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An Epidemiological Survey of Mumps in A Kindergarten, Taoyuan County

1. Introduction

On 13 and 14 October 1993, the Department of Health received reports of six mumps cases from the Taoyuan County Health Bureau. All six cases come from a kindergarten in Ping-Chen City of Taoyuan County. To understand the route of infection and to evaluate the efficacy of MMR (measles, mumps and rubella) vaccines, a survey was conducted.

Mumps (infectious parotitis) is an acute viral disease infecting the salivary glands, particularly the parotid. Incidence is high among pre-school and school children, particularly children aged 4-5 years. Immunity is lifelong. Incubation period ranges from 12 to 25 days, commonly 18 days. The mode of transmission is by droplet spread and by direct contact with saliva of an infected person. Symptoms include: swelling and pain of one or both sides of the parotid glands, abdominal pain, fever, headache and mild respiratory symptoms. Around 30-40% have inapparent infections. Complications such as orchitis and ovaritis are more common and severe in adolescents. In children, meningoencephalitis and encephalitis or impairment of hearing may occur as complications, though rarely[1-3].

Prevention is by immunization of MMR vaccines. The vaccines are administered at 15 months and above after birth. In susceptible children, antibodies can be found in serum 5 to 7 weeks after immunization. The rate of neutralizing antibody seroconversion is between 96.9 and 100%. The protective rate of vaccines is 95% and above[4-5].

2. Methods and Materials

Methods:

A structured questionnaire was used to interview children of the kindergarten. The questionnaire includes:

1) background information: name, sex, date of birth, class, use of school bus,

2) child or his/her siblings not feeling well after 1 September 1993, and if so, when, what symptoms, any contact with mumps patients, ever being infected with mumps;

3) child and his/her siblings ever being vaccinated with MMR, and if so, when and where.

One copy of the questionnaire was given by school teachers on 20 October to each child for filling-up by parents.

Definitions:

1) case: a case was one who met the following criteria:

(1) a child of the kindergarten;
(2) onset of disease between 1 September and 25 October 1993;
(3) swelling or pain of parotid glands.

2) post-exposure vaccination or incubation vaccination: vaccination of MMR after contact with mumps patients (first vaccination after birth), that is, vaccination after 1 September 1993.

3) unsusceptible: children with immunity either through previous infection of mumps or vaccination of MMR before exposure.

4) susceptible: never being infected with mumps nor being vaccinated before exposure. Those who did not remember being either infected or vaccinated were classified in this group (Figure 1).

3. Findings

All questionnaires (100%) were collected on 25 October. The kindergarten had three classes of different age groups with 24, 17 and 13 children in each, totaling 54 children. 51.9% boys and 48.1% girls. Ages ranged from 3 to 7 years, with 68.5% in the 4-6 year age group. 81.4% of families had 2 to 3 children. 66.7% came by school buses (Table 1).

41 children (75.9%) did not feel well between 1 September and 25 October 36 children (66.7%) had been vaccinated with MMR, 10 (18.5%) had not been, and 8 (14.8%) did not remember. Of the 36 being vaccinated, only 6 were vaccinated prior to exposure, and 4 vaccinated after being infected with mumps on 1 September 6 (11.1%) had been infected with mumps before 1 September; 43 (79.6%) had not been infected; and 5 (9.3%) did not remember (Table 1)

The epidemic curve is shown in Figure 2. 15 children met the criteria of a case. Onset of disease concentrated on 6-23 October. The earliest onset was on 7 September.

Distribution of symptoms was: swelling or pain of parotid (100%), fever (40.0%), coughing (26.7%), and headache (13.3%) (Table 2).

Infection of mumps gives lifelong immunity and the protective rate of MMR is as high as 95%, with the exception of the 11 children who had either been infected or vaccinated before 1 September 1993, the rest 43 were the susceptibles studied by the present survey (for detail, see Figure 1). When comparing cases and non-cases of the susceptibles in terms of class, sex, age, number of children per family, use of school bus, vaccination of MMR, contact with mumps cases outside kindergarten, siblings being infected with mumps or vaccinated with MMR, statistically significant difference was found only in the experience of MMR vaccination ($p<0.001$), that is, more in the non-case group had vaccination than the case group (85.7% vs. 20.0%) (Table 3).

