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Original Article

Measles Seroprevalence and Related Factors in Women Aged 15-49 Years Old, in Mersin, Turkey

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Abstract

Background: If the mother is immune to measles, the infant is protected against measles infection after birth with maternal immunity. Therefore, the mother's immunity to measles is the most important factor in protecting the baby from measles in the first year. This study aimed to investigate measles seroprevalence and related factors in women between Oct 2019 and Jun 2021.

Methods: The cross-sectional study was conducted on women aged 15-49 yr in Mersin city. Overall, 400 people were included in the study. NovaLisa Measles IgG ELISA (NovaTec Immunodiagnostica GmbH®) kit was used to measure measles IgG antibodies in serological analyses. The research was conducted between Oct 2019 and Jun 2021. In the analysis of the data; descriptive statistics, chi-square analysis, and binary logistic regression analysis were used. The statistical significance level was accepted as $P \leq 0.05$.

Results: Measles seropositivity was detected in 103 (25.7%) of the women. This rate was found 5.5% in the 15-19 yr age group, 20.0% in the 20-24 yr age group, 14.5% in the 25-29 yr age group, 23.0% in the 30-34 yr age group, 42.3% in the 35-39 yr age group, 42.3% in the 40-44 yr age group and 37.5% in the 45-49 yr age group. In the logistic regression analysis, the rate of seropositivity was compared to those in the 15-19 yr age group; it was found to be 4.33 times ($P=0.03$) at the age of 20-24 yr, 12.71 times ($P<0.001$) at the age of 40-44 yr, and 10.40 times ($P<0.001$) at the age of 45-49.

Conclusion: Three out of every four babies born in our region are not adequately protected against measles.

Keywords: Women; Measles; Seroepidemiological study; Enzyme-linked immunosorbent assay; Immunity

Introduction

Measles seropositivity is a humoral immune response that develops in those had a measles infection or have been vaccinated against measles. While this immune response against measles protects individuals from measles infection, it can also protect newborns and infants from measles infection through maternal immunity (1, 2). A statistically significant positive correlation was found between measles antibody levels in mothers and newborns (3). The higher the measles antibody level in the mother is, the longer the newborn and infants will be protected against measles by maternal immunity. Measles seroprevalence varies between

77.1% and 88.6% abroad (4-8), and 80.0%-99.2% in Turkey (3, 9-14).

According to the data announced by the WHO European Office, the incidence of measles in all age groups in the European Region in 2019 was 112.1 per million while it was reported to be 1060 per million under the age of one (15). In the first six months of 2020, 35% of the cases reported in the European Region were under the age of one (16). According to the WHO data, the incidence of measles in our country in 2019 was 34.6 per million in all age groups (15), and the highest incidence of measles in 2018-2019 and 2019-2020, respectively, was 754.9 and 188.3 per million under the age of one (17).

According to the data obtained both from abroad and from our country, the incidence of measles under the age of one is higher than in other age groups. Postnatal infants are not adequately protected against measles by maternal immunity, and therefore measles seropositivity is insufficient in women of reproductive age.

This study aimed to investigate measles seroprevalence and related factors in women between the ages of 15-49 yr living in Mersin city center to make an indirect evaluation of measles maternal immunity.

Methods

The population of the research consists of women aged 15-49 yr living in the central districts of Mersin. According to 2018 data, there are 270,634 women between the ages of 15-49 yr in the study population (18). In calculating the minimum sample size, when the measles seroprevalence was 85%, the population was 270,634, the margin of error was ±5, the pattern effect was 2.0, and the confidence interval was 95%, the minimum sample size was calculated as 392 and it was aimed to include 400 people in the study group.

Necessary Ethics Committee permission (The number of the Mersin University Clinical Research Ethics Committee is 2020/48) and official permissions were obtained. The research was conducted between Oct 2019 and Jun 2021.

The researchers created a questionnaire with 29 questions by reviewing the related literature. The form included questions about women's sociodemographic characteristics and measles immunity. In the section on measles; the history of having a childhood vaccination card, having school vaccinations, being vaccinated against measles, having a history of rash, having measles, and contacting a measles patient was questioned.

A multistage stratified sampling method was used to determine the women to be included in the study. Women in the 15-49 age group were stratified by district and age groups.

Consent was obtained from those who agreed to participate in the study, as well as from the parents of the participants under the age of 18, as well as their own. Following the filling of the data form, 8 ml of venous blood samples taken from the women were kept at room temperature for 15 min and then centrifuged at 4000 rpm/10 min in an Elektromag M-815P centrifuge device. 1.5ml serum samples were separated from venous blood. The serums taken from the participants were kept at +4 °C until they were transported to the laboratory environment on the same day. Eppendorf tubes were transported to Mersin University Advanced Technology Education Research and Application Center under cold chain conditions at the end of the day. The serums were stored in a deep freezer at -80 °C in this center until IgG analysis. NovaLisa Measles IgG Enzyme-Linked Immuno Sorbent Assay (ELISA) kit (NovaTec Immunodiagnostica GmbH) was used for the analysis of measles IgG antibodies. Analysis results were evaluated as '>11 NTU' Seropositive (Sufficient Immunity), '9-11 NTU' Grizone (Indeterminate immunity), and '<9 NTU' Seronegative according to the negative and positive control serum included in the kit. The sensitivity and specificity of this test kit are over 95%.

