npj | Primary Care Respiratory Medicine

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A community-based cross-sectional immunisation survey in parents of primary school students

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Immunisation is a very important aspect of child health. Invasive pneumococcal and influenza diseases have been major vaccine-available communicable diseases. We surveyed demographics and attitudes of parents of primary school students who received pneumococcal conjugate vaccination (PCV) and compared them with those who did not receive pneumococcal vaccination. The survey was carried out in randomly selected primary schools in Hong Kong. Questionnaires were sent to nine primary schools between June and September 2014. Parents of 3,485 children were surveyed, and 3,479 (1,452 PCV immunised, 2,027 un-immunised) valid questionnaires were obtained. Demographic data were generally different between the two groups. PCV-immunised children were more likely to be female (57.0 vs. 52.2%, $P=0.005$), born in Hong Kong (94.2 vs. 92.3%, $P=0.031$), have a parent with tertiary education (49.2 vs. 31.8, $P<0.0005$), from the higher-income group ($P=0.005$), have suffered upper respiratory infections, pneumonia, otitis media or sinusitis ($P=0.019$), and have doctor visits in preceding 12 months ($P=0.009$). They were more likely to have received additional immunisations outside the Hong Kong Childhood Immunization Programme (64.0 vs. 30.6%, $P<0.0005$) at private practitioner clinics (91.1 vs. 83.5%, $P<0.0005$). Un-immunised children were more likely to live with senior relatives who had not received PCV. Their parents were less likely to be aware of public education programme on PCV and influenza immunisation, and children were less likely to have received influenza vaccination. The major reasons for PCV immunisations were parent awareness that pneumococcal disease could be severe and vaccines were efficacious in prevention. The major reasons for children not being immunised with PCV were concerns about vaccine side effects, cost, vaccine not efficacious or no recommendation by family doctor or government. In conclusion, PCV unimmunized children were prevalent during the study period. Reportedly, they were generally less likely to have received influenza and other childhood vaccines, and more likely to live with senior relatives who had not received PCV and influenza. These observations provide important demographic data for public health policy in childhood immunisation programme.

npj Primary Care Respiratory Medicine (2016) **26,** 16011; doi:10.1038/npjpcrm.2016.11; published online 7 April 2016

INTRODUCTION

Immunisation is a very important aspect of child health. Invasive pneumococcal and influenza diseases have been major communicable diseases for which vaccines are available.[1–4] The Hong Kong Childhood Immunization Programme was launched in 2007, and universal pneumococcal conjugate vaccination (PCV)in children was implemented in 2009.[5–7] However, certain vaccine-preventable diseases, notably pneumococcal and influenza infections, are still not under control. The influenza and pneumococcal vaccine coverage rates were generally low.[8] This study evaluated the knowledge and practices of immunisation associated with these diseases among local parents. With such an understanding, public health effort in education and therapeutics for our patients can be targeted.

RESULTS

A total of 6,469 questionnaires were sent to nine primary schools between June and September 2014. Parents of 3,485 children were surveyed, and 3,479 (1,452 PCV immunised and 2,027 un-immunised) valid questionnaires were obtained (Table 1). Nine out of 10 parents believed that PCV is important for the health of their children, but only 42% of children had received PCV. Four out of 10 children lived with senior relatives (grandparents), but 7 out of 10 of these senior relatives had not received PCV. Twelve percent of children had a history of chronic conditions including prematurity (5.7%, <37 weeks gestation), asthma (5.4%) and congenital heart disease (0.7%). In terms of demographics and parental attitudes, PCV-immunised children were generally very different from their un-immunised counterparts (Tables 1 and 2). They were more likely to be female (57.0 vs. 52.2% female, $P=0.005$), born in Hong Kong (94.2 vs. 92.3%, $P=0.031$), have a parent with tertiary education (49.2 vs. 31.8, $P<0.0005$), from the higher-income group (HK$60,000+ per month, $P=0.005$), live in Hong Kong Island or Kowloon peninsula, have suffered from UTI, pneumonia, otitis media or sinusitis ($P=0.019$) and have doctor visits in the preceding 12 months ($P=0.009$). They were more likely to have received additional immunisations outside the Hong Kong Childhood Immunization Programme (64.0 vs. 30.6%, $P<0.0005$) at private practitioner clinics (91.1 vs. 83.5%, $P<0.0005$). The parents of PCV-immunised children generally believed that PCV, chickenpox, hepatitis A and B virus, rotavirus, influenza, encephalitis and *Hemophilus influenzae* B immunisation were important for their child. These parents were also more likely to be aware that *Streptococcal pneumoniae* (SP) infection could be