Further analysis of mumps patients and MMR vaccination shows that: cases occupied 0.0%, 11.1% and 75.0% in the vaccination before 1 September 1993 group, vaccination after this date group, and either not vaccinated or did not remember being vaccinated group respectively, with statistically significant difference ($p<0.01$) (Table 4). That is, none of children vaccinated before exposure had been infected; children vaccinated even after exposure still had lower infection rate than children not vaccinated or did not remember being vaccinated.

4. Discussion

1) Prior to the outbreak, there was an unreported outbreak in July and August in a kindergarten in Yangmei Township. Of 120 children in that kindergarten, around 30 were infected. Mother of one of the infected children works in a nursery affiliated to a research institute in Yangmei. The child visited his mother often, and 5 of the 36 children of the nursery became infected between July and September. The index case of the Ping-Chen kindergarten was originally with the nursery, came to the kindergarten on 3rd September, being diagnosed as mumps on 7 September yet continued to attend class. No isolation measures were taken by the kindergarten, hence the outbreak. The incubation period is between 12 and 25 days. From Figure 2, the interval between the first and the second to the seventh cases was about 30 days. A likely reason is, the date of onset filled out by parents on the questionnaire was the date when swelling and pain of parotid appeared, the actual date of onset could have been earlier. Further, a case was defined as one with swelling and pain of parotid, it is possible that someone could have been infected without either swelling or pain of parotid during the interval between the first and the second to the seventh cases and infected others.

2) Contact with mumps cases is the major cause of infection. However, in the present survey, those who shared the same school bus or in the same class with cases did not show higher infection rate. Observation, however, shows that though the three classes shared different classrooms, children played together after class and dined together in

the same dining room. Children of different classes also shared the two lines of school buses. The viruses could have been spread by droplets and saliva to all children. An analysis of the first few cases also shows that contact between siblings (coming from same family but in different classes) was also a reason for the spread of the disease in different classes. Table 3 on infection and various factors gives only significant difference to the experience of MMR vaccination and not to others. The likely reasons are that the kindergarten is small, the number of children small, and the sapce is not isolated.

3) 41 children did not feel well between 1 September and 25 October, though only 15 met the criteria of a case. 30 children had MMR vaccination after 1 September. Literatures show that around 30-40% of those infected by mumps have inapparent infections[2], and 0-5% of those vaccinated with MMR will experience swelling or pain of parotid[6]. A case was defined by the present survey as one with either swelling or pain of parotid, estimate of the actual number infected could be biased. Serological diagnosis of blood was considered. However, blood-taking of children would require consent of parents, and also, boosters of MMR were given to children by the local health station in the morning, serological diagnosis was not possible. There would have been less bias if serological testings were conducted. Teachers of the kindergarten did not recall any mumps outbreaks in the past. The 30-40% inapparent infections though might have some impacts on the estimate of the susceptibles, the bias should not be too large.

4) Post-exposure vaccination is said to give no protection[7]. The present survey found, however, that infection rate was still lower in the post-exposure vaccination group (by health station on 16 October) than in the non-vaccination or did not remember group (11.1% vs. 75.0%) (Table 4). Of the 15 who met the criteria of cases, 3 were vaccinated after 16 October, the rest 12 were never vaccinated. Though a high percentage of mumps infections is inapparent, cases and non-cases in the present survey could have been grouped wrongly. Tolpin and Schauf point out, however, that vaccination after exposure is not necessarily meaningless, and that, during the period when immunity has not yet developed after natural exposure, vaccines can provide protection[2].

5) There was an unreported outbreak in a kindergarten in Yangmei in July and August. This shows that mumps is often under-reported in the reporting systems of communicable diseases. Likely reasons are: inapparent infection, infection without swelling or pain of parotid, mild infection not noticed and hence not reported. Chances of reporting are higher if severe complications follow[2].

5. Conclusion

Mumps among children is considered a relatively benign disease, its prevention, infection control and reporting are not satisfactory. Only immunization of MMR in time can provide children effective protection. Whether MMR vaccination post-exposure will provide protection though requires further studies, post-exposure vaccination is still considered useful, particularly to the uninfected individuals under natural exposure.