The dependent variable of the study was determined as 'Sufficient measles immunity (Seropositive)'. Independent variables were determined as sociodemographic and personal characteristics of women.

Descriptive statistics such as frequency, mean and median were used to summarize the data. The Kolmogorov-Smirnov test was used to determine whether the continuous variables fit the normal distribution. Chi-square analyzes were used to compare categorical variables, and the z-test was used to determine the variables that made the difference in tables larger than 2x2. T-test and Mann-Whitney U significance tests were used to compare continuous variables. Independent variables with statistically significant differences in univariate analyzes were included in the model in Binary Logistic Regression. Risk factors associated with measles immunity in the model were determined using the Forward: LR method. The statistical significance level was accepted as $P \leq 0.05$.

Results

Out of 400 women with a mean age of 31.9±9.9 yr, 259 (64.8%) were married, 102 (25.5%) had a bachelor's degree or higher, and 183 (45.8%) mothers were primary school graduates. Other personal and obstetric characteristics of women are shown in Tables 1,2.

After the ELISA analysis, 103 (25.7%) of the women were seropositive (sufficient immunity) against measles and 297 (74.3%) were in the grizon (indeterminate immunity) group. No measles seronegativity was found among the participants in our study (Table 3).

In another single analyses, there was a statistically significant relationship between the women's age group, marital status, education level, number of pregnancies, number of living children, previous measles disease, time of measles disease, contact with a measles patient and measles seropositivity ($P<0.05$, Tables 4, 5). Variables associated with measles seropositivity in single analyzes were analyzed in the Binary Logistic Regression Model. In the model, there was a statistically significant relationship only between measles seropositivity and age group (Table 6).

Table 1: Sociodemographic characteristics of women

Variables	*N*	*%*
Age groups(yr)		
15-19	55	13.8
20-24	60	15.0
25-29	55	13.8
30-34	61	15.2
35-39	61	15.2
40-44	52	13.0
45-49	56	14.0
Woman's educational level		
Illiterate or literate	27	6.7
Primary school graduate	82	20.5
Secondary school graduate	89	22.3
High school graduate	100	25.0
Graduated from a university	102	25.5
Woman's mother's educational level		
Illiterate or literate	131	32.7
Primary school graduate	183	45.8
Secondary school graduate	45	11.3
High school graduate and above	41	10.2
Women's marital status		
Married	259	64.8
Single	114	28.5
Divorced or widow	27	6.7
Total	400	100.0

Table 2: Distribution of personal and obstetric characteristics of women

Variables	*N*	*%*
Total number of pregnancies of women		
0	131	32.7
1	56	14.0
2	85	21.3
3	55	13.7
4 and above	73	18.3
Total number of living children of women		
0	156	39.0
1	69	17.3
2	97	24.2
3	50	12.5
4 and above	28	7.0
Women's pregnancy status		
Yes	48	12.0
No	352	88.0
Number of people living in their homes (including themselves)		
1-2	62	15.5
3-4	217	54.3
5-6	93	23.2
7 and above	28	7.0
Presence of any chronic disease		
Yes	101	25.3
No	299	74.7
Total	400	100.0

Table 3: Women's medical history of measles

Variables	*N*	*%*
Available childhood vaccination card		
Yes	67	16.8
No	333	83.2
Status of women having school vaccinations		
Yes	376	94.0
No	24	6.0
Having at least one measles vaccination in their lifetime		
Yes	2	0.5
Not remember	398	99.5
History of measles disease		
Yes	112	28.0
No	152	38.0
Not remember	136	34.0
Total	400	100.0
Time to get measles		
0-15 years ago	13	11.6
16-30 years ago	63	56.3
31 years ago and more	36	32.1
Total	112	100.0
Contact status with a measles patient		
Yes	61	15.2
No	293	73.3
Not remember	46	11.5
Total	400	100.0

Contact time with measles patient		
0-10 years ago	26	42.6
11-20 years ago	22	36.1
21-30 years ago	9	14.7
31-40 years ago	4	6.6
Total	61	100.0
Whom is the measles patient contacted?		
My children	39	63.9
My sister/ brother	18	29.5
Other	4	6.6
Total	61	100.0
Measles Seroprevalence		
Seropositive (adequate immunity)	103	25.7
Grizone (indeterminate immunity)	297	74.3
Seronegative	0	0.0
Total	400	100.0

