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Original Article

Seroprevalence of mumps and its association with some social determinants in Manisa Province, 2014

Yasin Sağlam[a], Özgen Alpay Özbek[b], Duygu İşlek[c], Can Hüseyin Hekimoğlu[c], Nur Demirpençe[c], Mestan Emek[c], Sema Alp Çavuş[c], Gonca Atasoylu[d], İbrahim Mehmet Ali Öktem[e], Belgin Ünal[f]

[a] MD., Dokuz Eylul U. Faculty of Medicine, Department of Public Health, İzmir, Turkey

[b] MD., Assoc. Prof. Dr. Dokuz Eylul University Faculty of Medicine, Department of Medical Microbiology, İzmir, Turkey

[c] MD., Dokuz Eylul University Faculty of Medicine, Department of Public Health, İzmir, Turkey

[d] MD., Manisa Directorate of Public Health, Manisa, Turkey

[e] MD., Prof. Dr., Dokuz Eylul University Faculty of Medicine, Department of Medical Microbiology, İzmir, Turkey

[f] MD., Prof. Dr., Dokuz Eylul University Faculty of Medicine, Department of Public Health, İzmir, Turkey

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Abstract

Aims: The aim of this study was to determine the seroprevalence of mumps and its association with some social determinants of health in the Manisa Province. **Method:** A random sample of individuals, aged two years and over, from the Manisa Province was included in this cross-sectional study (n=1740). Individuals were interviewed and blood samples were taken in family health centres. Specific antibodies were analysed using the anti-mumps virus ELISA IgG test and values of ≥22 IU/mL were considered as positive. **Results:** Overall mumps seropositivity was found to be 80.3%. Furthermore, seropositivity was 72.5% for ages 2-19 and 83.1% for ages over 20 ($p<0.01$). The Odds Ratio of mumps seropositivity was 1.42 (0.94-2.08) for people who had an annual equivalent income per capita of more than 5692 TL; and OR = 1.23 (0.54-2.82) for people who were living in homes which had fewer than one person per room. **Conclusions:** In all age groups, there is between 10-20% of the population sensitive to the risk of a mumps epidemic. There is no statistically significant association between mumps seropositivity and social determinants. For a successful mumps control program, high vaccine coverage should be aimed and maintained.

Key words: Mumps, vaccines, seroepidemiologic study

Correspondence to: Yasin Sağlam, Amasya Toplum Sağlığı Merkezi, Hızırpaşa mah. Rahmet sok. 17/B D:5 Amasya dr.yasinsaglam@gmail.com

Manisa ilinde kabakulak seroprevalansı ve bazı sosyal belirleyicilerle ilişkisi, 2014

Öz

Amaç: Bu çalışmada Manisa ilindeki kabakulak seroprevalansının belirlenmesi ve bazı sosyal belirleyicilerle ilişkisinin incelenmesi amaçlanmıştır. **Yöntem:** Kesitsel tipteki bu çalışma Manisa ilindeki 2 yaş ve üzeri bireyler arasından rasgele seçilen 1740 kişilik bir örnek üzerinde yapıldı. Aile sağlığı merkezlerinde bireylerle görüşüldü ve kan örnekleri alındı. Özgül antikorlar anti-mumps virus ELISA IgG testi ile araştırıldı ve ≥ 22 IU/mL değerleri pozitif kabul edildi. **Results:** Kabakulak seropozitifliği %80.3'tü. Seropozitiflik 2-19 yaş grubunda %72.5 iken 20 yaş üstünde %83.1'di ($p<0.01$). Kabakulak seropozitifliği için yıllık kişi başı eş değer geliri 5692 TL'dan fazla olanlar için OR=1.23 (0.54-2.82); oda başına kişi sayısı birden az olanlar için OR=1.23 (0.54-2.82)'dir. **Conclusion:** Tüm yaş grupları içinde %10-20 oranında kabakulak salgın riskine karşı duyarlı bir nüfus bulunmaktadır. Kabakulak seropozitifliği ve sosyal belirleyiciler arasında istatistiksel olarak anlamlı bir ilişki saptanmamıştır. Başarılı bir kabakulak kontrol programı için aşı kapsayıcılığı yüksek tutulmalı ve korunmalıdır.