Reported by: 1. National Institute of Preventive Medicine, DOH
2. Bureau of Communicable Disease Control, DOH
3. Health Bureau of Taoyuan County, Taiwan Health Department

Prepared by: Y.H. Shen, H.Y. Kan, K.T. Chen (FETP, NIPM-DOH)

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Figure 1. Definition of Terms

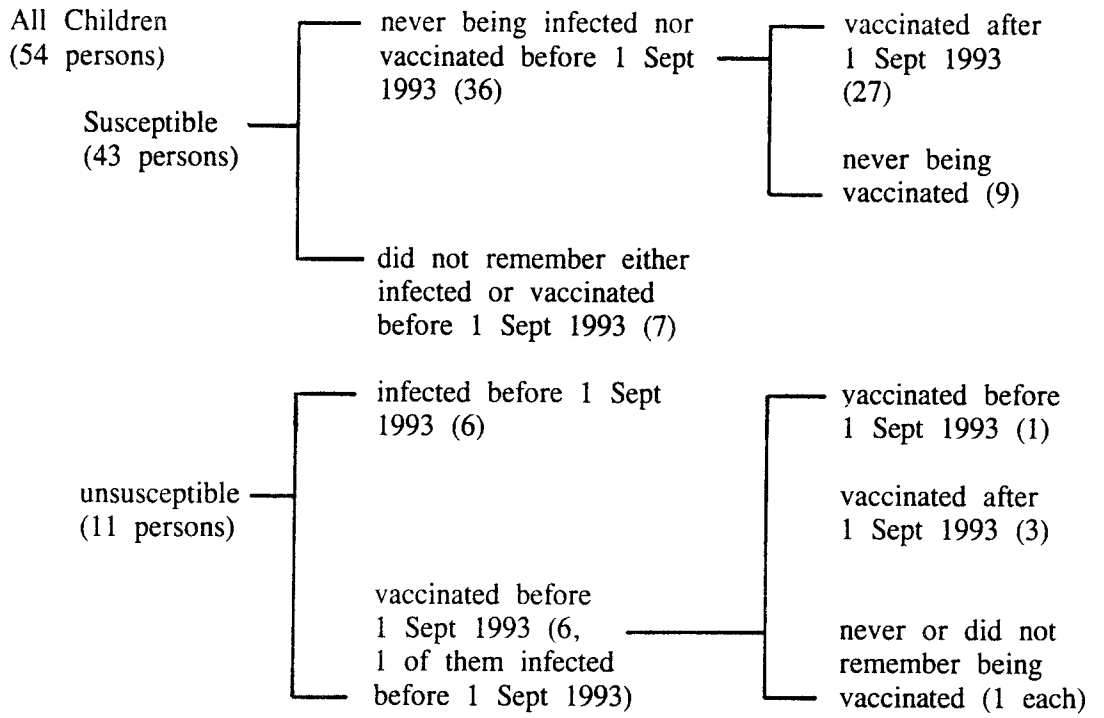

Figure 2. Epidemic Curve of Mumps Outbreak in a Kindergarden Taoyuan, Taiwan, September 1993 — Oct. 1993

