Journal of Medical Sciences

ISSN 1682-4474

science alert

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Research Paper

J. Med. Sci., 6 (1): 22-26
January-March, 2006

Immune Status of Primary School Children to Mumps

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The objective of this descriptive analytical prospective cross-sectional study was to determine the immunological status of mumps in school-age children in the 19 educational sectors of Tehran. Multistage sampling was used and a total of 1665 subjects were studied (mean age = 9.17±1.53 years), 945 (57%) of whom were girls and 720 (43%) were boys. Nine hundred and fifty two subjects (57%) and 713 subjects (43%) had negative and positive antibody titers, respectively. Overall, 533 (56%) and 412 (44%) girls had negative and positive antibody titers, while 419 (58%) and 301 (42%) boys had negative and positive antibody titers, respectively. The difference was not significant between the sexes (p = 0.0571). Out of 1665 students studied, 1135 (68 %) had no history of mumps vaccination, while 530 subjects had received the mumps vaccine at age 15 months onwards (32%). Among the unvaccinated subjects, 453 (40%) were seropositive and 682 (60%) were seronegative, while among the 530 vaccinated students, 260 (49%) and 270 (51%) were seropositive and seronegative, respectively. Most seropositive patients were in the 11-year age group and the least were in the 9-year age group, which was not statistically significant (p = 0.105). A significant statistical difference was, however, found between mumps antibody titer and the four geographical educational sectors (p<0.001).

Key words: Mumps, vaccination, antibody, children

JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original article in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued four times per year on paper and in electronic format.

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INTRODUCTION

Mumps is an acute viral infectious disease, which is associated with various complications. It has a worldwide distribution and its prevalence is not well known. Asymptomatic patients comprise 30-40% of all cases. With a prevalence of 250 cases in 100,000 subjects, meningoencephalitis is the most common complication of childhood and is three-to five-fold more frequent in males[1,2]. Mortality rate is around 2% but, overall, it has a good prognosis[2]. The incubation period lasts 14-24 days and infection may be acquired from 4-24 h prior to the appearance of parotitis until its disappearance[2] and meningoencephalitis may occur from one week before to three weeks after parotitis. One of the rare complications of mumps is deafness, which constitutes around 4% of cases[3] but is said to reach 25% in Iran[4]. Sensory deafness is more common among patients with mumps meningoencephalitis[5]. Inflammation of the lacrimal glands, lacrimal ducts and optic neuritis are bilateral and reversible[2,6]. Another complication is epidydimo-orchitis which fortunately does not occur in small children and is more prevalent in 15-29 years-old[7]. In a study performed to determine the causes of diabetes in Iran, it was seen that among the 20% of diabetic patients with a history of viral infection (measles, rubella, mumps, chicken pox), 7.5% were attributed to mumps[8]. Diagnosis is based on clinical features, history of contact with an infected person and a raised serum antibody titer to mumps. Many factors play different roles in its clinical presentation and complications, including early effects such as, duration of hospitalization, prolonged absence from school, cost of treatment and late effects like deafness, diabetes, learning disabilities, seizures and hydrocephalus[9], all of which are caused by failure to be vaccinated. In a study performed on hospitalized patients with mumps, 98% had not been vaccinated[10]. With national vaccination, there was a great decline in the complications of this disease at both individual and community levels as well as an improvement in the community health indices, thereby preventing the numerous disabilities caused by mumps. Regarding the fact that youngsters comprise a major proportion of the Iranian population, a significant percentage of whom are school children, any step taken to control the infection in schools, will ultimately help control the disease throughout the community to a large extent. Measures taken in this field will depend upon our knowledge about the immunologic status of school children and high risk age-groups. Regarding the lack of accurate data on mumps in primary school children, we decided to study these students in the 19 educational sectors of Iran.

MATERIALS AND METHODS

This prospective cross sectional study was performed in 2003-2004 on primary school children from the 19 educational sectors in Tehran. Through meetings and discussions with the Secretary of Sports and Health and the Ministry of Education and Manager Director of the School Health System of Tehran and the health authorities of the schools and educational sectors, permission was granted to perform the study. Specimen volume was calculated according to the population of the primary schools and the schools were chosen by simple randomization. The samples were also selected randomly from each school. Due to equal distribution of all subjects in the 19 educational sectors, two girls and two boys were studied from each sector. These schools were chosen by simple randomization by the health teacher of each school without the interference of the study executive. Thus four schools were chosen from each sector; two girl's and two boy's schools. Also subjects from each school were chosen by the school Health teacher using a list of all school children. Subjects were enrolled only after obtaining written consent from the student and parents and a questionnaire was then completed. Sample collection took place by multistage sampling on 1779 students. It was noteworthy that with this large specimen volume, none were confronted with problems. One hundred and fifteen cases were excluded from the study due to failure to participate, absence of a questionnaire and inadequate or hemolysed blood sample. Overall, 1665 samples were studied. After prior arrangement with the school health authorities, 2 mL of venous blood was drawn by a single person once a day from all enrolled subjects. The sera were separated and stored at -25°C and mumps antibody titer was estimated by the ELISA method using Bouty (Italy, code 20941). According to the recommendation of the manufacturer, results were calculated in micro units per milliliters. Antibody titers between 1-100 were considered negative and values >100 were considered positive.

