

Annals of Clinical and Medical Case Reports

Research Article

ISSN 2639-8109 | Volume 14

Predisposing factors of the Outbreak of Measles Infection in Thi-Qare province/ Iraq

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Received: 12 Aug 2024

Accepted: 16 Sep 2024

Published: 21 Sep 2024

J Short Name: ACMCR

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Citation:

Abdulla RK, Predisposing factors of the Outbreak of Measles Infection in Thi-Qare province/ Iraq. *Ann Clin Med Case Rep.* 2024; V14(5): 1-9

Keywords:

Measles; Outbreak; Infection; Children; Rubeola; Virus; vaccinated children

1. Abstract

In the last five years, measles has been posing a serious threat to the health of Iraqi children, although now to a lesser extent. Increased population movement has recently resulted in higher exposure to the disease. There is a safe and efficient vaccine available, and immunization is a priority program for the MoH. However, the deterioration in the security situation between 2005 and 2007 severely affected the distribution of the vaccine as well as supervisory and training activities. Most importantly, it limited access for parents and their children to immunization institutions. At the start of this intervention, WHO witnessed large numbers of unvaccinated children being exposed to the disease.

2. Introduction

Measles, also known as Rubeola, is a highly contagious, serious disease caused by an Ribonucleic Acid (RNA) virus of the genus Morbillivirus in the family Parmyxoviridae. Clinically, measles is characterized by a prodromal stage (high-grade fever, coryza, and conjunctivitis) and an eruptive stage (generalized descending pattern of maculopapular rash). It is spread by respiratory system contact with fluids from an infected person's nose and mouth by either droplet (coughing or sneezing) or aerosol transmission. The first scientific description of measles and its distinction from smallpox and chickenpox is credited to the Persia physician, known as "Rhazes".

It is estimated that before the implementation of measles elimination activities, there were 100,000 deaths each year due to measles in the Eastern Mediterranean Region. Although a vaccine has been available since 1959, measles remains an important cause of morbidity and mortality in children, particularly in developing coun-

tries where more than 95% of measles-associated deaths occur.

Because of the complications of measles infection, it remains the fifth leading cause of death in children under five years old in the world. The measles vaccine is a highly effective vaccine used against measles.

Measles remains one of the leading causes of death among young children globally, despite the availability of a safe and effective vaccine.

An estimated 164,000 people died from measles in 2008 – mostly children under the age of five. The measles epidemic has been quickly spreading throughout most of the country and remains a serious risk for the children of Iraq. In 2008, 8,134 measles cases were reported in the country. In the first 18 weeks of 2009 alone, 23,336 cases have been reported in the country, nearly 3 times the total number of cases reported in 2008 and more than the number of cases in the rest of the Middle East and North Africa (MENA) region. In 1997, the 23 member countries of the World Health Organization (WHO) Eastern Mediterranean Region resolved to eliminate measles from the region by 2010. Iraq, as a part of the Eastern Mediterranean Region of the WHO, began measles vaccination in 1985 and adopted and implemented the measles elimination strategies. In 2004, the average annual reported measles cases dropped from 9400 cases to around 1000 cases annually. Iraq routine immunization schedules recommend that the first dose of the measles vaccine be administered to children age ≥ 9 months. All infants vaccinated before their first birthday must receive another dose of the measles-containing vaccine at 15 months of age and at least one month after the first dose of the measles vaccine. Understanding the basic epidemiology of measles is a prerequisite for

effective control measures. Iraq routine immunization schedules recommend that the first dose of the measles vaccine be administered to children age ≥ 9 months. All infants vaccinated before their first birthday must receive another dose of the measles-containing vaccine at 15 months of age and at least one month after the first dose of measles vaccine. Understanding the basic epidemiology of measles is a prerequisite for effective control measures. It is recommended by WHO to collect adequate surveillance data on measles cases and outbreaks and analyze these data to allow further evaluation of vaccination coverage as well as the implementation of the appropriate preventive measures needed to control and prevent measles.

