the 18 governorates reported the highest mumps incidence in the time period[10]. In 2016, approximately 73919 mumps cases were reported in Iraq, compared to 36367 cases in 2017. Poor clinical case reporting and a lack of

epidemiological research make mumps a public health issue; conflict and battles between 2014 and 2016 contributed to this as well[11].

METHODOLOGY

Participants and study design

The case-control study conducted in the Thi-Qar province from September, 2023, to January, 2024. One hundred seventy-six children's serum were collected.

Data Collection

The history of child immunization for the Mumps virus was considered. The vaccinated group had 117 children (males 68 and females 49), and the unvaccinated group consists of 59 (males 36 and females 23) with an age less than 13 years old. In addition to primary health clinic records, parents also provided the following details: age, sex, and immunization history.

Laboratory Techniques Used

Enzyme-linked immunosorbent assay (ELISA) was the method utilized in this study to find mumps virus IgG in clinical sera. The manufacturer that was used in current study was SunLong Biotech; Details (Human Mumps IgG ELISA Kit, 96 Tests, Catalogue Number: SL3197Hu).

Statistical Analysis

The IBM SPSS 26 version was used. For categorical data, frequency and percentage were employed, while mean and standard deviation (SD) were utilised for continuous data. Chi-square, t-test, and ANOVA were used to investigate the relationship between variables. with a *P* value of less than 0.05.

RESULTS

Demographic Data

The Results According to Child Status (vaccinated and unvaccinated).

This study found that 110 (94.0%) out of 117 children were positive and 7 (6.0%) were negative for the mumps virus in the vaccinated group. While in the unvaccinated group, positive children were 45 (76.3%) and negatives were 14 (23.7%) out of 59 children. The study compared between both groups by vaccination status and outcomes using Chi-square. A significant difference was observed between the vaccinated and unvaccinated groups (X^2 = 11.754, *p* value = 0.001). As shown in Table 1.

The Results of Both Groups According to Sex and Results.

The study's analysis of Mumps Virus IgG in both groups revealed no statistically significant differences according to sex (*p* value s of 0.462 and 0.774, respectively). In the vaccinated group, there were males 63 (92.6%) positive and 5 (7.4%) negative; for females, positives numbered 47 (95.9%) and negatives 2 (4.1%). In the unvaccinated group, positive males comprised 27 (75%), negative females comprised 9 (25%), positive females comprised 18 (78.3%), and negative females comprised 5 (21.7%). as shown in Table 2.

Table 1: Illustrates the number and percentage of mumps results in both groups.

IgG	vaccination Status	Positive		Negative		Total		Chi-Square
		n	%	*n*	%	*n*	%	
Mumps virus IgG	Vaccinated	110	94.0	7	6.0	117	100	X^2= 11.754 *p* value 0.001
	Unvaccinated	45	76.3	14	23.7	59	100	
	Total	155	88.1	21	11.9	176	100	

Table 2: Shows proportion of results by gender in both of the groups.

IgG	Child Status	Sex	Positive		Negative		Total		Chi-Square
			n	%	*n*	%	*n*	%	
Mumps virus IgG	Vaccinated	Male	63	92.6	5	7.4	68	58.12	X^2= 0.542 *p* value 0.462
		Female	47	95.9	2	4.1	49	41.88	
		Total	110	94	7	6	117	100	
	Unvaccinated	Male	27	75	9	25	36	61.02	X^2= 0.082 *p* value 0.774
		Female	18	78.3	5	21.7	23	38.98	
		Total	45	76.3	14	23.7	59	100	

Estimation of Mumps Virus IgG Titre.

According to vaccination status, the current study indicated that the mumps virus IgG titers in the vaccinated and unvaccinated groups did not differ significantly (p-value = 0.320), but according to sex in the vaccinated group, the study found that the levels of mumps virus IgG were significantly higher in females than in males in the vaccinated group (p-value = 0.037).

Regarding the dosage of the mumps vaccine, the current study found no significant difference in mumps virus IgG concentrations between children who received a single dose and those who had two doses (p-value < 0.246), but according to the age group, the vaccinated group was divided into five age groups, and there was a significant difference in mumps virus IgG levels (p-value 0.049), as shown in Table 3.

Table 3: Estimation levels of Mumps Virus IgG.

Mumps virus IgG		**Mean ± S. D**		
Vaccination status		**Vaccinated** ***n*** **= 117**	**Unvaccinated** ***n*** **= 59**	***p*** **value (t-test)**
		4.75 ± 1.78	4.49 ± 1.41	**0.320**
Vaccinated group by Sex		**Female (*n* = 49)**	**Male (*n* = 68)**	***p*** **value (t-test)**
		5.16 ± 1.80	4.46 ± 1.73	**0.037**
Vaccine Dosage		**One dose** ***n*** **= 16**	**Two dose** ***n*** **= 101**	***p*** **value (t-test)**
		4.27 ± 1.71	4.83 ± 1.79	**0.246**
Age in Months	***n***	**Mean ± S. D**		***p*** **value (ANOVA)**
< 25	14	5.41 ± 1.53		**0.049**
25 - 48	39	4.99 ± 1.78		
49 - 72	30	4.90 ± 1.77		
73 – 96	9	4.77 ± 1.73		
> 96	25	3.83 ± 1.75		

DISCUSSION

In the last two decades, many mumps outbreaks have occurred in Iraq. and one of the causes of doubt was the vaccine's effectiveness. Our study's objective was to assess the Mumps vaccine's efficacy in children who had received the MMR vaccine in the province of Thi-Qar.