RESULTS

Specimens were collected from the 1779 subjects enrolled. One hundred and fourteen cases were excluded from the study due to various reasons, including hemolysis or inadequate blood sample. Of all subjects, 945 (57%) were girls and 720 (43%) were boys. Antibody titer was determined in 1665 cases and 952 (57%) and 713 (43%) of the subjects were seronegative and seropositive, respectively. Among the girls, mumps antibody titer was negative in 533 (58%) and positive in 412 (42%) subjects and there was no significant statistical difference regarding gender

Table 1: Mumps antibody titer in primary school children from the 19 educational sectors in Tehran based on gender

Antibody titer	Girl		Boy		Total	
	No.	%	No.	%	No.	%
Negative	533	56	419	58	952	57
Positive	412	44	301	42	713	43
Total	945	100	720	100	1665	100

Table 2: Mumps antibody titer based on vaccination status of primary school children from the 19 educational sectors of Tehran according to gender

Vaccination antibody titer	Gender	Seropositive		Seronegative		Total	
		No.	%	No.	%	No.	%
Vaccinated	Girl	155	53	137	47	530	32
	Boy	105	44	133	56		
Unvaccinated	Girl	257	39	396	61	1135	68
	Boy	196	40	286	60		
Total		713	44	952	56	1665	100

Table 3: Mumps antibody titer based on age group of primary school children in the 19 educational sectors of Tehran (2003-2004)

Antibody titer	Age group													
	6 years		7 years		8 years		9 years		10 years		11 years		12 years	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Positive	23	68	56	37	172	58	157	49	186	54	182	52.5	31	48
Negative	11	32	96	63	125	42	165	51	153	46	165	47.5	34	52

Table 4: Mumps antibody titer based on vaccination and sex among 6-12 year old school children from the 19 educational sectors in Tehran (2003-2004)

Antibody titer	Unvaccinated		Vaccinated	
	%	No.	%	No.
Positive	39	453	49	260
Negative	61	682	51	270

($p = 0.0571$) (Table 1). Out of 1665 students, 1135 (68%) had no history of prior mumps vaccination. Five hundred and thirty subjects had a history of mumps vaccination from 15 months onward (32%). Among those who had not been vaccinated, 453 (40%) were seropositive (females = 257, 39%; males = 196, 40%) while 682 (60%) subjects were seronegative (females = 396, 61%; males = 286, 60%). Out of 530 subjects without a history of mumps vaccination, 260 (49%) were seropositive (females = 155, 53%; males = 105, 44%) while 270 (51%) were seronegative (females = 137, 47%; males = 133, 56%) (Table 2). Most (n = 165) seropositive students were age 11, 112 of whom had not been vaccinated and 53 of whom had received vaccination. Among the 9-year olds, 194 were seronegative; this age shows the highest seronegative titer. Fifty seven of them had a history of prior vaccination and 137 had not been vaccinated. There was no significant statistical difference between the age groups regarding mumps antibody titer ($p = 0.105$) (Table 3 and 4). Out of 514 students from North Tehran educational sector, 198 (39%) and 316 (61%) were seropositive and seronegative, respectively. Among the seropositive cases, 76 had history of mumps vaccination and 122 did not. While among the 316 seronegative cases, 97 had history of mumps vaccination. On the whole, 219 subjects had not been vaccinated. 434 subjects were studied from South Tehran, 164 (38%) of whom were seropositive and 270 (62%) were seronegative. Among the seropositive cases, 52 had been vaccinated while 112 had not while among the seronegative cases, 71 had been vaccinated and 199 had not. In East Tehran educational sector, out of the 319 subjects who look part in the study, 165 (52%) were seropositive of whom 82 had history of vaccination and 83 had not been vaccinated. Among the 154 (48%) seronegative cases, 50 were vaccinated and 104 had not been vaccinated. In West Tehran educational sector, out of the 398 subjects, 186 (47%) were seropositive, 50 of whom were vaccinated and 136 subjects had not been vaccinated. Out of the 212 (53%) seronegative cases, 52 had been vaccinated and 160 had not. There was a significant statistical relationship between mumps antibody titer and the four geographical educational sectors of Tehran ($p<0.001$) (Table 5).