Anahtar kelimeler: Kabakulak, aşılar, seroepidemiolojik çalışma

Introduction

Mumps is an acute viral disease which is generally located on parotid and other salivary glands and causes them to swell. The agent for mumps belongs to Rubulavirus genus which is a member of Paramyxoviridae familia. This single-stranded RNA virus gets inactivated quickly at degrees above 50°C, UV light, acidic pH, ether, chloroform and formol.[1] Mumps disease is seen globally. It usually affects children aged between 5-9 years in countries without a vaccination programme. Mumps is one of the most frequent causes of aseptic meningitis and sensorineural deafness among children and outbreaks among military personnel.[2,3] In temperate climates number of mumps cases peak during the end of winter and spring months. In areas where the mumps vaccination programme is routinely implemented seasonality is not evident but sporadic cases and epidemics occur all year round.[4,5]

The importance of mumps for public health is its epidemics and complications. Mumps infection may cause severe complications including orchitis, oophoritis, meningitis and hearing loss. Complications may occur with or without parotitis.[6,7] Human is the only host of mumps virus. The virus spreads with inhaling respiratory droplets or with direct contact with respiratory secretions. Even though mumps is less contagious compared to rubeola or varicella, it may spread fast among sensitive individuals and the chance for sensitive individuals to get infected during the first encounter is 85%.[1]

However, mumps is a viral disease that can be prevented by vaccination. The most commonly used formulation for the mumps vaccine is the trivalent measles, mumps and rubella (MMR) formulation.[8] For a preventive level of immunity, MMR vaccine is applied twice; the first dose is applied at 12th month and the second dose between age 2 and 6. In Turkey, the second dose is applied in the first year of primary school.[9] Since the year 2000, WHO recommends MMR vaccine to be used especially in countries that have a high burden of mumps and rubella due to its easiness in the application, if the country can afford the vaccination programme and the vaccine coverage is sustained over 80%. In Turkey, MMR vaccine has been introduced as part of the national immunization programme since 2006.[9]

Clinical studies show 95% preventive efficiency and a long-lasting immunity after the application of the vaccine.[8] On the other hand, some studies based on mumps epidemics show lower

efficiency, 78% (49%-91%) for single dose and 88% (66%-95%) for double dose.[2,8]

Mumps is still seen in our country as sporadical cases and sometimes as epidemics which cause public health problems. In the recent WHO's Reported Cases of Selected Vaccine-Preventable Diseases Report, 419 cases of mumps were reported in 2017 from Turkey.[10] Social determinants of health are the conditions in which people are born, grow up, live, work and age. These conditions influence a person's opportunity to be healthy, his/her risk of illness and life expectancy.[11] The level and distribution of wealth within a society play significant roles in determining vulnerabilities to communicable diseases. A recent systematic review addressing the reasons for under-or non-vaccination of children from low and middle-income countries suggested that social determinants may have a substantial impact on routine childhood vaccination[12] Low household income, poor housing conditions, poor living conditions are associated with reduced immunization rates and also with increased incidence of disease, which in turn raises the overall burden placed on an existing poor healthcare infrastructure in low and middle-income countries. Main social determinants that reported to influence the immunisation programs in low and middle-income countries are parents' education, migration, war, place of residence rural-urban, access to health care, gender and religion and ethnicity.[12]

Determination of socio-demographic risk factors for mumps may provide valuable information for the prevention of future epidemics. This study aims to explore the seroprevalence of mumps and its association with some social determinants in the scope of the vaccination programme in Manisa Province, in the year 2014.

Method

This cross-sectional study was carried out in collaboration with the Manisa Public Health Directorate as a part of the study titled "Determination of the seroprevalence of some vaccine-preventable diseases in Manisa, 2014". Seroprevalence of five diseases including measles, mumps, rubella, chicken pox, pertussis were determined in the Manisa Study. The findings of each disease were presented in separate manuscripts since each has slightly different epidemiology. Manisa province has a population of 1.3 million and is located in West Anatolia. In terms of socioeconomic development, Manisa ranks 23rd among the 81 provinces of Turkey.