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Received 17 November 2015; revised 12 January 2016; accepted 26 January 2016

Table 1. Demographic data for the pneumococcal vaccine survey

	Overall		*Vaccinated*		*Not vaccinated*		P *value*
	N	%	N	%	N	%	
Total	3,485	100.0%	1,455	41.8%	2,030	58.2%	
Gender (n = *3,479*)							
Male	1,593	45.8%	624	43.0%	969	47.8%	**0.005**
Female	1,886	54.2%	828	57.0%	1,058	52.2%	
Missing	12	0.3%	3	0.2%	3	0.1%	
Birth year							
Before 2002	385	11.1%	75	5.2%	310	15.3%	< **0.0005**
2003	497	14.3%	118	8.2%	379	18.7%	
2004	497	14.3%	184	12.7%	313	15.5%	
2005	611	17.6%	261	18.0%	350	17.3%	
2006	753	21.7%	371	25.6%	382	18.9%	
2007	722	20.8%	436	30.1%	286	14.1%	
After 2008	4	0.1%	2	0.1%	2	0.1%	
Missing	23	0.6%	8	0.5%	8	0.4%	
Birth weight (kg)							
Mean	3,141	3.39 ± 1.08	1,333	3.35 ± 1.04	1,808	3.42 ± 1.10	0.064
Born in Hong Kong (n = *3,473*)							
Yes	3,234	93.1%	1,367	94.2%	1,867	92.3%	**0.031**
No	239	6.9%	84	5.8%	155	7.7%	
Missing	19	0.5%	4	0.3%	8	0.4%	
Parent or guardian's highest education (n = *3,470*)							
Primary school	181	5.2%	70	4.8%	111	5.5%	< **0.0005**
Secondary school	1,933	55.7%	665	45.9%	1,268	62.7%	
Tertiary or above	1,356	39.1%	713	49.2%	643	31.8%	
Missing	23	0.6%	7	0.5%	8	0.4%	
Monthly household income (n = *3,416*)							
⩽HK$10,000	437	12.8%	140	9.8%	297	14.9%	< **0.0005**
$10,001–19,999	869	25.4%	291	20.4%	578	29.0%	
$20,000–$39,999	855	25.0%	325	22.8%	530	26.6%	
$40,000–$59,999	512	15.0%	242	17.0%	270	13.6%	
⩾$60,000	743	21.8%	427	30.0%	316	15.6%	
Missing	83	2.3%	30	2.1%	39	1.9%	
Residence (n = *3,468*)							
HK Island	472	13.6%	218	15.1%	254	12.6%	**0.031**
Kowloon	1,657	47.8%	710	49.1%	947	46.9%	
New Territories	1,235	35.6%	474	32.8%	761	37.7%	
Outlying islands	8	0.2%	4	0.3%	4	0.2%	
Outside Hong Kong	96	2.8%	41	2.8%	55	2.7%	
Missing	23	0.6%	8	0.5%	9	0.4%	

The bold entries indicate the significant *P*-values.

fatal (90.9% vs. 71.5%, $P < 0.0005$), and that it could cause meningitis, pneumonia, otitis media and septicaemia. Un-immunised children were more likely to live with senior relatives who had not received PCV. Their parents were less likely to be aware of public education programme on PCV, as well as influenza immunisation, and less likely to have received influenza vaccination (16.4% vs. 30.8%, $P < 0.0005$). Generally, the majority of informants did not know which PCV their child had received (Table 3). Private practitioners, family doctors and paediatricians were generally important sources of vaccine information. The major reasons for PCV immunisations were parental awareness of the severity of SP disease, PCV being effective in prevention and recommendations by the paediatrician or government. The major reasons for children not being immunised with PCV were concerns about vaccine side effects, cost, vaccine not efficacious and no recommendation by the private practitioner or the government (Table 4).

