

# Seroprevalence of Measles, Mumps, and Rubella Antibodies in Libyan Children at School Entry: Evaluation of MMR Immunization Program

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## ABSTRACT

Measles, Mumps, and rubella (MMR) are serious diseases that can lead potentially to disability and death.

The study aimed to determine seroprevalence rates of antibody levels against MMR among Libyan children at school entry.

This was a cross sectional study undertaken in Tripoli, from August to September 2016. Children of school-entry age (> 5 to ≤ 7 years) were randomly recruited at vaccination centers. Sera were tested for antibodies against MMR. Data analyzed by SPSS program version 20.

Out of 546 children, 290 were males. IgG antibodies against measles, mumps, and rubella were positive in 513 (94%), 436 (80%), 538 (98.5%) children, respectively.

Seropositivity rates in Libyan children at school entry is protective and this is similar in so many other studies. This indicates that MMR vaccine program is effective in strengthening herd immunity in the Libyan community.

**Key words-** Measles; Mumps; Rubella; Antibodies; Prevalence; Immunization program; Libya.

## INTRODUCTION

Measles is one of the most infectious human diseases and highly contagious vaccine-preventable can cause serious illness, life-long complications and death.

Prior to the availability of measles vaccine, measles infected over 90% of children before they reached 15 years of age. These infections were estimated to cause more than two million.<sup>1</sup> Measles is a significant public health threat, not only for developing countries, but also for developed ones.<sup>2</sup>

The Measles Initiative developed a joint strategic plan to reduce measles-related deaths by strengthening routine immunization, supplementary immunization activities (SIAs) in the form of mass vaccination campaigns, reinforced surveillance, and adequate case management.<sup>3</sup>

Accelerated immunization activities have had a major impact on reducing measles deaths. During 2000- 2017, measles vaccination prevented an estimated 21.1 million deaths. Global measles deaths have decreased by 80% from an estimated 545 000 in 2000 to 110 000 in 2017.<sup>4</sup>

Mumps is a viral infection of humans, mostly a mild childhood disease, with peak incidence occurring among those aged 5-9 years, the mumps virus may also affect adults, in whom complications such as meningitis and orchitis are relatively more common. Safe and effective

vaccines against mumps have been available since the 1960s. The vaccine is most often incorporated into national immunization programmes in a combined measles-mumps-rubella (MMR) vaccine.<sup>5</sup>

Rubella is an acute, usually mild viral disease traditionally affecting susceptible children and young adults worldwide. Rubella infection just before conception and in early pregnancy may result in miscarriage, foetal death or congenital defects known as congenital rubella syndrome (CRS). The highest risk of CRS is found in countries with high rates of susceptibility to rubella among women of childbearing age. Large-scale rubella vaccination during the last decade has drastically reduced or practically eliminated rubella and CRS in many developed and in some developing countries.<sup>6</sup>

Measles-mumps-rubella (MMR) vaccine protects against three diseases: measles, mumps, and rubella. Centre for Disease Control and Prevention (CDC) recommends that children get two doses of MMR vaccine, starting with the first dose at 12 through 15 months of age, and the second dose at 4 through 6 years of age.<sup>7</sup>

The current Libyan national vaccination program includes two separate doses of MMR vaccine at 12 and 18 months of age.<sup>8</sup> Antibodies induced by MMR vaccine wane over time and this happens especially when the incidence of



measles, mumps, and rubella become very low and natural diseases do not boost the once-gained antibody levels.<sup>9</sup>

Measles-mumps-rubella (MMR) vaccine protects against three infectious diseases, its effectiveness to induce protective antibodies is unknown in Libyan children, hence the present study conducted to determine seroprevalence of antibodies against MMR among Libyan children at school entry, from August to September 2016, in Tripoli.

## MATERIALS AND METHODS

The study was a health facility-based cross-sectional type. Children at school entry (> 5 to ≤ 7 years) were recruited randomly from seven vaccination centres (Abu shosha, Arada, Aleanetaq, Alhamedya, Aljehad, Algargny and Altoshani) in Tripoli. A total of 546 children were surveyed. Study participants were enrolled from August to September 2016.

Data collected by interviewing, using a questionnaire consists of Demographic and clinical data, including age, sex, education of father and mother, occupation of father and mother, address, prior measles, mumps and rubella vaccination, anti-measles IgG antibody level, anti-mumps IgG antibody titer, and anti-rubella IgG antibody level at the time of enrolment.

### Antibody assay

Blood samples were collected by trained paediatricians and experienced nurses. Serum samples were tested for immunoglobulin (Ig) G antibodies by enzyme linked immunosorbent assay (ELISA) using Nova Lisa manufactured by Nova Tec Immundiagnostica GmbH. Regarding measles, the following cut off values were used: positive > 220 mIU/mL, equivocal 120-220 mIU/mL, and negative <120 mIU/mL. For mumps, the Nova Tec Units (NTU) was used. Cut off values were as follows: positive > 11 NTU, equivocal 9-11 NTU, and negative <9 NTU and for rubella, the following values were used: positive > 15 IU/ml, equivocal 10-15 IU/ml, and negative <10 IU/ml.

The collected data were sorted, coded, and analyzed using the statistical package for social sciences (SPSS version 20).

Continuous variables were summarized using descriptive statistics in terms of means ± standard deviations and 95% confidence intervals (95% CI).

