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Original Research

Measles Seroprevalence and Associated Factors among Adult Individuals in the City Center of Şanlıurfa Province

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Abstract

Objectives: The aim is to determine measles seroprevalence in adult individuals in Şanlıurfa city center and to evaluate related factors.
Methods: The research is of a cross-sectional type. The research was carried out in Şanlıurfa city center between March 2023 and April 2023. The population of the study consisted of individuals over the age of 18 who applied to the Family Health Centers (FHC) in the city center of Şanlıurfa. A 30-cluster sampling method was used to determine the FHCs where the study would be conducted. In this study, the number of people to be included in each cluster was determined as 7, and the total sample size was 210. Thirty FHCs were randomly selected from a total of 80 ASMs in 3 central districts in Şanlıurfa, proportional to the number of units. Blood was drawn from the participants by the researcher. The blood samples were then sent by a private hospital to a private laboratory for testing.
Results: A total of 210 adults were included in the study. Fifty-one percent of the participants were women. The measles seropositivity rate of the adults participating in the study was 87.6%, and the measles seronegativity rate was 8.6%. When the participants were examined according to age groups, it was found that the measles seropositivity level was lowest in the 18-21 age group, at 52.63%. In the created logistic regression model, measles seropositivity status in adults: being 33 years or younger reduces it 10 times.
Conclusion: This study showed that measles seropositivity in the adult population in Şanlıurfa city center was 87.6%. This suggests the need to reconsider the administration of an extra-dose measles vaccine using the catch-up vaccination method for individuals aged 18-21 and then 22-25, the most susceptible age group in this study.
Keywords: Adult, immunization, measles, seroprevalence, vaccination

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Measles is a highly contagious acute infection caused by the Rubeola virus, often observed during childhood. The disease is characterized by fever and maculopapular rash. The virus has no reservoir outside of humans, and its only natural host is humans.[1]

Measles is the most contagious among diseases that can be prevented through vaccination. It is transmitted through the respiratory route, and patients are considered contagious from four days before the onset of the rash to four days after it. One patient can infect 16-18 people. Although it is generally

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known as a childhood disease with a benign course, serious complications and deaths are more commonly seen among children under 5 years old and adults over 20 years old.[2]

Before the introduction of the measles vaccine in 1963, measles epidemics occurred every 2-3 years, resulting in over 30 million measles cases and more than two million deaths annually. Immunization efforts significantly reduced measles-related deaths and prevented an estimated 23.2 million deaths between 2000 and 2018.[3] It is believed that the elimination of measles can be achieved by reaching and maintaining a vaccination coverage of 95% in the population.[4]

Following the elimination of measles in America in 2002, the World Health Organization (WHO) aimed to eliminate measles in five WHO regions by 2020 and achieve its subsequent eradication as part of the Global Vaccine Action Plan.[5] However, measles has re-emerged in many European countries. In Europe, the annual regional measles incidence decreased from 30.1 in 2010-2015 (28,021 cases) to 5.8 in 2016 (5,263 cases), but increased approximately fourteen-fold to 89.5 in 2018 (82,596 cases). Adults over 20 years old constituted 37% of cases.[6]

A measles elimination program has been implemented in Türkiye since 2002.[7] Despite ongoing efforts, there was a measles outbreak in İstanbul in 2011 with 111 cases, and an outbreak affected more than 7,000 individuals nationwide in the winter season of 2012-2013.[8] The number of cases dropped to 9 in 2016 due to intensive vaccination and control efforts but increased to 716 in 2018 and 2,890 in 2019.[9]

Population-based seroprevalence studies are particularly necessary after an outbreak in order to determine and explain seropositivity in the community, assess the effectiveness of existing vaccination programs, and identify the cause of outbreaks. This can enable healthcare professionals and policymakers to identify susceptible populations, implement vaccination, and apply specific preventive strategies.[10]

Even though some studies carried out on different age groups and locations in Türkiye have reported measles-specific IgG positivity ranging between 79% and 91%, population-based studies on measles seroprevalence in the past decade have been inadequate.[11]

The objectives of this study are as follows:

1. To determine measles seroprevalence and associated factors among adult individuals in the city center of Şanlıurfa.
2. To identify age ranges in the adult population susceptible to measles.