Table 4: Distribution of women's measles immunity by sociodemographic characteristics

	Measles Seroprevalence				***Total***		***P***
	Seropozitive		Grizone				
Variables	n	%*	n	%*	n	%**	
Age groups(yr)							
15-19	3	5.5	52	94.5	55	13.8	<0.001[2]
20-24	12	20.0	48	80.0	60	15.0	
25-29	8	14.5	47	85.5	55	13.8	
30-34	14	23.0	47	77.0	61	15.2	
35-39	23	37.7	38	62.3	61	15.2	
40-44	22	42.3	30	57.7	52	13.0	
45-49	21	37.5	35	62.5	56	14.0	
Woman's mother's educational level							
İlliterate or literate	42	32.1	89	67.9	131	32.7	0.253
primary school graduate	42	23.0	141	77.0	183	45.8	
secondary school grad.	10	22.2	35	77.8	45	11.3	
high school grad. and above	9	22.0	32	78.0	41	10.2	
Marital status							
Married	80	30.9	179	69.1	259	64.8	0.005[1]
Single	17	14.9	97	85.1	114	28.5	
Divorced or widow	6	22.2	21	77.8	27	6.7	
Woman's educational level							
İlliterate or literate	7	25.9	20	74.1	27	6.7	0.012[1]
primary school graduate	30	36.6	52	63.4	82	20.5	
secondary school grad.	12	13.5	77	86.5	89	22.3	
high school grad.	24	24.0	76	76.0	100	25.0	
bachelor's degree and over	30	29.4	72	70.6	102	25.5	
Total	103	25.7	297	74.3	400	100.0	

*Row percentage, **Column percentage,[1] Pearson chi-square, [2] Linear by linear association

Table 5: Distribution of measles immunity status according to some characteristics of women

	Measles Seroprevalance				***Total***		***P***
	Seropozitive		Grizone				
Variables	n	%*	n	%*	n	%**	
Women's pregnancy status							
Yes	11	22.9	37	77.1	48	12.0	0.632
No	92	26.1	260	73.9	352	88.0	
Total number of pregnancies of women							
0	22	16.8	109	83.2	131	32.7	0.001[1]
1	13	23.2	43	76.8	56	14.0	
2	23	27.1	62	72.9	85	21.3	
3	21	38.2	34	61.8	55	13.7	
4 and above	24	32.9	49	67.1	73	18.3	
Total number of living children of women							
0	25	16.0	131	84.0	156	39.0	0.001[1]
1	21	30.4	48	69.6	69	17.3	
2	31	32.0	66	68.0	97	24.2	
3	15	30.0	35	70.0	50	12.5	
4 and above	11	39.3	17	60.7	28	7.0	
Possession of a childhood vaccination card							
Yes	13	19.4	54	80.6	67	16.8	0.193
No	90	27.0	243	73.0	333	83.2	
Status of women having school vaccinations							
Yes	96	25.5	280	74.5	376	94.0	0.693
No	7	29.2	17	70.8	24	6.0	
History of measles disease							
Yes	40	35.7	72	64.3	112	28.0	0.015[1]
Not remember	32	23.5	104	76.5	136	34.0	
No	31	20.4	121	79.6	152	38.0	
Contact status with a measles patient							
Yes	21	34.4	40	65.6	61	15.2	0.021[1]
Not remember	5	10.9	41	89.1	46	11.5	
No	77	26.3	216	73.7	293	73.3	
Total	103	25.7	297	74.3	400	100.0	
Time to get measles							
0-15 years ago	2	15.4	11	84.6	13	11.6	
16-30 years ago	19	30.2	44	69.8	63	56.3	0.006[2]
31 years ago and more	19	52.8	17	47.2	36	32.1	
Total	40	35.7	72	64.3	112	100.0	

*Row percentage, **Column percentage,[1] Pearson chi-square, [2] Linear by linear association

Table 6: Risk factors affecting measles immunity in a logistic regression model

Variables	***OR***	***Measles Immunity P***	***%95 CI***
Age groups(yr)			
15-19 *(ref)*	1.00		
20-24	4.33	0.03	1.15-16.30
25-29	2.95	0.13	0.74-11.78
30-34	5.16	0.01	1.40-19.09
35-39	10.49	<0.001	2.94-37.50
40-44	12.71	<0.001	3.51-46.05
45-49	10.40	<0.001	2.88-37.53