The study population consists of individuals aged above age 2, who were registered to Manisa Province Family Medicine Information System (FMIS) as of October 2013 (n=1.317.917). The minimum sample size was estimated to be 1337 individuals, assuming expected seronegativity of 2.0% and the absolute precision of 0.75% with 95% confidence level using EpiInfo program (EpiInfo Center for Disease Control and Prevention, Atlanta, GA). The sample size was then inflated by 30% for possible nonresponse bias. The sampling frame was Manisa FMIS, that included the Manisa population by Family Health Centres. The sample of 1740 people older than two years of age was then selected using simple random sampling method using Oracle programme. Age-gender distribution of the sample was compared with the Manisa population in order to check the similarity of the sample and the study population (available from the authors upon request).

Out of 1740 people, 1572 (90.3%) responded to telephone calls and 1260 of them (72.4%) agreed to participate in the study. 1255 participants agreed to provide serum samples and 1246 (71.6%) antibody results were obtained from laboratory analyses.

The sample size was estimated to determine the seroprevalence of mumps but we also evaluated the association between social determinants and mumps. A post hoc power analysis was done to check if we had enough power.

Data were collected during March-June 2014 at the family health centres (FHC). After obtaining written consent, the questionnaires were filled by the trained

interviewers during a face to face interviews and blood samples were taken by nurses in FHC.

The study protocol was ethically approved by the Dokuz Eylül University Clinical Studies Ethical Committee (date 26.12.2013, number: 2013/26-01). Administrative permissions were obtained from the Manisa Governorship. The study was funded by the Dokuz Eylül University Scientific Research Projects Funds.

The dependent variable of the study was mumps seropositivity. Specific antibodies were analysed by anti-mumps virus ELISA IgG test in serum samples. The brand name was Euroimmun (Medizinische Labordiagnostika AG, Lübeck, Germany). Sample IgG levels <16 IU/mL were considered negative, levels ≥22 IU/mL were positive and the ones between 16 and 22 IU/mL were considered to be uncertain. During the analyses uncertain and negative results were accepted as "seronegative", positive results were accepted as "seropositive".

The independent variables were gender, age groups, family size, number of person per room, annual equivalent income per capita, educational status and occupation. Educational status was grouped according to the highest degree of graduation; those who were under the age of primary school graduation were grouped as "still attending to primary school" and "under the age of primary education". Occupational class was grouped as "unemployed (looking for a job)", "blue collar/temporary worker/worker/agriculture worker)" and "white collar/professionals" and others (nonworker, employer, self-employed and student).[13] Children until age 15 were grouped in the father's occupational category. Annual equivalent income per capita was calculated by dividing the total annual household income by equivalent household size. This calculation method has been used by OECD since 1982 and updated in 1994. The equivalent household size was calculated by multiplying the reference person in the household with "1", while the number of those who are 14 years and over were multiplied with "0.5" and those who are below 14 years with "0.3".[14]

In the study, categorical variables were summarized with count, percent and 95% confidence intervals (Cl) and compared using Chi-Square test in the univariate analyses. Odds ratios (OR) and 95% CI for social determinants of mumps seropositivity were calculated using logistic regression analysis. The association between mumps seroprevalence and educational status and occupational class variables were analysed in over 25 years of age group. All statistical analyses were performed using Statistical Package for Social Sciences (SPSS) version 15.0 (SPSS Inc., USA).

Results

Overall mumps seropositivity for the whole study group was 80.3%. Mumps seropositivity was 79.2% in men and 81.2% in women (p=0.38).

Seropositivity was significantly higher in the younger age groups compared to over 20 years of age groups as 72.5% and 83.1%, respectively (p<0.01). An Odds ratio of being mumps seropositivity was 1.85 times higher (1.85-2.5) for people aged over 20 compared to younger age group (Table1). The seropositivity was over 80% in all age groups over 20 (p<0.001) (Figure 1). Seropositivity was 94.4% in those graduated from university and over 80% in all education groups except secondary school graduates that had 77.6% seropositivity. There was no statistically significant difference between the education groups regarding mumps seropositivity (p=0.05) (Table1). Prevalence of seropositivity was 89.2% in participants categorised as white collar workers, 81.5% in blue collar, 78.4% in unemployed and 81.5% in participants with other professional categories (p=0.18). Prevalence of seropositivity was similar between the categories of annual equivalent income per capita (p=0.68), household size (p= 0.52) and the number of person per room (p=0.69). Odds Ratio of mumps seropositivity was 1.42 (0.94-2.08) for

people who have annual equivalent income per capita more than 5692 TL; and OR = 1.23 (0.54 - 2.82) for people who were living in homes that have less than 1 person per room (Table 1).