Methods

Fundamental Characteristics of the Study

This study has a cross-sectional design. The research was conducted at the Family Health Centers (FHCs) in the city center of Şanlıurfa between March 2023 and April 2023. The universe of the study consisted of individuals aged 18 and over who applied to the Family Health Centers (FHC) in the city center of Şanlıurfa. Şanlıurfa, the research area, is a region where the majority of the population are elementary school graduates, unemployed, and lack social security. In this region, most families have low income levels, and extended families are common.[12] The 30-cluster sampling method was used to determine the FHCs where the study would be conducted. Developed by the World Health Organization (WHO), this method is used to evaluate expanded immunization programs implemented in developing countries. This method is also used to determine the immunity level in a community. In the 30-cluster sampling method, 7, 10, 15, etc., individuals can be included in each cluster for research purposes. The use of 7 individuals as the cluster size is supported by studies that suggest it can provide results close to the actual seroprevalence with a 95% confidence interval and a 5% margin of error.[13,14] In this study, the number of participants to be included in each cluster was determined to be 7, and the total sample size was 210. The list of 80 FHCs in the urban and rural areas of the 3 central districts in Şanlıurfa was obtained from the Şanlıurfa Provincial Health Directorate. Thirty FHCs were randomly selected from this list, in proportion to the number of units in each FHC. Each FHC selected represents a separate cluster.

Study Variables

The independent variable of the study is the sociodemographic characteristics of the participants, whereas the dependent variable is the prevalence of measles seropositivity. The presence of specific IgG measles antibodies in serum samples was determined using the enzyme-linked immunosorbent assay (ELISA) test.

Data Collection

The Sociodemographic Characteristics Information Form was used for data collection. The Sociodemographic Characteristics Form consists of 18 questions.

Sociodemographic Characteristics Information Form

The age, gender, place of residence, educational status, employment status, marital status, having children, lifestyle, seasonal agricultural labor status, the total number of people living in the same household, the number of people per room, the adequacy of the total household income to

meet needs, presence of chronic illnesses, disability status, location of residence during the first 7 years of life, measles vaccination status, history of measles, and information about the cost of vaccination services were questioned in this form.

Implementation Phase

The first 7 individuals aged 18 and older who applied to the selected 30 FHCs constituted the sample for this study. In order to balance the number of male and female participants, the first 3 males and the first 4 females from the first 15 FHCs on the list and the first 4 males and the first 3 females from the remaining 15 FHCs were included in the research. Verbal consent was obtained from all participants. Researchers filled out the questionnaire form containing sociodemographic characteristics by conducting face-to-face interviews with the participants. Then, blood samples were taken from the participants by the researchers. Serum samples collected on a daily basis were centrifuged at 4000 rpm for 15 minutes at the Family Health Center and then transported to a private hospital, which was contracted previously, under cold chain conditions (2°C - 8°C). The serum samples were stored in accordance with cold chain conditions (2°C - 8°C) at the hospital. Then, the serum samples were sent to a private laboratory to perform the enzyme-linked immunosorbent assay (ELISA) test. Participants were classified using the reference ranges for measles IgG antibody levels of the private laboratory. Given these reference ranges, measles IgG antibody levels were considered negative for <9.0 IU/ml, threshold for 9.0 – 11.0 IU/ml, and positive for >11.0 IU/ml.

Ethical Approval and Study Expenses

Ethical approval for the research was obtained from the Non-Interventional Research Ethics Committee of the Medical Faculty of Harran University Faculty (Date: 08.22. 2022, Decision no: 16). Written permission was obtained from the Harran University's Research Projects Coordination Office and verbal consent was obtained from the participants. The research expenses were covered by Harran University's Research Projects Coordination Office (HÜBAK/22218). The support provided by Harran University was used for laboratory services, transportation, and materials required during blood collection (syringes, yellow-capped tubes containing gel, cotton, alcohol, and latex gloves). This study is conducted in accordance with the Declaration of Helsinki.