A binomial logistic regression was performed to ascertain the effects of child's gender, birth year, Hong Kong born, residing with grandparents, history of respiratory tract-related infections, history of immunisation in Hong Kong, history of influenza immunisation, parents' highest education, monthly household income, knowledge on the risk of death caused by Pneumococcus, predicted risk of cross-infectivity and knowledge on a local propaganda 'Left influenza and Right pneumococcus immunization' on the likelihood that the child has received Pneumococcal vaccine. Child of female gender (odds ratio (OR): 1.22; 95% confidence interval (CI): 1.05–1.43; $P = 0.010$), later birth year (OR: 1.42; 95% CI: 1.35–1.49; $P < 0.0005$ for every level increase), with history of influenza immunisation (OR: 2.11; 95% CI: 1.75–2.53; $P < 0.0005$), higher parental education (OR: 1.19; 95% CI: 1.01–1.40; $P = 0.038$ for every

Table 2. Paediatric medical history and parental attitudes

	Overall		*Vaccinated*		*Not vaccinated*		P *value*
	N	%	N	%	N	%	
Total	3,485	100.0%	1,455	41.8%	2,030	58.2%	
Any upper respiratory infection, pneumonia, middle ear infection or sinusitis in the past 6 months (n = *3,478*)							
Yes	2,431	69.9%	1,053	72.5%	1,378	68.0%	**0.019**
No	1,024	29.4%	392	27.0%	632	31.2%	
Uncertain	23	0.7%	8	0.6%	15	0.7%	
Missing	10	0.3%	2	0.1%	5	0.2%	
Any doctor visit (n = *2,417*)							
Yes	2,157	89.2%	954	91.1%	1,203	87.8%	**0.009**
No	260	10.8%	93	8.9%	167	12.2%	
Missing	16	0.6%	6	0.6%	8	0.6%	
Any hospitalisation (n = *2,403*)							
Yes	75	3.1%	39	3.8%	36	2.6%	0.121
No	2,328	96.9%	1,001	96.2%	1,327	97.4%	
Missing	32	1.3%	13	1.2%	15	1.1%	
Any antibiotic by doctor (n = *2,404*)							
Yes	832	34.6%	381	36.6%	451	33.1%	0.165
No	1,486	61.8%	628	60.3%	858	63.0%	
Uncertain	86	3.6%	33	3.2%	53	3.9%	
Missing	32	1.3%	11	1.0%	16	1.2%	
Medication without doctor consultation (n = *2,404*)							
Yes	957	39.8%	379	36.5%	578	42.3%	**0.004**
No	1,447	60.2%	659	63.5%	788	57.7%	
Missing	30	1.2%	15	1.4%	12	0.9%	
Past medical history (more than one choice)							
Prematurity < 37 weeks	196	5.7%	94	6.5%	102	5.1%	0.068
Asthma	187	5.4%	68	4.7%	119	5.9%	0.130
Congenital heart disease	24	0.7%	12	0.8%	12	0.6%	0.409
Chronic lung disease	0	0.0%	0	0.0%	0	0.0%	—
Congenital immunodeficiency	2	0.1%	0	0.0%	2	0.1%	0.514