Table 1. Seroprevalence of mumps by sociodemographic characteristics of the participants

Variables	Total (n)	Prevelance (%)	95%CI	p	OR (95% CI)
Women	654	81.2	78.0 – 84.0	0.38	1
Men	592	79.2	75.8 – 82.3		0.97 (0.92 – 1.03)
Age Group					
< 20	331	72.5	67.5 – 77.1	<0.01	1
≥ 20	915	83.1	80.5 – 85.4		1.85 (1.4 – 2.5)
Educational Status*					
Illiterate	100	84.0	75.1 – 89.6	0.05	0.31 (0.10 – 0.98)
Literate	34	82.4	69.8 – 92.4		0.28 (0.07 – 1.06)
Primary school	451	80.0	74.9 – 81.9		0.24 (0.08 – 0.67)
Secondary school	67	77.6	72.0 – 83.9		0.21 (0.07 – 0.66)
High school	97	86.6	79.2 – 90.5		0.39 (0.12 – 1.23)
University	71	94.4	88.1 – 97.9		1
Profession*					
White collar	83	89.2	80.8 – 92.9	0.18	1
Blue collar	336	81.5	74.1 – 81.0		0.53 (0.26 – 1.13)
Unemployed	51	78.4	67.8 – 87.0		0.44 (0.16 – 1.16)
#Other	415	81.5	77.9 – 84.7		-
Household Size					
Number of people in the house > 4	354	80.2	75.8 – 84.1	0.52	1
Number of people in the house ≤ 4	892	80.3	77.5 – 82.7		1.00 (0.94 – 1.06)
Number of persons per room					
> 1	35	83.3	69.0 – 92.0	0.69	1
≤ 1	965	80.1	77.8 – 82.3		1.23 (0.54 – 2.82)
Annual equivalent income per capita (TL) (n = 1211)					
First quartile (< 1814)	236	79.2	74.3 – 83.5	0.68	1
Second quartile (1815 – 3265)	226	78.2	73.1 – 82.8		0.94 (0.63 – 1.39)
Third quartile (3266 – 5692)	229	78.4	73.4 – 83.0		0.95 (0.64 – 1.41)
Fourth quartile (> 5692)	309	84.2	80.2 – 87.6		1.42 (0.94 – 2.08)

*Analyses restricted to over 25 years of age group, #Other group includes people out of workforce, housewives and students and this group was excluded from the analyses.

Table 2. Seropositivity of mumps by sociodemographic characteristics of participants known to be vaccinated

	Vaccinated (n)	Seropositivity (%)	95 % CI	p
Gender				
Women	77	74.1	63.4 – 82.9	0.47
Men	97	69.1	59.4 – 77.6	
Age Groups				
Age 2 - 9	131	73.3	65.2 – 80.3	0.15
Age 10 - 19	43	65.1	50.1 – 78.2	
Vaccine dose				
Single dose	142	66.2	58.1 – 73.6	<0.01
Double dose	32	93.8	80.8 – 98.9	

Mumps seropositivity was 71.4% for 174 children that were known to had mumps vaccine. In children who had the vaccine, there was no significant difference between gender and age groups (p=0.47 and p=0.15), but seropositivity in those who had two doses was significantly higher than children who had only one dose (93.9% and 66.2%, respectively (p<0.01) (Table 2). The titers of mumps immune globulin were also significantly higher in children who had two doses of mumps vaccine 102.4 ±48.3 and 49.6±48.3 respectively (p<0.01) (Figure 2).

Discussion

The overall mumps seropositivity was approximately 80% in the over two years of age population of Manisa Province. While the seropositivity was 72.5% in younger age groups, it remained over 80% in age groups 20 and over. Among younger than 20 years of age, the seropositivity was 72.7% and 72.4% for 2-9 and 10-19 years group, respectively. The 2 to 9 age group reflects the period after vaccination program started in 2006. The first dose of MMR vaccine is applied at 12th month and the second dose is at age 6 in Turkey.[9] Therefore relatively low levels of seropositivity in the 2 to 9 age group is likely due to the children who did not receive the second dose of the MMR yet.