Statistical Analysis

Statistical analysis was performed using the IBM SPSS 26.0 (Statistical Program for Social Sciences 26) (Armonk, New York) software package. Descriptive data were expressed with the number (n) and percentage values for categorical variables and with mean ± standard deviation (Mean±SD) and median (minimum-maximum) values for continuous variables. Pearson's Chi-square (χ^2) test was applied to compare the categorical variables between groups. Multivariate analyses were performed to analyze the relationship between significant independent variables and the outcome variable. The logistic regression model was developed by first conducting chi-square tests to identify variables significantly associated with measles seropositivity. Four variables that showed significant associations were selected for inclusion in the model: age, having children, marital status, and educational level. The model was validated using statistical methods, including the Hosmer-Lemeshow goodness-of-fit test to assess model calibration. Additionally, pseudo R^2 values were examined to evaluate the explanatory power of the model. Potential collinearity between independent variables was checked prior to model construction. Following model development, p-values and odds ratios for each included variable were calculated and interpreted to assess their individual contributions to measles seropositivity. In this study, the age of 33 was used as a threshold in the logistic regression model, as the median age of the participants was 33. Statistical significance was set at a p-value of <0.05.

Results

In total, 210 adults were included in the study, and 51% of the participants were female. The median age of the individuals participating in the study was found to be 33.5 years, and the median number of children they had was 4. The median number of people per household was 5, and the median number of people per room was 2. Moreover, 36.7% of the participants were residing in Haliliye, 23.3% in Karaköprü, and 40.0% in Eyyübiye. Furthermore, 47.6% of the participants had an elementary school education or less, 59.0% were not employed, and 77.6% were in the lower social class. It was also determined that 40.4% of the participants had insufficient or very insufficient income, whereas 38.1% had a medium income level. 25.2% of the participants had no social security coverage, 86.2% were married, and 78.1% had children. It was also found that 76.7% of the participants had a nuclear family structure, while 22.9% had an extended family structure. Additionally, 17.6% of the individuals included in the study worked as seasonal agricultural laborers. 19% of them had chronic illnesses (Table 1).

Regarding the place of residence for the first 7 years of life, 48.6% of the participants lived in the provincial center, 41.9% in villages, and 9.5% in the district center. Examining the measles vaccination status, 31.4% stated that they had

Table 1. Distribution of participants sociodemographic characteristics

Characteristics	Number	Percentage
Sex		
Female	107	51.0
Male	103	49.0
District of residence		
Haliliye	77	36.7
Karaköprü	49	23.3
Eyyübiye	84	40.0
Educational level		
Illiterate	38	18.1
Literate	11	5.2
Elementary school	51	24.3
Secondary school	40	19.0
High school	48	22.9
University and higher	22	10.5
Employment status		
Yes	86	41.0
No	124	59.0
Social class		
Medium social class	47	22.4
Lower social class	163	77.6
Marital status		
Non-married	27	12.9
Married	181	86.2
Divorced/separate	0	0.0
Widow	2	1.0
Having child		
Yes	164	78.1
No	46	21.9
Lifestyle		
Single	1	0.5
Nuclear family	161	76.7
Extended family	48	22.9
Status of seasonal agricultural employment		
Yes	37	17.6
No	173	82.4
Income level		
Very sufficient	1	0.5
Sufficient	44	21.0
Moderate	80	38.1
Insufficient	82	39.0
Very insufficient	3	1.4
Chronic disease		
Yes	40	19.0
No	170	81.01
Disability status		
Yes	2	1.0
No	208	99.0
Social security		
Yes	157	74.8
No	53	25.2
Total	210	100.0

been vaccinated, 15.7% said they had not been vaccinated, and 52.7% could not remember. Regarding the history of measles infection, 24.3% reported having had the disease, 38.1% reported not having had it, and 37.6% could not remember. Moreover, 7.6% of the participants thought that vaccination services were paid (Table 2).