MMR vaccination has been thought to provide lifetime protection against the mumps virus; however, recent mumps outbreaks in patients who received two doses have cast doubt on its efficiency[12]. Our study's results found that 110 (94.0%) out of the 117 children were positive and only 7 were negative, which represents 6.0% of the total. This is compatible with a Bulgarian study, where protective MuV immunity was detected in 93% of the cases[13], However, we disagree with two studies: the first, carried out in Jiangsu Province, China, by Liu, Y.B., *et al.*,[14] which aimed to assess mumps was protection following the MMR vaccine in children aged 2 to 7 years old and discovered that the prevalence of IgG antibodies was 81.38%. In the second study performed by Ferreira., *et al.*[15] who reported that seropositive were only 355 (74.9%) out of 474 children in two doses. Additionally, it disagrees with a cross-sectional study that only 75.4% of people carry mumps antibodies overall[16]. Other study found that 17.4% of the participants lacked serological protection for mumps, despite having received the MMR vaccine in their early years[17]; This disagrees with our study, which was 6.0% only.

Mumps immunity waning over time[18]. A study reported that mumps IgG titres dropped over time, and the percentage of participants who were not protected was shockingly high, even among those who had received two doses of the MMR vaccine. So, achieving herd immunity requires MMR vaccination coverage of at least 95%[17].

Regarding the control group, our study revealed that 45 (76.3%) out of 59 children were positive. The source of IgG in unvaccinated children is infection by the mumps virus or from the mother (across the placenta or

breast feeding)[19]. Maternal antibodies can only protect infants for a few months after birth; after that, everyone is susceptible to the infection[20, 21]. In a Thai study, children lost maternally derived measles, mumps, and rubella antibodies at 7 months[22]. According to a number of studies, vaccinated mothers produce offspring with lower antibody concentrations and shorter transplacentally acquired antibody durations than mothers who contract an infection naturally. where After three months, children's antibody titres decreased, and by six months, no antibodies were detectable against the three diseases[23].

In our study there was a significant difference between the vaccinated and unvaccinated groups (X2 = 11.754 and p value =0.001). This agrees with a study performed in Amiriyat Alfallaujah district, Iraq, by Al-Khazraji, and M.T. Al-Khazraji, who reported there was a significant difference between vaccinated and unvaccinated children[11]. Also, our study agrees with a study performed by Terada, *et al*., for pre- and post-vaccination in two groups (negative and intermediate), respectively[24].

A Spanish study found that for mumps, newborns born to mothers before and after immunisation had a median antibody titre of 980 IU/ml, compared to 1200 IU/ml, respectively, and a clear drop in mumps antibodies was observed. Immunization at a very young age may be ineffective, considering the immaturity of the immune system of newborns less than one-year-old[23]. As a result, the risk of children becoming infected before the vaccination date increases. As well, our study reported no significant differences in both groups according to sex. This disagrees with Zhang, *et al*., whose study showed, the seroprevalence was considerably greater in females (78.0%) than in males (73.1%)[16]. Also, disagrees with Hussein study found a significant difference between mumps infection and sex[25]. A study of medical students aged 18–23 showed a substantial difference in immunological resistance between males and females. Females had considerably greater serological protection for mumps, even after adjusting for age and vaccine dosages (p value <0.01)[17], but our study revealed that there was a significant difference between males and females by using a t-test. This agrees with Krumova, *et al*., who found that male and female individuals had significantly different seropositivity rates[13].

According to vaccine dosage, our study revealed no significant difference. This may be due to the small size of our sample. Children who received two doses of Mumps vaccine had significantly increased seroprevalence compared to those with one dose[16]. A study comprised 734 immunized children in Belgaria. Children aged ≥ 1–11 years received one MMR dosage, whereas those aged 12 and up received two. Positivity increased between ages ≥1–6, declined after 7 years, and then increased again after the second dosage at 12 years. Age groups showed no statistically significant difference[13]. According to a Chinese study, mumps seroprevalence was too low to stop transmission. suggesting that one MMR vaccine dosage may not be enough to stop mumps outbreaks[16].

CONCLUSION

According to own findings, the current study concluded that the currently used mumps vaccine is a highly effective vaccine and provides a protection rate of 94%. The outbreaks that occurred in various regions of Iraq are due to insufficient coverage of the mumps vaccine in those regions.

Ethical Approval:

The study was conducted in accordance with the ethical principles that have their origins in the Declaration of Helsinki. The committee of researchers at the Thi-Qar Health Directorate (No. 2023/163 on 7/8/2023) has viewed and approved this study. The informed consent was obtained (the parents' consent was obtained verbally during sample collection).

Author contributions

All authors had seen and approved the submission of the manuscript with full responsibility, and this research had not been published or under consideration by any other journal.

Conflict of Interest:

The authors declare that they have no conflict of interest.

Financial disclosure

The authors deny receiving any financial support or grant from any organization

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