In Turkey, a few studies evaluated mumps seropositivity by ELISA before the mumps vaccine introduced into the universal immunization programme in 2006. Mumps seropositivity was reported as approximately 80% in a hospital in Ankara during October 2005–June 2006 among the 9-16 years age group.[15] In the same age group mumps seropositivity was 72.5% in the city centre of Sivas Province in 2005.[16] Mumps seropositivity was 35.3% among 331 unvaccinated 0-59 month aged children in Adana Province in 2005.[17] Consistent with these studies, there was, approximately, a 10 to 28% sensitive population that was under the risk for mumps epidemic in the all age groups in Manisa. Therefore, it is crucial to keep the vaccine coverage at the highest levels in the target age groups in order to keep the level of immunity in the community above the herd immunity threshold.

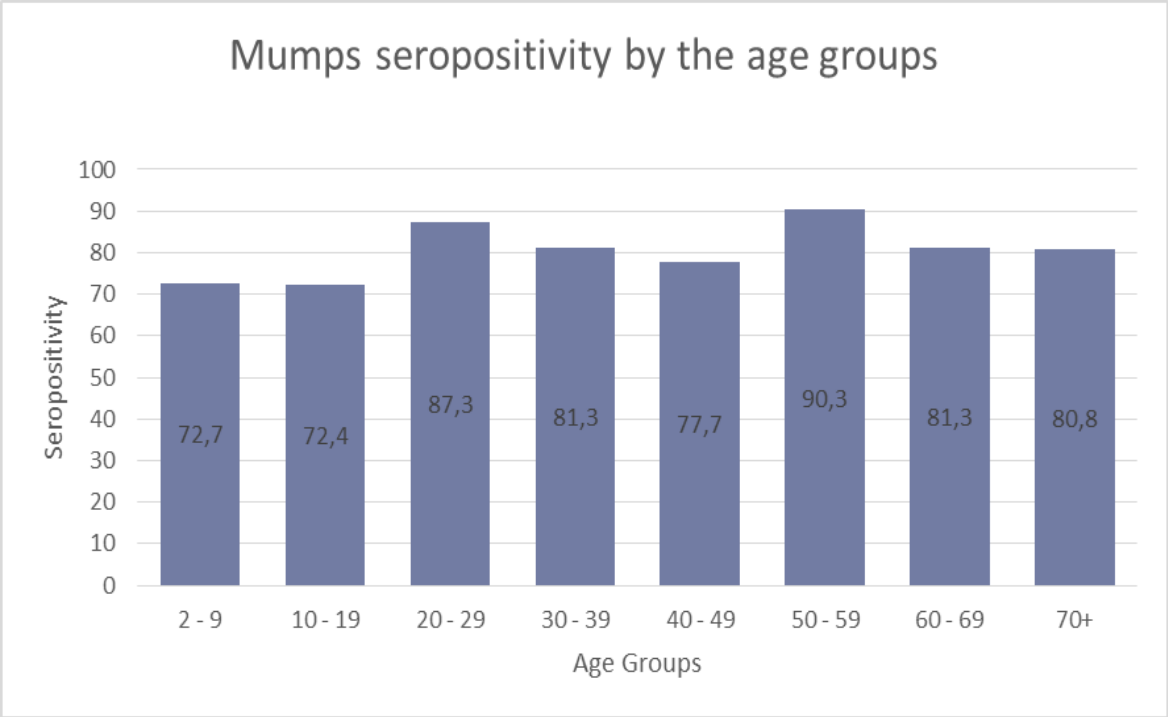

Figure 1. Seropositivity status of the participants by the age groups

In our study, the seropositivity is low in the 2-9 age group that reflects the population after the routine immunisation program started, compared to adult age groups that did not get a vaccination against mumps. This finding suggests that the population gets a strong lifelong protection from the natural infection. In England, mumps seroprevalence was reported as over 80% in adolescents and adults. Even though the vaccine coverage in England was over 90% among 2-9 years of age, the seropositivity was found to be at 70's%.[18] This finding is similar to our seropositivity levels suggesting a likely primary vaccine failure.