Measles is an acute, viral, infectious disease. References to measles can be found as early as the 7th century. The disease was described by the Persian physician Rhazes in the 10th century as “more to be dreaded than smallpox.” In 1846, Peter Panum described the incubation period of measles and lifelong immunity after recovery from the disease. John Enders and Thomas Chalmers Peebles isolated the virus in human and monkey kidney tissue culture in 1954. The first live, attenuated vaccine (Edmonston B strain) was licensed for use in the United States in 1963. In 1971, a combined measles, mumps, and rubella (MMR) vaccine was licensed for use in the United States. In 2005, a combination measles, mumps, rubella, and varicella (MMRV) vaccine was licensed. Before a vaccine was available, infection with the measles virus was nearly universal during childhood, and more than 90% of persons were immune due to past infection by age 15 years. Measles is still a common and often fatal disease in developing countries. The World Health Organization estimates there were 142,300 deaths from measles globally in 2018. In the United States, there have been recent outbreaks; the largest occurring in 2019 primarily among people who were not vaccinated. The measles virus is a paramyxovirus of the genus *Morbillivirus*. It is 120 to 250 nm in diameter, with a genome of single-stranded, negative sense RNA, and is closely related to the rinderpest and canine distemper viruses. Two membrane envelope proteins are important in pathogenesis. They are the F (fusion) protein, which is responsible for fusion of virus and host cell membranes, viral penetration, and hemolysis, and the H (hemagglutinin) protein, which is responsible for binding of virus to receptors on host cells. There is only one antigenic type of measles virus. Although studies have documented antigenic changes in the H protein, these changes do not appear to be epidemiologically important (i.e., no change in vaccine efficacy has been observed). The measles virus is rapidly inactivated by heat, sunlight, acidic pH, ether, and trypsin. Measles is a systemic infection. The primary site of infection is alveolar macrophages or dendritic cells. Two to three days after replication in the lung, measles virus spreads to regional lymphoid tissues, followed by a systemic infection. Following further viral replication in regional and distal reticulo-endothelial sites, a second viremia occurs 5 to 7 days after initial

infection.

During this phase, infected lymphocytes and dendritic cells migrate into the subepithelial cell layer and transmit measles to epithelial cells. Following amplification in the epithelia, the virus is released into the respiratory tract.

The incubation period of measles from exposure to prodrome averages 11 to 12 days. The time from exposure to rash onset averages 14 days, with a range of 7 to 21 days. The prodrome lasts 2 to 4 days, with a range of 1 to 7 days. It is characterized by fever, which increases in a stepwise fashion, often peaking as high as 103°F to 105°F, cough, coryza, and conjunctivitis. Koplik spots, present on mucous membranes, are considered unique to measles. They occur 1 to 2 days before the measles rash (i.e., during the prodromal period) and appear as punctate blue-white spots on the bright red background of the buccal mucosa. The measles rash is a maculopapular eruption that usually lasts 5 to 6 days. It begins at the hairline, and then involves the face and upper neck. During the next 3 days, the rash gradually proceeds downward and outward, reaching the hands and feet. The maculopapular lesions are generally individually distinct but may run together, particularly on the upper body.

Initially, lesions blanch (become white or pale) with fingertip pressure. By 3 to 4 days, most do not blanch with pressure. The lesions peel off in scales in more severely involved areas. The rash fades in the same order that it appears, from head to extremities. Other symptoms of measles include anorexia and generalized lymphadenopathy. Approximately 30% of measles cases in the United States from 1987 to 2000 were reported to have one or more complications. Complications include diarrhea, otitis media, pneumonia, encephalitis, subacute sclerosing panencephalitis, and death. Complications of measles were most common among children younger than 5 years and adults. The most widely used methods for laboratory confirmation of measles are detection of measles virus RNA in nasopharyngeal aspirates, throat swabs, or urine by reverse transcriptase polymerase chain reaction (RT-PCR) or detection of measles specific in serum samples by enzyme immunoassay (EIA).

Dai Qar as a part of Iraq, has adopted and implemented the measles Elimination strategies. So, the aim of the present study was to describe the demographic and epidemiological attributes of measles cases in Dai Qar governorate during the year 2024 in order to inform public health strategies to improve measles control and elimination in the country as well as Dai Qar governorate.