Cochlear implant	1	0.0%	0	0.0%	1	0.0%	>0.999
Others	105	3.0%	53	3.7%	52	2.6%	0.063
Immunisation in Hong Kong (n = *3,467*)							
Yes	3,072	88.6%	1,309	90.5%	1,763	87.3%	**0.014**
Partly	312	9.0%	110	7.6%	202	10.0%	
No	83	2.4%	28	1.9%	55	2.7%	
Missing	25	0.7%	8	0.5%	10	0.5%	
Child immunised according to Hong Kong Childhood Immunization Programme for 0–18 months (n = *3,374*)							
Yes	3,120	92.5%	1,322	93.4%	1,798	91.8%	0.056
Partly	184	5.5%	73	5.2%	111	5.7%	
No	70	2.1%	20	1.4%	50	2.6%	
Missing	86	2.4%	32	2.2%	48	2.4%	
Immunisations at (more than one)							
Total	3,260		1,384		1,876		
GP clinic	1,111	34.1%	740	53.5%	371	19.8%	< **0.0005**
Private hospital	218	6.7%	141	10.2%	77	4.1%	< **0.0005**
MCH clinic	2,665	81.7%	1,002	72.4%	1,663	88.6%	< **0.0005**
Other	85	2.6%	30	2.2%	55	2.9%	0.176
Any additional immunisation beyond Hong Kong Childhood Immunization Programme (n = *3,447*)							
Yes	1,535	44.5%	922	64.0%	613	30.6%	< **0.0005**
No	1,912	55.5%	519	36.0%	1,393	69.4%	
Missing	46	1.3%	14	1.0%	24	1.2%	
Additional immunisation at (more than one)							
Total	1,517		911		606		
GP clinic	1,336	88.1%	830	91.1%	506	83.5%	< **0.0005**
Private hospital	88	5.8%	59	6.5%	29	4.8%	0.168
Other	125	8.2%	41	4.5%	84	13.9%	< **0.0005**
Importance of immunisation for your child's health							
Pneumococcal conjugate vaccine (PCV; n = *3,461)*							
Very important	2,074	59.9%	1,072	74.1%	1,002	49.8%	< **0.0005**
Important	1,027	29.7%	331	22.9%	696	34.6%	
Fair	185	5.3%	23	1.6%	162	8.0%	
Not important	17	0.5%	0	0.0%	17	0.8%	
Uncertain	158	4.6%	21	1.5%	137	6.8%	
Missing	31	0.9%	8	0.5%	16	0.8%	
Chickenpox (n = *3,457*)							
Very important	1,741	50.4%	872	60.4%	869	43.1%	< **0.0005**
Important	1,276	36.9%	462	32.0%	814	40.4%	
Fair	315	9.1%	85	5.9%	230	11.4%	
Not important	36	1.0%	11	0.8%	25	1.2%	
Uncertain	89	2.6%	13	0.9%	76	3.8%	
Missing	34	1.0%	12	0.8%	16	0.8%	
Hepatitis A (n = *3,446*)							
Very important	1,753	50.9%	809	56.2%	944	47.0%	< **0.0005**
Important	1,169	33.9%	450	31.3%	719	35.8%	
Fair	326	9.5%	128	8.9%	198	9.9%	
Not important	32	0.9%	9	0.6%	23	1.1%	
Uncertain	166	4.8%	43	3.0%	123	6.1%	
Missing	48	1.4%	16	1.1%	23	1.1%	
Hepatitis B (n = *3,450*)							
Very important	2,021	58.6%	938	65.1%	1,083	53.9%	< **0.0005**

Table 2. (Continued)