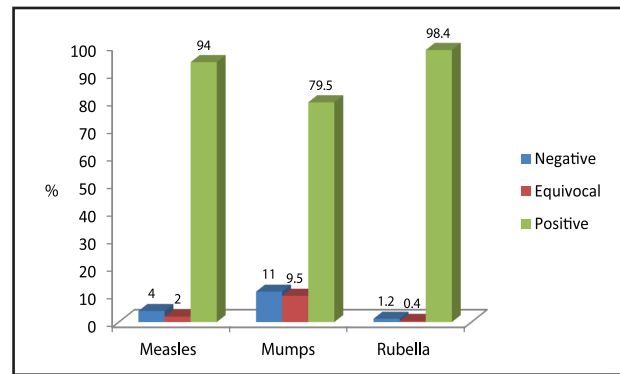
Chi-square test was used to evaluate significant difference between groups for categorized variables. A *P* value <0.05 was considered statistically significant.

The study was conducted with the approval of the Libyan Ethical Committee Board. Informed consent was obtained from guardians of children after full explanation of the research purpose. Privacy, confidentiality, and rights of participants were ensured during and after the study.

## RESULTS

Overall, 546 children 288(52.7%) were male subjects, were enrolled with mean age  $6.53 \pm 0.29$  years and all had received 2 doses of MMR.

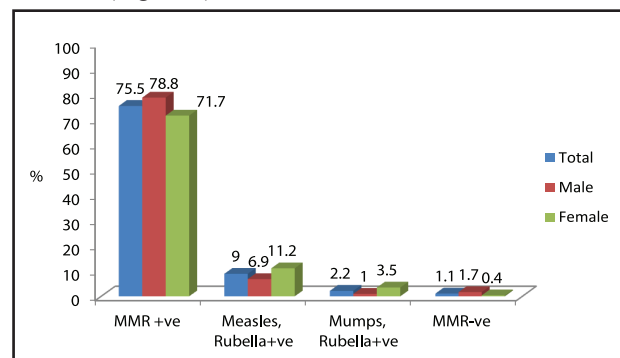
IgG antibodies against measles, mumps, and rubella were positive in 513 (94%), 434(79.5%), 537(98.4%) children, respectively (Figure 1).



**Figure 1:** Distribution of MMR IgG antibodies titer.

Overall the highest level of seronegativity was seen with regard to mumps specific antibodies (11%; 95% CI 14.4-16.3) and also the prevalence of children with equivocal titre level was higher for mumps antibodies than for measles and rubella antibodies.

The prevalence of IgG antibodies to MMR in children was 75.5%, prevalence of antibodies to measles and rubella in the absence of mumps specific antibodies was 9%. Seronegativity was higher in male than in female children (Figure 2).



**Figure 2:** Seroprevalence of MMR IgG titer in Libyan children by gender, 2016.

## DISCUSSION

MMR vaccine is very effective at protecting people against measles, mumps, and rubella, and preventing the complications caused by these diseases. Two doses of MMR vaccine are 97% effective against measles and 88% effective against mumps. One dose of MMR vaccine is 93% effective against measles, 78% effective against mumps, and 97% effective against rubella.<sup>10</sup>

The differences among studies might be explained by the difference in the national vaccination program and also the prevalence of natural infection in each community.<sup>11</sup> Low titers are not necessarily indicating lack of immunity. Since immunity for measles, mumps and rubella is cell-mediated, seronegativity is not the equivalent of susceptibility.<sup>12</sup>

However, waning antibody does not necessarily mean that protection from measles also has waned, because cellular immunity persists, resulting in a vigorous secondary



antibody response upon exposure to measles virus.<sup>13</sup> A study showed that cellular immunity to mumps persists at least 21 years after the first MMR vaccination.<sup>14</sup>

In current study, the seroprevalence of measles antibodies in school entry children was 94%, which correlates with finish study which showed in 3-year-old children vaccinated once with MMR vaccine was 99%.<sup>15</sup> On the other hand another study showed, the seroprotective rates for those aged 1-7 years was 76%, which were lower than present study.<sup>16</sup>

It is important to note that while serology can be used as an evidence of immunity in regard to vaccination guidelines, it cannot necessarily be correlated with protective immunity.<sup>17</sup> A rise in the proportion of persons with low antibody levels suggests an increase in potential susceptibility, but low titres are unlikely to represent the same risk of illness or viral transmission as absent antibodies.<sup>18</sup>

Regarding equivocal individuals, amesles seroepidemiology study conducted in seven Western European countries, found that the proportion of this equivocal group was highest in the vaccinated age-groups, which is probably explained by lower antibody titre after vaccination (or more rapid antibody loss) than after natural infection.<sup>19</sup> The proportion of equivocal cases of measles among those aged 1-7 years was 6.5%.<sup>16</sup> The proportion of susceptible in each age group must not exceed 15% in children aged 1-4 years, 10% in 5-9 years old. These levels are those felt to be sufficient to interrupt measles transmission.<sup>20</sup> Regarding mumps, although the mumps virus component of most MMR vaccines has been shown to be a fairly good immunogen, one that usually leads to seroconversion rates of >90%<sup>14</sup>, but the seroconversion rate for mumps vaccination is lower than the seroconversion rate for measles vaccination<sup>14</sup>, as shown in our present study, 79.5% of the studied children showed IgG antibodies against mumps, and this in accordance with finish study with Seroprevalence in 3-year-old children vaccinated once with MMR vaccine was 84% for mumps.<sup>15</sup>

Concerning rubella, the results showed the seroprevalence rate was 98.4%, which is similar to Kontio et al study.<sup>15</sup>

We conclude that seropositivity rates in Libyan children at school entry showed a high protective rate similar to many published studies. This indicates that Libyan MMR vaccine program is effective in strengthening herd immunity in the Libyan community. But there is still a need to evaluate seropositivity after longer periods to assure persistence of antibody titers in teenagers and young adults.

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