The measles seropositivity rate among the adult participants in the study was 87.6%, whereas the seronegativity rate was found to be 8.6%. It was also determined that 3.8% of the participants had measles IgG antibody levels within the threshold levels. Considering measles seropositivity

Table 2. Distribution of participants' characteristics related to measles and immunization

Characteristics	Number	Percentage
Place of residence for the first 7 years of life		
Provincial center	102	48.6
District center	20	9.5
Village	88	41.9
Status of vaccination for measles		
Vaccinated	66	31.4
Not vaccinated	33	15.7
Couldn't remember	111	52.9
History of measles disease		
Caught the disease	51	24.3
Haven't caught the disease	80	38.1
Couldn't remember	79	37.6
Are vaccination services paid?		
Yes	16	7.6
No	194	92.4
Total	210	100.0

levels among adult participants by age groups, it was found that the lowest seropositivity level was 52.63% in the 18-21 age group, followed by 77.78% in the 22-25 age group, and 79.41% in the 26-29 age group (Fig. 1).

Significantly higher measles seropositivity was found in adult participants aged 33 years and younger ($p<0.05$). Those with middle school and high school education had lower seropositivity levels compared to individuals with other education levels ($p<0.05$). Measles seropositivity was significantly higher among those who had children and those who were married ($p<0.05$). There was no statistically significant relationship found between participants' employment status, lifestyle, seasonal agricultural labor status, total number of people living in the same household, the number of people per room, the ability of total household income to meet needs, the presence of chronic illness, disability status, place of residence during the first 7 years of life, measles vaccination status, measles infection status, social security status, and measles seropositivity (Table 3).

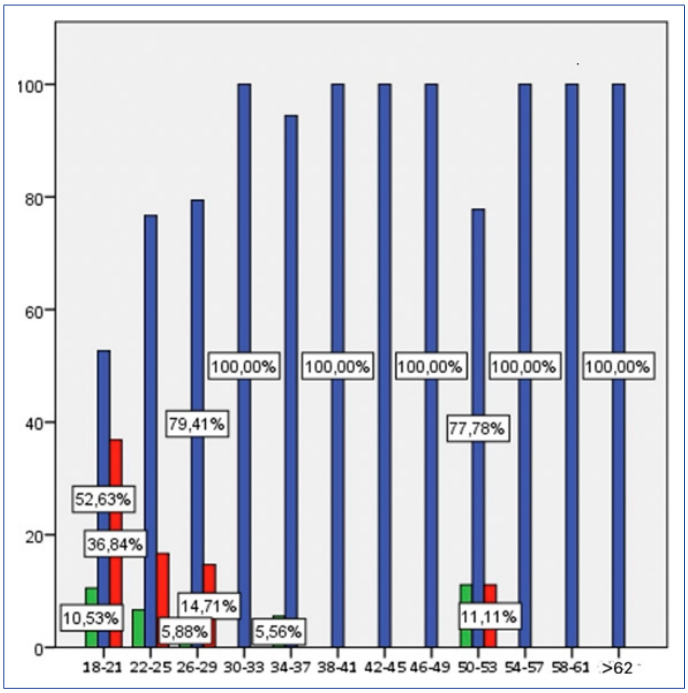

Figure 1. Distribution of measles seroprevalences by 3-year age groups.

In the logistic regression model created, being 33 years old or younger reduces the likelihood of measles seropositivity in adults by a factor of 10 (Table 4).

Discussion

In this study, the aim was to determine the measles seroprevalence among the adult population in the city center of Şanlıurfa. The research was conducted in Şanlıurfa, a region where the majority of the population has a primary level of education or below, is unemployed, and lacks social security. Most families in this area have low income levels and a high prevalence of extended family structures.[12]

The study population consisted of individuals aged 18 years and older who applied to Family Health Centers (FHCs) in the city center of Şanlıurfa. A total of 210 individuals from 30 different FHCs were included in the sample. Among the participants, 184 (87.6%) were seropositive, 18 (8.6%) were seronegative, and 8 had antibody levels within the borderline range.

The results showed that measles immunity and antibody levels increased with age. Of the 18 seronegative individuals, 17 (94.4%) were aged 30 or younger. When analyzed by age groups, measles seropositivity was as low as 52.63% in the 18–21 age group. These findings emphasize the need for completing measles vaccination among adults under the age of 30. Seropositivity among individuals older than 30 was much higher (99%), likely due to natural infection and subsequent immunity.

Similar patterns have been reported in studies conducted in different regions and countries. For instance, in a measles seroprevalence study conducted by Emek et al.[15] in Manisa province in 2017, seroprevalence among individuals sampled at FHCs was 82.2%. In those aged 40 and above, seroprevalence exceeded 95%, consistent with the findings of the present study.