3. Methodology

An EPI study (a descriptive study) on measles cases was carried out in Dhi Qar governorate, which is one of Iraq's governorates, from October 20th, 2023, to April 25th, 2024. Prior to the data collection, official permission was granted from Iraq ministry of Health as well as the Health Directorate of Dhi Qar to facilitate the

data collection. Data were collected retrospectively by reviewing patients's files that were registered at the department of statistics in the health directorate of Dhi Qar during the year 2024. Non-probability sampling: a purposive sample of (1700) confirmed measles cases (clinically and laboratory) that were registered at the department of statistics in the health directorate of Dhi Qar during the year 2024, was selected for the purpose of the study. These data include demographic data, vaccination status, place and time of reporting the cases by month. The obtained data of the registered cases were entered into the computer and analyzed through the use of the statistical package social sciences (SPSS 11.5). The data analysis was performed through a descriptive statistical approach, such as (frequency and percentage).

4. Statistical Analysis

To compare the significance of the difference in the mean values of any two groups, an independent sample T-test was applied. χ^2 -test (chi square test) was used appropriately for group comparisons. All data were analyzed with SPSS software (Statistical Package for the Social Sciences, version 11.0 for windows XP; SPSS, Inc, Chicago, 111) $P < 0.05$ was considered statistically significant.

5. Results

The findings show that about half of measles cases were in the age group (1–5) year, which constitutes (50.35%) of total cases, followed by age groups (6–10) year and (<1) year, which represent (10.5%) and (5-14) year respectively, that the (259) confirmed measles cases 37 (14.2%) were under 1 People did not take the vaccine after the COVID-19 disease due to fear and intimidation from some charlatans. Fortunately, scientists began studying people's hesitation in studying cases earlier than the Corona virus was first discovered in Wuhan in December 2019, and they explored our models to find out. There are various differences in people's health behaviors. Among the most promising models, this one takes into account the following psychological

- 1)Trust: A person's confidence in the effectiveness and safety of vaccines, the health services they provide, and the policymakers who decide to roll them out
- 2)Conviction: Whether or not the person considers the disease itself to be very dangerous to his health
- 3)Calculation: The individual's participation in the comprehensive search for information that makes him weigh the risks and benefits of obtaining the vaccine

4)Restrictions (or convenience): How easily the person concerned can access the vaccine

5)Collective responsibility: the desire to protect others from infection, through personal vaccination.

As demonstrated in (table 1), male cases constitute (52.78%) and the remaining (47.21%) of cases are female, so male cases outnumbered female cases and this result is strongly supported by Desai and others, who stated in their study that male cases outnumbered female cases. The findings of (table 2) show that about half of measles cases were in the age group (1-5) year, which constitutes (50.35%) of total cases, followed by age groups (6-10) year and (<1) year, which represent (10.5%) and (5-14) year respectively. Of those (259) confirmed measles cases 37 (14.2%) were under 1 year of age, 16 (6.1%) were 11–15 years old, and only 22 (8.4%) were above 15 years of age (15).

According to the time of measles occurrence, the peak of the cases were in winter and early spring, with (37.2%) and (47.97%) reported in January and February, respectively (table 3). This result is strongly supported by the Pan American Health Organization, which stated that measles occurs worldwide in distinct seasonal patterns. In temperate climates, outbreaks generally occur in late winter and early spring. In tropical climates, transmission appears to increase after the rainy season. The city of Dhi Qar is divided into several areas, including: AL AHWAAR and AL DAWAYA and AL ESLAH and AL FAJER and AL NASR AL NASSERIA 1 and AL NASSERIA 2 and AL QARAF and AL RIFAIAND AL SHATRA and QLAT SKER and SAYED-DKHEL and SUQ-ALSHYOKH and GARMAT BANI SAED, and as showed in (table 4), altogether AL NASSERIA 1 and AL NASSERIA 2 formed more than half of measles cases occurred inside Dhi Qar city (51%). This indicates that cases of measles in urban areas were higher than in rural areas, which may suggest lower case detection in villages or higher urban measles cases as a result of overcrowding because measles is a highly contagious viral illness.

In (table5) the spread of the disease between a child and a student is very high compared to an employee and earners, which is spread by nasal contact, contact with the infection (through emergency attacks or sneezing), or inhalation of air breathed by a person with the viral infection. The outcome of disease was available for 1707 cases (99.1%) reported in 2024, two deaths were reported, respectively.