When we analysed mumps seropositivity in those known to be vaccinated, it was 66.2% and 93.8% in individuals with the single dose and with the double dose, respectively. This supports the fact that the second dose enhances the effect of the vaccine. Similar to our findings, in Denmark, the first dose is applied at age 6 and the second dose at age 12 and it was reported that there was a decline in mumps seropositivity from age 6 to 10. The seroprevalence was 62% at 10 years old and it was over %90 for children at age 6.[19] On the other hand, in populations with high vaccine coverage, a waning vaccine – conferred immunity is reported in the absence of natural boosters in individuals who had received their last MMR dose many years before.[20] This waining effect is suggested as one of the most important reasons for mumps outbreaks in highly vaccinated populations.[20] Turkey has an expanded immunisation program and currently mumps vaccination coverage is high, over 90%. This high coverage should be maintained in order to keep the herd immunity levels for mumps. When the majority of the population are vaccinated and reached to the late adulthood the third dose of vaccine is recommended, during the outbreaks to individuals whose second dose dates back more than 10 years.[21]

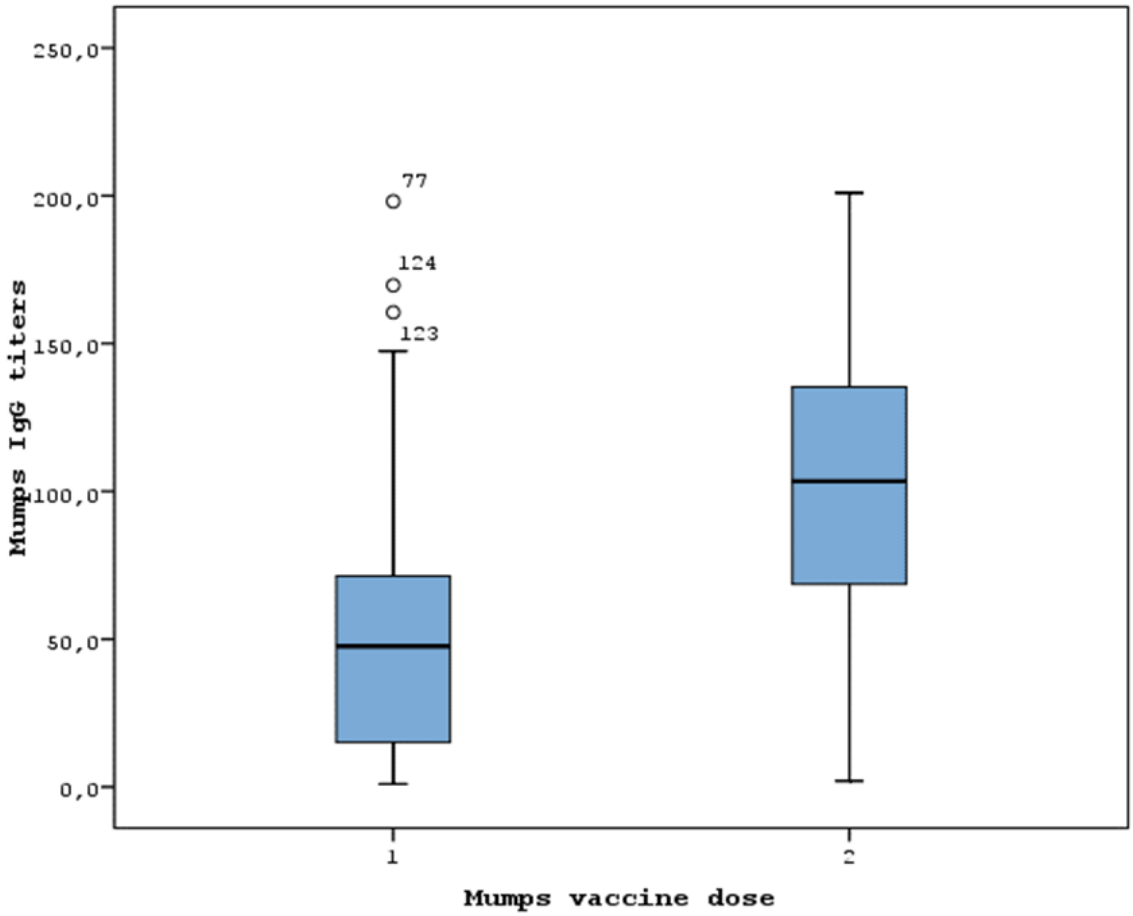

Figure 2. Mumps Ig G titers by the applied mumps vaccine dose

Mumps seropositivity was associated only with age in our study. There was no significant association between the other independent variables such as gender, educational status, profession, household size, number of persons per room, annual per capita equivalent income and mumps seropositivity in our study. One of the interpretations of this lack of association lies on the relatively well organised primary health care system in Turkey, hence in Manisa. A population around 3500 is registered to a family physician whom he/she is responsible for providing and monitoring the free of charge immunisation services for children.[22]

In a recent review, parents' education, migration, war, place of residence rural-urban, access to health care, gender and religion and ethnicity were identified as the main social determinants associated with immunisation programs in low-income countries. However, in middle and high-income countries safety concerns, misinformation, religious/cultural beliefs, immigration, urban vs rural residence and complementary medicine are the main determinants for immunisation.[12] Turkey is considered a middle-income country, especially Manisa is relatively well developed, a mid-size city on the western part of Turkey, where income, education, access to health care inequalities may be relatively low. However, inequalities in immunisation do exist in Turkey at the national level. In the Turkish Demographic Health Survey conducted in 2013, the low level of vaccination uptake was associated with living in a rural region, living in the eastern part of Turkey, having a non-educated mother, having a high birth order and being in the lowest quintile of income. [23]

This study has some strengths. First of all, the study group was randomly selected from a large province population framework that includes individuals above 2 years old in Manisa Province. The sample reflects the age, gender, urban-rural