Likewise, Smetana et al.[16] in the Czech Republic reported an overall seropositivity of 83.3%, with the highest rates (>96%) observed in individuals aged 50 and older who had acquired natural infection before the introduction of vaccination. The lowest rates were found in the 30–39 (61.5%),

Table 4. Logistic regression model of independent variables affecting the measles seroprevalence

Variables	B	Standard error	p	O.R.	95% Confidence level
Age	2.307	1.104	**0.037**	10.048	1.154 – 87.506
Having children	0.503	0.680	0.459	1.653	0.436 - 6.263
Marital status	0.486	0.701	0.488	1.626	0.411 – 6.424
Educational level	0.599	0.705	0.395	1.821	0.457 – 7.250

B: Beta coefficient; OR: Odds ratio.

Table 3. Comparing the participants' measles seroprevalence and sociodemographic characteristics

Sociodemographic characteristics	Measles immunity status				χ^2	p
	Yes		No			
	Number	%	Number	%		
Age						
33 years and younger	86	83.5	17	16.5	14.93	**<0.001**
34 years and older	98	99.0	1	1.0		
Sex						
Female	92	92.0	8	8.0	0.20	0.65
Male	92	90.2	10	9.8		
Educational level						
Elementary school and lower	93	96,9	3	3.1	8.42	**0.015**
Secondary school and high school graduates**	71	84.5	13	15.5		
University and higher	20	90.9	2	9.1		
Employment status						
Yes	79	92.9	6	7.1	0.62	0.43
No	105	89.7	12	10.3		
Marital status						
Not married	19	73,1	7	26.9		**0.003***
Married	163	93.7	11	6.3		
Having children						
Yes	150	94.9	8	5.1		**0.001***
No	34	77.3	10	22.7		
Lifestyle						
Nuclear family	143	92.3	12	7.7	0.056	0.813
Extended family	40	87.0	6	13.0		
Seasonal agricultural employment						
Yes	30	85.7	5	14.3		0.20*
No	154	92.2	13	7.8		
Number of persons per household						
5 persons and less	98	92.5	8	7.5	0.51	0.47
6 persons and more	86	89.6	10	10.4		
Number of persons per room						
Less than 2 persons	142	90.4	15	9.6		0.76*
2 persons and more	42	93.3	3	6.7		
Income level						
Sufficient and higher	16	72.7	6	27.3	0.59	0.74
Medium level	25	80.6	6	19.4		
Insufficient and lower	21	80.8	5	19.2		
Chronic disease						
Yes	38	97.4	1	2.6		0.20*
No	146	89.6	17	10.4		

Table 3. Continue

Sociodemographic characteristics	Measles immunity status				χ^2	p
	Yes		No			
	Number	%	Number	%		
Place of residence for the first 7 years of life						
Provincial center	91	91.0	9	9.0	0.04	0.97
District center	18	90.0	2	10.0		
Village	75	91.5	7	8.5		
Vaccination status						
Vaccinated	56	87.5	8	12.5	1.56	0.45
Not vaccinated	31	93.9	2	6.1		
Couldn't remember	97	95.6	8	9.4		
Measles history						
Caught the disease	47	95.9	2	4.1	3.081	0.214
Haven't caught the disease	67	87.0	10	13.0		
Couldn't remember	70	92.1	6	7.9		
Social security status						
Yes	141	92.8	11	7.2		0.15*
No	43	86.0	7	14.0		
Are vaccination services paid?						
Yes	15	93.8	1	6.3		1.00*
No	169	90.9	17	9.1		

*Fisher's Exact Test; ** Group causing the difference

40–49 (77.5%), and 18–29 (81.1%) age groups. These results align with the current study, in which seropositivity was higher in older individuals and lower in the 20–30 age group.

Similarly, in a 2012 study by Chen et al.[17] in Taiwan, overall measles seroprevalence was 74.7%, with 50.6% in the 21–25 age group and over 95% in those aged 35 and above. This age-related increase in seropositivity is also consistent with our findings.