According	specifics	S.Measles	Confirm Measles	percentage
Gender	Female	586	29	52.78%
	Male	643	36	47.21%
Age	1-5 Y	700	141	50.35%
	6-10 Y	222	43	10.30%
	11-15 Y	76	16	6%
	More than 15 years	156	22	8.40%
Districts	AL NASSERIA 1	4	0	32%
	AL NASSERIA 2	534	1	48%
occupation	chid	1027	269	57%
	student	137	114	28%

Count of Patients Name	Column Labels				
Row Labels	Confirm Measles	S.Measles	Epi-link	Clinical	Grand Total
Female	29	586	0	191	806
Male	36	643	3	219	901
Grand	65	1229	3	410	1707
P value	0.17		0.032		

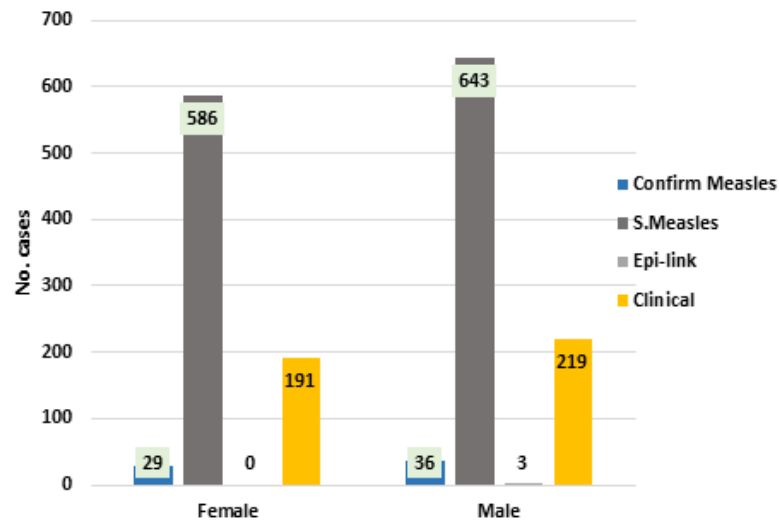


Table 1: Distribution of measles cases according to gender.

Count of Patients Name	Column Labels				
Row Labels	Confirm Measles	Epi-link	S.Measles	Clinical	Grand Total
less than 9 month	21	1	157	50	229
9-12 month	16	0	96	29	141
1-5 Y	141	14	700	215	1070
6-10 Y	43	5	222	64	334
11-15 Y	16	2	76	25	119
More than 15 years	22	1	156	53	232
Grand	259	23	1407	436	2125