	Overall		Vaccinated		Not vaccinated		P value
	N	%	N	%	N	%	
Important	1,078	31.2%	402	27.9%	676	33.6%	
Fair	201	5.8%	68	4.7%	133	6.6%	
Not important	13	0.4%	1	0.1%	12	0.6%	
Uncertain	137	4.0%	31	2.2%	106	5.3%	
Missing	42	1.2%	15	1.0%	20	1.0%	
Rotavirus oral vaccine (n = *3,446*)							
Very important	1,543	44.8%	744	51.7%	799	39.8%	< **0.0005**
Important	1,157	33.6%	449	31.2%	708	35.3%	
Fair	453	13.1%	182	12.6%	271	13.5%	
Not important	35	1.0%	9	0.6%	26	1.3%	
Uncertain	258	7.5%	56	3.9%	202	10.1%	
Missing	48	1.4%	15	1.0%	24	1.2%	
Influenza vaccine (n = *3,447*)							
Very important	1,025	29.7%	465	32.3%	560	27.9%	< **0.0005**
Important	1,179	34.2%	481	33.4%	698	34.8%	
Fair	984	28.5%	415	28.8%	569	28.4%	
Not important	156	4.5%	61	4.2%	95	4.7%	
Uncertain	103	3.0%	18	1.2%	85	4.2%	
Missing	47	1.3%	15	1.0%	23	1.1%	
Japanese B virus (n = *3,445*)							
Very important	1,735	50.4%	788	54.8%	947	47.2%	< **0.0005**
Important	1,108	32.2%	428	29.8%	680	33.9%	
Fair	349	10.1%	139	9.7%	210	10.5%	
Not important	35	1.0%	8	0.6%	27	1.3%	
Uncertain	218	6.3%	74	5.1%	144	7.2%	
Missing	48	1.4%	18	1.2%	22	1.1%	
Hemophilus influenzae B (Hib; n = *3,444*)							
Very important	1,427	41.4%	658	45.8%	769	38.3%	< **0.0005**
Important	1,085	31.5%	435	30.3%	650	32.4%	
Fair	418	12.1%	159	11.1%	259	12.9%	
Not important	39	1.1%	11	0.8%	28	1.4%	
Uncertain	475	13.8%	174	12.1%	301	15.0%	
Missing	50	1.4%	18	1.2%	23	1.1%	
Pneumococcal disease (more than one)							
Meningitis	1,515	44.0%	794	55.1%	721	35.9%	< **0.0005**
Arthritis	59	1.7%	25	1.7%	34	1.7%	0.922
Pneumonia	2,216	64.3%	1,057	73.4%	1,159	57.7%	< **0.0005**
Otitis media	541	15.7%	262	18.2%	279	13.9%	**0.001**
Sinusitis	138	4.0%	55	3.8%	83	4.1%	0.645
Septicaemia	317	9.2%	151	10.5%	166	8.3%	**0.026**
Asthma	335	9.7%	125	8.7%	210	10.5%	0.083
Do not know	1,077	31.2%	277	19.2%	800	39.8%	< **0.0005**
Missing	53	1.5%	15	1.0%	21	1.0%	
Do you know SP can kill? (n = *3,458*)							
Yes	2,751	79.6%	1,311	90.9%	1,440	71.5%	< **0.0005**
No	707	20.4%	132	9.1%	575	28.5%	
Missing	42	1.2%	12	0.8%	15	0.7%	
Residing with grandparents? (n = *3,471*)							
Yes	1,550	44.7%	597	41.3%	953	47.1%	**0.001**
No	1,921	55.3%	849	58.7%	1,072	52.9%	
Missing	26	0.7%	9	0.6%	5	0.2%	
Does co-inhabiting grandparent(s) receive PCV?							
Total	1,544		595		949		
Yes	122	7.9%	79	13.3%	43	4.5%	< **0.0005**
No	1,147	74.3%	404	67.9%	743	78.3%	
Uncertain	275	7.8%	112	18.8%	163	17.2%	
Missing	6	0.4%	2	0.3%	4	0.4%	
What do you think about cross-infectivity risk? (n = *3,432*)							
Low	383	11.2%	162	11.3%	221	11.0%	< **0.0005**
Average	2,038	59.4%	755	52.7%	1,283	64.2%	
High	1,011	29.5%	515	36.0%	496	24.8%	
Missing	72	2.0%	23	1.6%	30	1.5%	
Have you heard of propaganda `Left influenza and Right pneumococcus immunization' (n = *3,461*)							
Yes	215	6.2%	105	7.3%	110	5.5%	**0.029**
No	3,246	93.8%	1,339	92.7%	1,907	94.5%	
Missing	34	1.0%	11	0.8%	13	0.6%	
Child received influenza immunisation? (n = *3,458*)							
Yes	775	22.4%	444	30.8%	331	16.4%	< **0.0005**
No	2,683	77.6%	997	69.2%	1,686	83.6%	
Missing	39	1.1%	14	1.0%	13	0.6%	
How much are you willing to pay for catch-up immunisation? (n = *3,442*)							
Not willing	648	18.8%	176	12.3%	472	23.5%	< **0.0005**
HK$100–500 per vaccine	2,253	65.5%	925	64.6%	1,328	66.1%	
HK$501–1,000	436	12.7%	258	18.0%	178	8.9%	
HK$1,001–1,500	62	1.8%	43	3.0%	19	0.9%	
HK$1,501–2,000	43	1.2%	30	2.1%	13	0.6%	
Missing	59	1.7%	23	1.6%	20	1.0%	