residential distribution of Manisa. The study represents a good example of cooperation between a university and Public Health Directorate which is the highest authority that plans, implements and monitors vaccination services in Manisa. The findings of this study can be used to evaluate and improve the vaccination services. Another important feature of the study is that not only children but also adult age groups were evaluated. In recent years, together with children adult patients are also seen in mumps epidemics in European countries.[5] Therefore, knowing the adult age groups that are sensitive to the disease may help to decide who will be primarily vaccinated in possible outbreaks.

Our study has also some limitations. Firstly, vaccination histories for MMR were not asked the participants, some participants may have received the vaccine in private clinics before the vaccination programme started. However, the number of these people should not be a large proportion of all participants. Secondly, mumps disease history was not asked the participants due to possible recall bias. Thirdly, the overall response rate was relatively low, approximately 72%, but we evaluated the age and gender structure of responders and nonresponders in our study. There was no statistically significant difference between the two groups by age but females were represented more than males in the study. However, no statistically significant seroprevalence difference was found between the two genders. Therefore it can be considered that the overall seroprevalence in the study is not widely affected by this limitation. The fourth limitation might be the relatively low power of the study to explore the association between some social determinants and mumps seropositivity. We estimated the sample size using only the seroprevalance of mumps that may be resulted in fewer participants in some subcategories of social determinants variables. For example, the number of people who were unemployed was 55 only which might have prevented us to show some likely weak associations. A post-hoc power analysis for profession confirmed this limitation; the power achieved for professional categories was 0.76 for a sample size of 997 people, small effect size (0.1) and Df=3 (Estimated using Gpower).

In conclusion, there was a sensitive population of 10-20%, in all age groups which was under the risk for mumps epidemic. Our findings also suggested that there was no association between the social determinants of health we studied and mumps seropositivity. To keep the level of immunity in Manisa above the herd immunity threshold, it is necessary to keep the vaccine coverage at high levels in the target age groups.

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Author contribution

BÜ, ÖAÖ, ME, GK, GA, SAÇ, MAÖ conceived and designed the study; YS, Dİ, ME, ND,GA, CHH collected data; ÖAÖ, MAÖ performed laboratory analyses; YS,ÖAÖ,BÜ analysed the data and drafted the manuscript. All authors read, commented and approved the manuscript

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