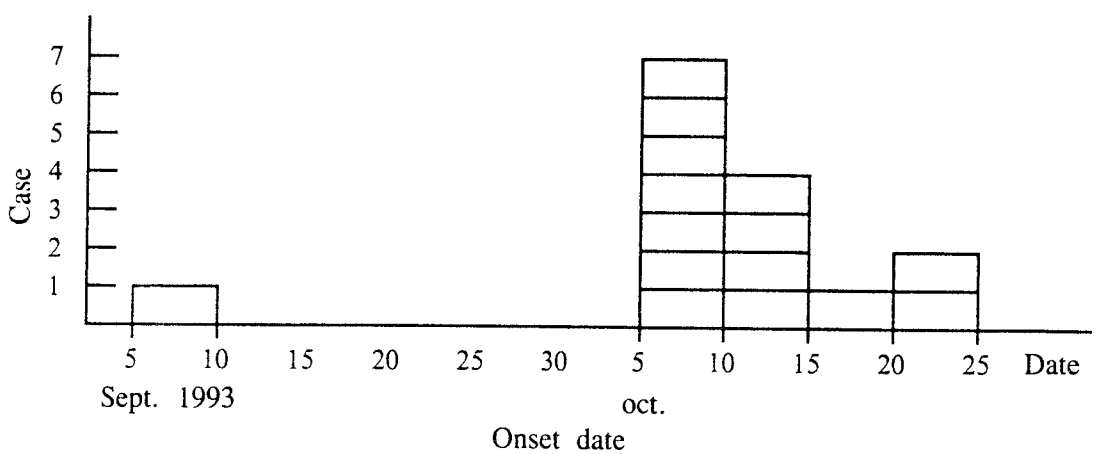

Table 1. Distribution of Background Characteristics

	No.	%		No.	%
	N=54	100.0		N=54	100.0
Class:			Use of school bus:		
Young	24	44.4	No	18	33.3
Younger	17	31.5	Yes	36	66.7
Youngest	13	24.1	Tungshi line	27	50.0
Sex:			Chungli line	9	16.7
Male	28	51.9	Not feeling well (1 Sept — 25 Oct 93'):		
Female	26	48.1	Yes	41	75.9
Age:			No	13	24.1
-3 yrs	5	9.3	Being vaccinated:		
3-4	7	13.0	Yes	36	66.7
4-5	16	29.6	No	10	18.5
5-6	21	38.9	Don't know	8	14.8
6-7	5	9.3	Being infected before (1 Sept 93'):		
No. of children in a family:			Yes	6	11.1
1	6	11.1	No	43	79.6
2	20	37.0	Don't know	5	9.3
3	24	44.4			
4	4	7.4			

Table 2. Distribution of Symptoms

Symptoms	No.	%
	N=15	100.0
Swelling or pain of parotid	15	100.0
Fever	6	40.0
Coughing	4	26.7
Headache	2	13.3
Abdominal pain	1	6.7
Others	0	0.0

Table 3. Comparing Cases and Non-Cases Among the Susceptibles

	Cases	%	Non-cases	%	p-value
	N=15	100.0	N=28	100.0	
Class:					
Young	8	53.3	12	42.9	0.70
Younger	4	26.7	11	39.3	
Yongest	3	20.0	5	17.9	
Sex:					
Male	9	60.0	13	46.4	0.40
Female	6	40.0	15	53.6	
Age:					
-3	0	0.0	2	7.1	0.66
3-4	3	20.0	3	10.7	
4-5	4	26.7	10	35.7	
5-6	7	46.7	10	35.7	
6-7	1	6.7	2	7.1	
No. of children:					
1	2	13.3	2	7.1	0.93
2	5	33.3	10	35.7	
3	7	46.7	14	50.0	
4	1	6.7	2	7.1	
Use of school bus:					
No	5	33.3	10	35.7	0.70
Yes	10	66.7	18	64.3	
Tungshi line	7	46.7	15	53.6	
Chungli line	3	20.0	3	10.7	
Vaccinated with MMR:					
Yes	3	30.0	24	85.7	0.00*
No	5	33.3	4	14.3	
Don't know	7	46.7	0	0.0	
Siblings vaccinated:					
Yes	4	26.7	6	21.4	0.93
No	7	46.7	14	50.0	
Don't know	4	26.7	8	28.6	
Siblings infected:					
Yes	1	6.7	5	17.9	0.30
No	10	66.7	20	71.4	
Don't know	4	26.7	3	10.7	
Contact with case outside kindergarten:					
Yes	2	13.3	2	7.1	0.35
No	8	53.3	21	75 0	
Don't know	5	33.3	5	17 0	

#: Non-case = Susceptibles — cases; *: $p < 0.01$

Table 4. Mumps Cases and MMR Vaccination

	Cases	%	Non-cases	%	Total	%	p-value
	N=15	31.3	N=33	68.8	N=48	100.0	
MMR vaccination							
before 1 Sept 1993	0	0.0	5	100.0	5	100.0	0.00*
after 1 Sept 1993	3	11.1	24	88.9	27	100.0	
not or forgotton	12	75.0	4	25.0	16	100.0	

#: Non-case = all children − cases − children ever infected
*: $p < 0.01$