Abbreviations: GP, general practitioner; MCH, Maternal and Child Health; SP, *Streptococcus pneumoniae*. The bold entries indicate the significant *P*-values.

Table 3. Which pneumococcal conjugate vaccine (PCV) and reasons for immunisation

	N (n = 1,455)	%
PCV (more than one)		
PCV 7	292	20.1%
PCV 10	159	10.9%
PCV 13	181	12.4%
PCV 23	32	2.2%
Uncertain	842	57.9%
Missing	8	0.5%
Immunisation at (more than one)		
GP clinic	998	68.6%
Private hospital	94	6.5%
MCH clinic	308	21.2%
Other	50	3.4%
Missing	24	1.6%
Immunisation		
Once	492	33.8%
Twice	282	19.4%
Three times	133	9.1%
Four times	140	9.6%
Uncertain	397	27.3%
Missing	11	0.8%
Know about PCV from (more than one source)		
Friends or relatives	343	23.6%
Paediatrician/family doctor	718	49.3%
Television/newspaper/magazine	507	34.8%
Government/Department of Health	467	32.1%
Other	26	1.8%
Reasons for PCV immunisation (can choose ⩽3)		
Know that PD is serious	1,128	77.5%
PCV is efficacious for prevention	689	47.4%
Recommended by friends or relatives	237	16.3%
Recommended by paediatrician/ family doctor	511	35.1%
Recommended by television/newspaper/ magazine	172	11.8%
Recommended by Government/ Department of Health	295	20.3%
Other	18	1.2%
Missing	11	0.8%

Abbreviations: GP, general practitioner; MCH, Maternal and Child Health; PD, pneumococcal disease.

Table 4. Reasons for child not receiving PCV (⩽3 items)

	N (2,030)	%
Concerns about adverse effects	507	25.0%
Too expensive	368	18.1%
Child immunity already high	269	13.3%
No knowledge about PCV	439	21.6%
Child fear of needle jab	70	3.4%
Uncertain about PCV efficacy	490	24.1%
Difficult-to-temper child	7	0.3%
No immediate risk, unnecessary	297	14.6%
PCV not available then	354	17.4%
No knowledge about SP	271	13.3%
No recommendation by GP	416	20.5%
No recommendation by Government or DH	450	22.2%
No reason	284	14.0%
Other	56	2.8%

Abbreviations: DH, Department of Health; GP, general practitioner; PCV, pneumococcal conjugate vaccine; SP, *Streptococcus pneumoniae*.

level increase), higher monthly household income (OR: 1.22; 95% CI: 1.14–1.31; $P < 0.0005$ for every level increase), parents being knowledgeable on the risk of death caused by Pneumococcus (OR: 3.13; 95% CI: 2.50–3.91; $P < 0.0005$) and higher predicted risk of cross-infectivity (OR: 1.29; 95% CI: 1.13–1.46; $P < 0.0005$ for every level increase) were independently associated with increased likelihood of the child being vaccinated with Pneumococcal vaccine.