In addition, a 2008 study conducted by Fu et al.[18] in China reported an overall measles seroprevalence of 70.6%, with the lowest rate (58.8%) in the 15–29 age group. This further supports the present study's observation that younger adults exhibit lower immunity levels. Finally, 19. García-Comas et al.,[19] in a study conducted in Spain, found an overall seroprevalence of 97.8%. The highest rates (99.7%) were in the 2–5 and 40–60 age groups, while the lowest were observed in the 21–30 age group. Taken together, these consistent findings across multiple studies suggest that waning immunity or incomplete vaccination coverage among younger adults remains a significant public health concern.

A 2019 study by Sasaki et al.[20] in Japan, which examined measles antibody titers among young adults, found significantly higher antibody levels in individuals with a previous history of measles infection. Similarly, in the present study, individuals reporting a history of measles showed higher seropositivity; however, unlike Sasaki et al.,[20] this difference did not reach statistical significance.

Supporting this age-related pattern, recent studies have consistently demonstrated that measles seropositivity tends to be lower among individuals aged 18–30 and increases progressively with age.[17,21,22] These findings collectively highlight the persistence of immunity gaps among younger adults, particularly those born after the introduction of routine vaccination programs. Furthermore, Emek et al.[15] reported that, after adjusting for age, measles seroprevalence was not associated with any social determinants such as education level, occupation, or income.

Consistent with this, the present study also found no significant relationship between sociodemographic variables and measles seropositivity once age was controlled for. In addition, Chen et al.[17] identified age as an independent

predictor of seronegativity in Taiwan. This finding aligns with our results, reinforcing the conclusion that age is a primary determinant of measles immunity, independent of other demographic or social characteristics.

Limitations

The data were directly obtained through face-to-face interviews by the researchers. Therefore, the reliability of the data is limited to the information provided by the participants. Since some participants did not speak Turkish, a translator was used, and the reliability of the data depends on the translator's translation skills and the participant's ability to understand the questions correctly.

One of the limitations of this study is the potential for recall bias. Since the data were collected through face-to-face interviews, participants were asked to report their history of measles infection and vaccination. However, many participants may not have accurately remembered whether they had been vaccinated against measles or had previously contracted the disease. This could have led to the collection of inaccurate or incomplete information, potentially affecting the validity of the results.

Conclusion

This study confirmed the hypothesis that measles seroprevalence increases with age and that younger adults have lower immunity levels. The overall seroprevalence among adults in the Şanlıurfa city center was 87.6%, indicating an immunity gap among individuals aged 18-30. The hypothesis that sociodemographic factors independently influence seroprevalence was not supported; age is the only significant determinant of measles immunity.

Although first-dose measles vaccination coverage in Türkiye has exceeded the 95% threshold for elimination, inadequate second-dose coverage and the accumulation of unvaccinated individuals likely contributed to the decline in herd immunity. These findings highlight the need to strengthen routine vaccination programs and ensure full MMR vaccination coverage, particularly among adults born after 1993. Based on these results:

✓ Catch-up vaccination programs targeting individuals aged 18-30 could be implemented.

✓ Periodic serological testing could be performed to monitor immunity levels.

✓ Public education and awareness campaigns should be conducted to reduce vaccine hesitancy and anti-vaccine sentiment.

Disclosures

Ethics Committee Approval: This study was approved by the Non-Interventional Research Ethics Committee of the Medical Faculty of Harran University Faculty (Date: 08.22. 2022, Decision no: 16).

Informed Consent: Written informed consent was obtained.

Conflict of Interest: The authors declare that there is no conflict of interest.

Financial Disclosure: The research expenses were covered by Harran University's Research Projects Coordination Office (HÜBAK/22218). The support provided by HÜBAK was used for laboratory services, transportation, and materials required during blood collection (syringes, yellow-capped tubes containing gel, cotton, alcohol, and latex gloves).

Use of AI for Writing Assistance: None declared.

Authorship Contributions: Concept –B.B., A.G.; Design – A.G., B.B.; Supervision – A.B., B.B., F.B.; Resource – A.G.; Materials – A.G.; Data collection and/or processing – A.G., F.B.; Analysis and/or interpretation – A.G.; Literature review – A.G., B.B.; Writing – A.B., B.B., F.B.; Critical review – A.B., B.B., F.B.

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