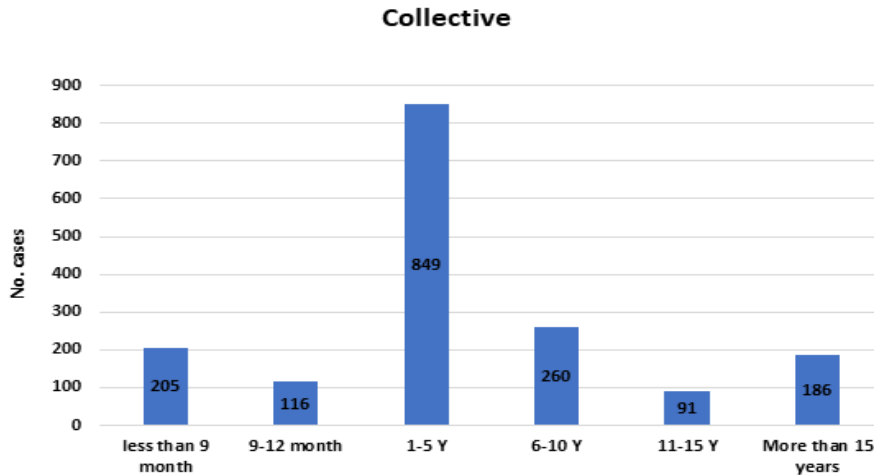


Table 2: Distribution of measles cases according to age group

Row Labels	Count of Patients Name
2024	1707
JAN	636
FEB	819
MAR	252

Distribution of Measle infection in Thi-Qare during 2024

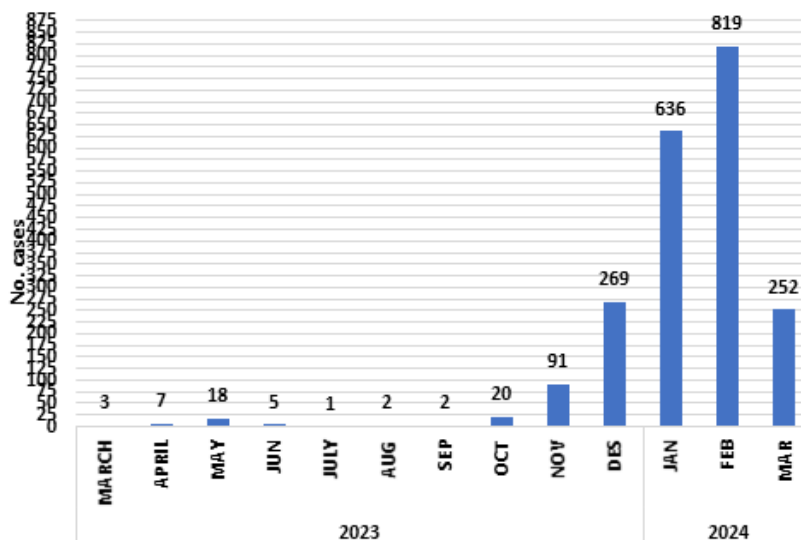


Table 3: Distribution of Measles Cases according to the months

Count of Patients Name	Column Labels				
Row Labels	Confirm Measles	Epi-link	S.Measles	Clinical	Grand Total
AL AHWAAR	9	2	21	117	149
AL DAWAYA	0	0	0	15	15
AL ESLAH	7	0	2	30	39
AL FAJER	7	0	9	19	35
AL NASR	2	0	1	31	34
AL NASSERIA 1	0	0	4	198	202
AL NASSERIA 2	1	0	534	0	535
AL QARAF	0	0	118	0	118
AL RIFAI	16	0	23	0	39
AL SHATRA	0	0	118	0	118
QLAT SKER	3	0	170	0	173
SAYED-DKHEL	0	0	125	0	125
SUQ-ALSHYOKH	10	0	87	0	97
GARMAT BANI SAED	10	1	17	0	28
Grand Total	65	3	1229	410	1707

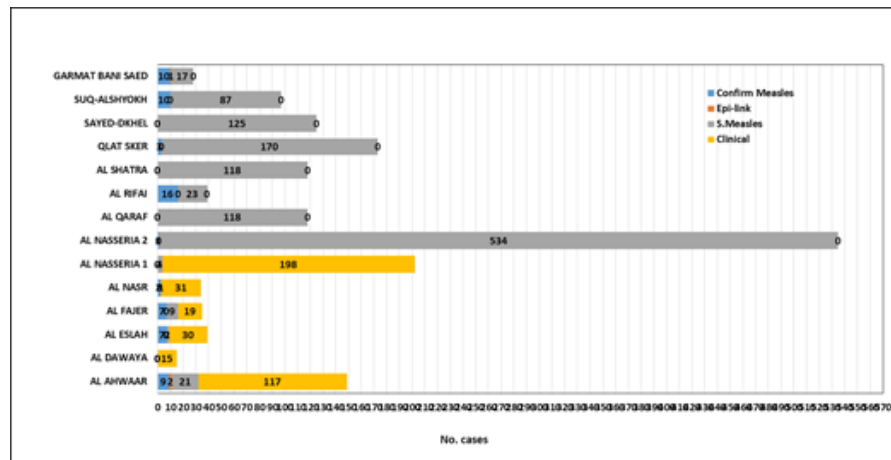


Table 4: Distribution of Measles Cases according to districts

name	number	S.Measles	Clinical
child	1296	1027	269
earner	63	32	31
house wife	96	36	60
employee	5	1	4
student	251	137	114
total	1711	1233	478