DISCUSSION

Main findings

This survey reveals many important public health issues for childhood immunisations. A majority of parents are aware that SP and influenza can cause serious disease, but less than half of their children were immunised. Alarmingly, more than half of the children with chronic respiratory disease such as asthma did not receive PCV immunisation. The same phenomenon of low immunisation rates in children with chronic respiratory diseases has been observed by Talbot *et al*.[9] Invasive pneumococcal disease results in higher mortality in children with comorbidity.[10] Asthma is a common respiratory disorder among children and is most studied, which is an independent risk factor for invasive and severe pneumococcal disease.[11,12] The risk among persons with asthma was at least double compared with that among controls.[9]

During the winter influenza season, prevention of co-infections with pneumococcal disease continues to be challenging in at-risk population.[13–15] In our study, parents reported that the un-immunised children often had senior relatives (usually grandparents) who were also un-immunised. In recent years, the Hong Kong government has advocated and implemented PCV and influenza vaccination in the elderly population. Health education should target both the elderly and the paediatric population to optimise immunisation coverage and to provide more extensive or herd protection to the population at large with these vaccines.[2,9]

Reportedly, the major reasons for PCV immunisations were that parents were aware that SP disease could be severe and vaccines were efficacious in prevention. The information indicates that public education is important in encouraging or facilitating parents to take up immunisation for their child.[3] The major reasons for children who were not immunised with PCV were concerns about vaccine side effects, cost, vaccine not efficacious and no recommendation by the private practitioner, family doctors or government.[16] The perceived side effects could be because of publicity of exceedingly rare but exaggerated reports of associated side effects such as Guillain–Barre syndrome, which is not proven to have direct associations with vaccination.[17–20]

Childhood vaccination in Hong Kong is generally free under a government universal Childhood Immunization Programme.[6] Vaccination uptake has generally been excellent for all the conventional vaccines. The low-uptake situation for pneumococcal, influenza or 'newer' and more recently introduced vaccines in HK may be primarily because of socioeconomic reasons. General practitioners might not view health promotion programmes as worthwhile, and they are not very familiar with the latest model of health promotion linking to holistic approach of patient care, as reflected in an Australian study.[21] A Swiss study has reported general practitioners mentioning low priority of the pneumococcal vaccination in daily practice, as they rarely experienced cases of severe pneumococcal disease in their daily work.[22] In Hong Kong, one study has reported that only half of the general practitioner respondents actively recommend pneumococcal vaccination to elderly and only 18.8% would recommend it for middle-aged patients.[23] This might explain the

low-uptake rate for 'non-conventional vaccines'. More public awareness and education efforts, together with strong input efforts from healthcare professionals, would be essential to enhance vaccine uptake.[6]

Strengths and limitations of this study

A strength of this study is the large sample size and standardised questionnaire to ensure uniformity for data. Limitations include the intrinsic problems associated with the use of questionnaire, possible misinterpretation of questions and the relatively low return rate of filled questionnaires. Despite the small number of schools included in this study, detailed demographic data such as household income, guardian's highest education, past medical and immunisation history allow comprehensive analysis to be performed. There would be clustering of data at the school level, with nine schools involved in the study. The socioeconomic status of the study population as reflected by parental education level and monthly household income (Table 1) is not markedly different from Hong Kong population as a whole.

Interpretation of findings in relation to previously published work

The same phenomenon of low immunisation rates in children with chronic respiratory diseases has been observed by Talbot *et al*.[9] Invasive pneumococcal disease results in higher mortality in children with comorbidity.[10] Asthma is a common respiratory disorder among children and is most studied, which is an independent risk factor for invasive and severe pneumococcal disease.[11,12]

Similar to previously reported work, the major reasons for children not being immunised with PCV were concerns about vaccine side effects, cost, vaccine not efficacious and no recommendation by the private practitioner, family doctors or government.[16] The perceived side effects could be because of publicity of exceedingly rare but exaggerated reports of associated side effects such as Guillain–Barre syndrome, which is not proven to have direct associations with vaccination.[17–20]

Implications for future research, policy and practice

PCV-un-immunised children and senior relatives (grandparents) were prevalent during the study period. Public education and facilitation of immunisation of PCV and influenza should target for both at-risk groups of children and the elderly.