Discussion

In our study, measles seropositivity was detected in 25.7% of women aged from 15-49 yr. In studies conducted with women of similar age groups regarding measles seropositivity, seropositivity rates were as 81.4% in Japan (19), 67.7% in China (20), 77.1% in Vietnam (8), 66.3% in the Republic of South Africa (21) and 80.7% in Iran (22). In a meta-analysis performed on 20,546 pregnant women worldwide, measles seropositivity was found to be 89.3% (95% CI: 87.3-91.1%), and this rate decreased over time despite statistically insignificant (P=0.54) (23). In Turkey, measles seropositivity was found to be between 80% and 97.2% (3,9,10,12). Compared to the studies in the literature, measles seropositivity is very low in women of reproductive age in our study area. This low level of seropositivity can be explained by several reasons. First, the women participating in the study may not have been adequately vaccinated against measles. When this was questioned, only two people remembered that they had been vaccinated against measles. This information may explain our hypothesis of insufficient measles vaccination, but such low measles vaccination is not expected in our region. Therefore, the study cannot support our results. A second reason is that in our region, measles vaccines were also administered according to age groups within the childhood and school vaccination periods, but antibody titers may have decreased over time. This may cause the majority of women to remain immune to measles in the grizon zone.

In our study, measles seropositivity was only statistically correlated with age, and seropositivity increased with age. There was no statistically significant relationship between the measured measles antibody concentrations and the age of the women (P>0.05) (24). The lowest measles seropositivity is 89.7% in women aged 19-29 yr (25). Measles antibody positivity in women was found to be 1.6 times higher in women aged 32 yr and over than those aged 26 yr and under (P=0.015) (3). Single-dose measles vaccination in Turkey started in 1970 and was increased to two doses in 1998. In our country, the measles vaccine was started to be administered in combination with rubella and mumps as MMR in 2006 (26-28). When our study results are compared with the studies in the literature, they are similar to the results of the studies above except for the study of Honarvar et al. (24). Accordingly, the measles seropositivity increases as the age of women increases. Even though all of the women participating in our study were born after 1970 and the rate of measles vaccine coverage increased in the 2000s, the low seropositivity in young women is considered an unexpected result (29,30). This can be explained by the fact that older women live when measles is more intense, get sick with the wild-type virus and encounter it from time to time, and each contact has a booster effect on measles immunity. On the other hand, the younger ones become immune by vaccination without encountering the virus during the period of increased herd immunity, and then do not come into contact with the wild measles agent, which provides a booster effect, and thus may cause a lower measles seropositivity.

In our study, women declared that measles in single analysis had higher measles seropositivity compared to those who said they did not have measles or did not remember, but this difference was not detected in further analyzes. In a case-control study (31), mothers who had measles vaccination without measles history had statistically significantly lower measles antibody titer than women with measles history (P<0.05). In Turkey (3), measles seropositivity was 2.1 times higher in women who declared that they had measles disease compared to those who had measles vaccine (P=0.001). Our study result (according to a single analysis) shows that similar to many studies in the literature, having measles increases measles sero-

positivity in women of reproductive age. This difference may be because the natural transmission of measles creates a stronger immunity.

In our study, measles seropositivity increased as the number of pregnancies increased in single analyses, but this difference was not detected in further analyzes. Women who had two pregnancies had a 1.64 times higher measles seropositivity than those who had one pregnancy (P=0.016) (6). Measles seronegativity was unrelated to the number of births in women (P>0.05) (32). Measles seropositivity was found 2.6 times higher in women with four or more births than in women with one pregnancy (P=0.001) (3). In our study, similar to those studies above, except for the Bodilis et al. (32) studies, the rate of seropositivity increased as the number of pregnancies increased in single analyses. This situation is not directly related to pregnancy and suggests that measles seropositivity is affected by age as a confounding factor, as the number of pregnancies will increase as age increases. Indeed, the number of pregnancies was not found to be an effective variable in further analysis shows that there is no direct relationship between the number of pregnancies and seropositivity.

Due to the content of the permission obtained from the Ministry of Health, the registered population information of the family physicians could not be accessed. For this reason, the women to be included in the study group were not selected from the list of women aged 15-49 yr registered with family physicians, as planned, by systematic sampling method. Since the working time coincided with the COVID-19 pandemic, random household selection could not be made by going out to the neighborhood. The women to be included in the study were selected from the women aged 15-49 yr who applied to the Family Health Center for any reason. We also wanted to evaluate the correlation of low antibody levels with the incidence of disease in the population, but we could not obtain this data from health institutions. The number of studies conducted with the antibody kit we used in our study is limited. For this reason, comparisons were made with studies using different types of antibody kits. It is recommended to consider these limitations when evaluating the study results.

Conclusion

Measles seropositivity was found only in one out of every four women in our study. Measles seropositivity increases with increasing age in women of reproductive age. Because the measles immunity in the 15-19 age group is lower than in other ages, girls be vaccinated against Measles or MMR with a dose of Td vaccine at the 156th month. If a woman has been assessed or determined to have a baby without adequate measles immunity, it is recommended that her baby be given an additional dose of measles vaccine before the time specified in the Extended Immunization Program (preferably between 6 and 9 months).

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

Non-declared.

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