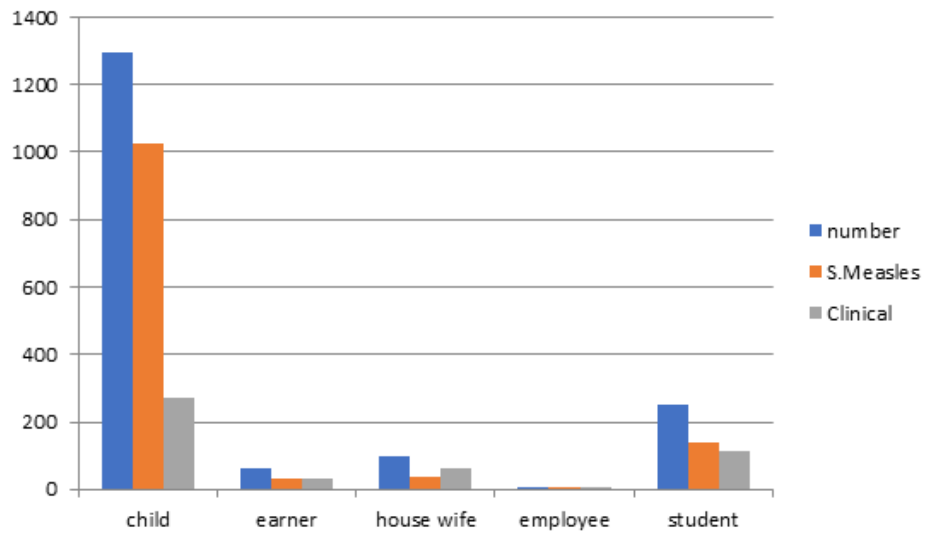


Table 5: Distribution of Measles Cases according to occupation

YEAR	2024
Row Labels	Count of Patients Name
addmitted	10
Recover	1697
Grand Total	1707

PT outcome	cases
death	2
Recover	1697

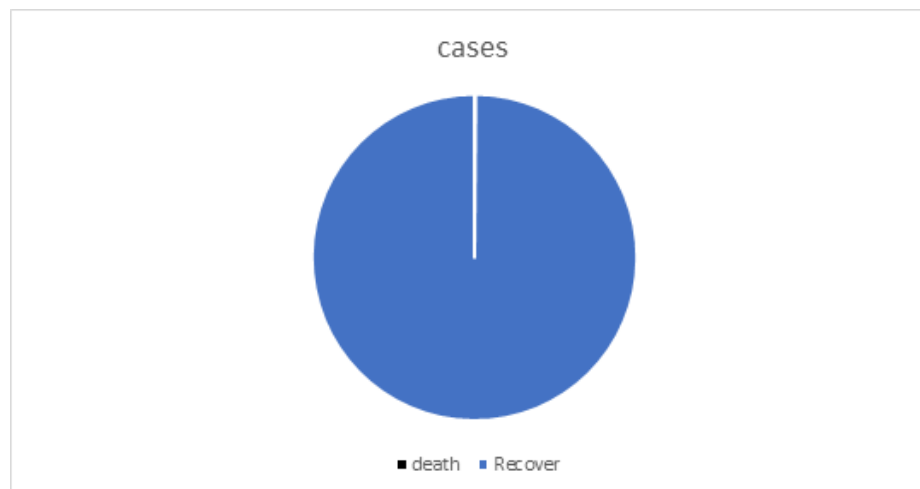


Table 6: Distribution of Measles Cases according to Outcome

6. Effects of vaccine refusal on public health

Postponing or ruling out vaccines affects public health. When fewer people are vaccinated, the proportion of the population that has immunity to the disease decreases. The disease then becomes more widespread, especially among people at high risk of contracting the disease.

7. Discussion

As demonstrated in (table 1), male cases constitute (52.78%) and the remaining (47.21%) of cases were female, so male cases outnumbered female cases, and this result is strongly supported by Desai and other (, who stated in their study that male cases outnumbered female cases. Conversely, according to Davidson's, women's cases are higher than men's. The findings of (table 2) show that about half of measles cases were in the age group (1-5) year, which constitutes (50.35%) of total cases, followed by age groups (6-10) year, (<1) year, which represent (10.5%) and (5-14%) respectively. Of (259) confirmed measles cases 37 (14.2%) were under 1 year of age, 16 (6.1%) were 11–15 years, while only 22 (8.4%) were above 15 years of age. Al-Kuwari and others cited that of (362) confirmed measles cases, 56 (17.1%) were under 1 year of age, 121 (33.4%) were 1–4 years, and only 61 (16.9%) were above 15 years of age. For interpretation of these differences, we support Fiebelkorn and others, who stated in their study that age groups most affected varied by year, depending on the setting of the outbreak.