DISCUSSION

Mumps is an acute infectious viral disease which is associated with numerous early and late complications. 30-40% present subclinically. Meningoencephalitis is the most common complication of childhood which usually results in hospitalization[2]. The percentage of people at risk of mumps can be determined just by knowing the immune status of mumps in children. This was the first study performed to such an extent with the aim to determine the level of immunity of mumps in primary school children in the 19 educational sectors in Tehran. In this study, 1665 healthy primary school children aged 6-12 years from the 19 educational sectors

Table 5: Mumps IgG antibody titer in primary school children from the various geographical regions of Tehran based on vaccination (2003-2004)

Vaccination antibody titer		Geographical regions: North No.	North %	South No.	South %	East No.	East %	West No.	West %
Vaccinated	Positive	97	56	71	58	50	38	52	51
	Negative	76	44	52	42	82	62	50	48
Unvaccinated	Positive	219	64	199	64	104	56	160	54
	Negative	122	36	112	36	83	44	136	46

in Tehran were studied. 952 (57%) of the cases were seronegative and 713 (43%) were seropositive. Out of the 945 girls, 533 (56%) and 412 (44%) were seronegative and seropositive and out of the 720 boys, 419 (58%) and 301 (42%) were seronegative and seropositive, respectively. There was no significant statistical relationship according to gender ($p = 0.057$). In a similar study performed on the students of South Tehran, 67% boys and 67% girls were seropositive[10]. The cause of this difference between the two diseases is predominantly due to the variation in the age groups; infection rises with advancing age. In the present study, 9-year-olds had the lowest and 11-year-olds had the highest antibody titer to mumps. In a similar study the lowest and highest antibody titers were found in 7-11 and 12-14 year olds, respectively[10]. Antibody titer increased with advancing age, which is probably due to the increased period of contact with the virus or due to acquiring the infection. Similar reports are in agreement with our findings[11,12]. By studying the four geographical educational sectors, in our study seropositivity was found in 39, 38, 52 and 47% of the students from North, South, East and West Tehran, respectively. There was a significant statistical difference between mumps antibody titer and the geographical regions ($p < 0.001$). Maximum seropositivity occurred in East Tehran (52%) which was lower than values obtained in 1988 in South Tehran (67%)[10] and higher (38%) than what we found for South Tehran. This difference may be caused by the following factors:

- The previous study was performed on older subjects (≤ 20 years), which resulted in higher infectivity. Furthermore, this group had no history of mumps vaccination thus the natural immunity which was acquired by the subject lasted for a longer time. Previous studies confirm the fact that naturally acquired immunity, almost always, produces a definite immunity which also lasts longer[13], whereas that brought about by vaccination has been said to last 9.5-10.5 years in some studies[14] while it has been said to be 4 years in others[15].
- Out of 1665 primary school students that we studied, 1135 had no history of vaccination (68%) and 530 (32%) had received only a single dose of the vaccine at 15 months of age. Among the unvaccinated individuals, 40% had a positive antibody titer to mumps, which meant that they had acquired subclinical infection; this is in agreement with other studies[2] and suggests the need for national vaccination programs. Among the vaccinated individuals, 51% were seronegative and are therefore at risk of acquiring the infection.

In a study performed in the year 2000 in Luxemburg, which studied the protective effect of the MMR vaccine in children and adults who had received a single dose of the vaccine, 75% were seropositive. This shows the gradual falling antibody titer produced by vaccination during childhood, indicating the need for a booster dose in later years[7]. In a study performed in the year 2000 by the Center for Disease Control (CDC) in Atlantia, 54.4% of patients who had contracted mumps had a history of a single dose of MMR vaccine, while only 0.9% of cases had received two doses; this indicates the need for giving the booster dose[9]. This finding is consistent with that of another study[15]. Considering that studies show that maternal antibodies rapidly decrease in the newborn, 90% of infants are at risk of developing mumps infection by 6-8 months age[16]. Therefore it is better to give the first dose of the vaccine at around 1 year age. Regarding that in some reports the prevalence of mumps is much higher in persons who had received the last dose of mumps vaccine more than four years ago, as compared to those who had received the vaccine at less than this time[15]. In this study, in the 6-7 year old group, out of the 92 vaccinated subjects, 56.5% were seronegative and considering this minimal time interval, it is recommended that the second dose of the vaccine be given at least within 4 years of the initial dose and before entering school at the latest.

CONCLUSIONS

The percentage of mumps infection is high in school aged children. Forty percent of mumps cases in children are subclinical. Mumps vaccination should be a part of the national vaccination program. Mumps vaccination is recommended from age 1 year onward.

The efficacy of the vaccine is short-term and its protective role falls with increasing age to such an extent that even if production, storage, transport and cold-chain system of the vaccine were optimum, the antibody level will fall leading to a higher risk of acquiring mumps infection by at least 44 years. In order to prevent the numerous irreversible complications associated with mumps and prolonged absence from school and in order to prevent the economic burden imposed on the community and family, it is advised to repeat mumps vaccination prior to entering school.

ACKNOWLEDGMENTS

Our sincerest gratitude go to the Deputy of Sports and Health of the Ministry of Education, Dr. Sajjadi and the Director General and the Deputy of School Health System of Tehran as well as to the school health teachers who helped us in performing this study by their financial help, advice and guidance of the students and their parents. Also we would like to thank the technician who collected the blood samples and the Noor Laboratory staff.

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