Conclusions

PCV-un-immunised children were prevalent during the study period. Parents of PCV-un-immunised children had lower education background and lower income. They were less aware of the potential seriousness of invasive pneumococcal disease. Public education and facilitation of immunisation of PCV and influenza should target for both at-risk groups of children and the elderly.

MATERIALS AND METHODS

This study was a community-based cross-sectional survey in which young children were randomly recruited according to the distribution of their primary schools. Parents of participating subjects were of Chinese ethnicity. After informed consent, questionnaires were sent to children's families in the schools. The survey was carried out in randomly selected primary schools in Hong Kong. On the basis of the assumption that more than 50% children did not receive influenza vaccination or pneumococcal vaccination, a sample size of 3,000 children from Hong Kong would have a power of 80% at a 95% level of confidence to detect a representable significance. As we conservatively expected a participation rate of 80% among all the subjects, this study aimed to recruit 2,880 primary school children. A complete list of primary schools was obtained from the Education Department of Hong Kong. In participating primary schools, all grades of primary students were targeted for the study. Schools were selected from the three major geographic regions of Hong Kong (Hong Kong Island, Kowloon, New Territories and outlying islands). Sample selection was based on a stratified (by districts) randomised sampling frame. We stratified all schools according to the above three geographic regions. We then selected 10 primary schools randomly from each district. According to data obtained from the Education Department of Hong Kong and our past experience of similar school-based study, each primary school would contribute a minimum of four classes in each grade for the study. Assuming class sizes of 30 and a parental co-operation rate of 80%, approximately 2,880 students would be recruited. This sampling method would ensure that our sample can truly be representative of the young children in Hong Kong.

A standard questionnaire in Chinese was used to screen for the medical history of pulmonary diseases. We added items to assess also the participation of the Childhood Immunization Programme. Consent was first obtained from headmasters or principals of all primary schools. Parents in these consented schools were then given standard written questionnaires to be completed at home and collected within 1 week of distribution. The questionnaire was modified from a previously used version, which gathered demographic data, medical history of upper respiratory diseases, awareness vaccine-preventable diseases, severity of certain vulnerable diseases and acceptance of vaccination.

Data entry and statistical analyses

The research assistant conducting the questionnaire survey entered all the data into a database, and an independent research staff validated the accuracy of the entered data. Data were categorised and analysed using SPSS (Statistical package for the social sciences for Windows). Chi-square test was used to compare the prevalence rates between different schools. Logistic regression with adjustment for covariates was used to estimate the possible associations between self-reported influenza and pneumococcal diseases with SPSS v.18 (IBM Corp., New York, NY, USA). *P* values (two-tailed) less than 0.05 were considered significant. Approval for the clinical research ethics was obtained from The Joint Chinese University of Hong Kong—New Territories East Cluster Clinical Research Ethics Committee. Parents or legal guardians of the children signed consent before they joined this study.

ACKNOWLEDGEMENTS

We thank the parents and the schools for helping with this survey.

CONTRIBUTIONS

K-LEH is the principal author. YCKT performed the statistical analyses. LCNC, DKKN, TYM, JYC and AL helped in drafting of the manuscript. TFL is an allergist/infectious disease professor who helped in drafting of the manuscript.

COMPETING INTERESTS

The principal author K-LEH was commissioned by the Hong Kong Society of Paediatric Respirology and Allergy to perform this survey. K-LEH has previously received travel and conference sponsorships from WyethNutrition, Pfizer and GSK. The remaining authors declare no conflict of interest.

FUNDING

K-LEH was commissioned by the Hong Kong Society of Paediatric Respirology and Allergy, and received a small commission of approximately US$2,000 for his department.

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