In 2002, the majority of cases occurred in infants! 1 year of age, because of an outbreak in a child care center, compared with 2006, when a large office building was the epicenter of an outbreak and persons 20–39 years of age therefore comprised the majority of cases. Furthermore, these suggest that in Thi Qare governorate, the occurrence of measles has shifted to older age groups. According to the time of measles occurrence, the peak of the cases was in winter and early spring, with (37.2%) and (47.97%) reported in January and February, respectively (table 3). This result is strongly supported by the Pan American Health Organization, which stated that measles occurs worldwide in distinct seasonal patterns. In temperate climates, outbreaks generally occur in late winter and early spring. In tropical climates, transmission appears to increase after the rainy season.

The city of Thi Qare is divided into several areas, including: AL AHWAAR and AL DAWAYA and AL ESLAH and AL FAJER and AL NASR AL NASSERIA 1 and AL NASSERIA 2 and AL QARAF and AL RIFAI and AL SHATRA and QLAT SKER and SAYED-DKHEL and SUQ-ALSHYOKH and GARMAT BANI SAED, and as showed in (table 4), altogether AL NASSERIA 1 and AL NASSERIA 2 formed more than half of measles cases occurred inside Thi Qare city (51%). This indicates that cases of measles in urban areas were higher than in rural areas, which may suggest lower case detection in villages or higher urban measles cases as a result of overcrowding because measles is a highly con-

tagious viral illness.

In (table5) 5, the spread of the disease between a child and a student is very high compared to that between an employee and earners, which is spread by nasal contact, contact with the infection (through emergency attacks or sneezing), or inhalation of air breathed by a person with the viral infection. The outcome of the disease was available for 1707 cases (99.1%) reported in 2024, two deaths were reported, respectively. As for measles, which is similar to COVID-19, it is almost hope for the end of the “nightmare.” Regarding the COVID-19 vaccine, Najim A. Al awwadi and psychologist Alaa Hijazi says that in light of the Corona crisis, “there has become a dilemma of trust” for many of us. Therefore, this fear is understandable at this stage, as the vaccine “has become what saves us from terrorists, as humans do not usually need certainty, and the vaccine so far has limited knowledge - even if we are supporters of the vaccine, this does not negate our knowledge, for example, of the beneficial effects in 5 or 7 years. “It is difficult for a person to put pressure on all these circumstances due to the lack of inevitability in light of the current circumstances.” The reasons for the current fear of the vaccine varied, but perhaps the most prominent was the speed of arriving at a vaccine, which usually takes years. But the World Health Organization (WHO) attributes this to scientific development and the pumping of investments from different countries over the past year in order to reach it, which led to a reduction in the time period. As for side effects, Amjad Al-Kholy, an epidemiologist consultant at the World Health Organization, says that this fear is true to a certain degree, but a distinction must be made between simple and serious side effects. Al-Kholy added that so far, “side effects such as a rise in temperature or pain at the puncture site have been observed.” ... The third phase of clinical trials for vaccines is carried out on tens of thousands of people and is followed up for several months. Of course, several months are not enough to monitor all long-term side effects, but the indicators so far confirm that there are no severe long-term side effects.”

8. Conclusion and Recommendations

The present study shows that measles control in Iraq is still poor, as there is high number of cases every year and epidemics occur every 3-4 years, and these two facts are manifestations of poor coverage with the measles vaccine and especially the second dose; therefore, the researcher recommends:

1. A higher coverage rate of immunization with the first and the second dose of measles vaccine;
2. Considering the addition of a third dose of vaccination on entry to school, to compensate for the weak and perhaps waning immunity conferred by the first dose and to achieve a real two-dose vaccine program;
3. Repeated measles immunization campaigns should target large population and including groups 1-15 years to increase the coverage rate to more than 90%.

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