

Risk Factors for Recurrent Respiratory Infections in Preschool Children in China

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Abstract

Objective: To identify and compare risk factors for recurrent respiratory infections in preschool children between resident and floating population in Yiwu, China.

Methods: Investigations was conducted in resident and floating population in Yiwu city, Zhejiang province. A structured questionnaire was used to collect information on influence factors. Univariate and multivariate analyses were carried out using the Binary logistic regression.

Findings: The study was conducted in Yiwu from June 2009 to September 2010. We recruited 844 participants, resident population 639 (75.7%) and floating population 205 (24.3%) who were preschool children. Multivariate analysis showed that Childbearing age (OR=0.93, 95%CI: 0.88-0.99), Asthma (OR=3.20, 95%CI: 1.60-6.45), Rickets (OR=5.30, 95%CI: 1.99-14.09), Food preference (OR=1.57, 95%CI: 1.02-2.43), Snack (OR=1.50, 95%CI: 1.07-2.07) were the influence factors for recurrent respiratory infections in resident preschool children. Infant feeding (OR=2.24, 95%CI: 1.31-3.81), Snack (OR=2.06, 95%CI: 1.07-3.98), Trip mode (OR=2.77, 95%CI: 1.11-6.94) were the influence factors for recurrent respiratory infections in floating preschool children.

Conclusion: Public health measures against risk factors should be taken to protect against recurrent respiratory infections in resident and floating preschool children respectively.

*Iranian Journal of Pediatrics, Volume 24 (Number 1), February 2013, Pages: 14-22***Key Words:** Recurrent Respiratory Infection; Risk Factor; Child; Floating Population**Introduction**

China has the largest floating population in the world. The floating population refers to the large and increasing number of migrants without local household registration status. Most of these migrants came from the rural areas of the central and western parts of China. They face daunting problems particularly with access to health care, adequate housing, employment opportunities. The children of floating population can not fully enjoy the social medical services, and that should bring a

bad impact on their health.

According to a systematic analysis reported in Lancet, of the estimated 8.795 million deaths in children younger than 5 years worldwide in 2008, infectious diseases caused 68%, with the largest percentages due to pneumonia^[1]. According to the concept of recurrent respiratory tract infections (RRIs), a child with upper respiratory infection at least 6 times or lower respiratory infection at least 2 times per year was defined as a child with recurrent respiratory infection^[2]. Diagnosis of rhinitis, nasopharyngitis, oropharyngitis, tonsillitis

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or laryngitis, Otitis media was evaluated as upper respiratory tract infections. Tracheitis, bronchitis, bronchiolitis and pneumonia were assessed as low respiratory tract infections.

Some literatures reported the associated factors for recurrent respiratory infections, such as socioeconomic status, family characteristics, air pollution, smoking, maternal age, breast feeding, micronutrient Condition of children et al[3-10]. But often only a few risk factors have been studied at a time. The present study aimed to identify and compare risk factors for recurrent respiratory infections in preschool children between resident and floating population in Yiwu, China; and to give suggestions for the health care provider to prevent recurrent respiratory infections according to the key findings for resident and floating population children respectively.

Subjects and Methods

Study Area and Population

Yiwu, located in the central part of Zhejiang Province, covers an area of 1,105 sq km with 6 towns and 7 sub-districts and has 740,000 resident populations and 1,430,000 floating population. The study was conducted in Yiwu from June 2009 to September 2010. According to the principle of random sampling, we recruited 844 participants, resident population 639 (75.7%) and floating population 205 (24.3%) who were preschool children. They were sampling among nursery schools registered in the bureau of education in Yiwu. The sample size was calculated according the prevalence rate and the feasibility of the investigation. The sampling procedure was as follows. The registered children were coded and then selected by the method of random number which generated by Microsoft Office Excel with the function RAND. Children with congenital disease, hereditary disease and tumor as well as having a history of surgery were excluded from this study. Children using immunosuppressive agent or hormonal drugs were also excluded. In this paper, floating children were defined as preschool children who had urban registered permanent residence of Yiwu and lived in Yiwu for three and more months.

Diagnosis procedure for RRI

Diagnosis was made by a physician according to their hospital records. Based on the clinical concept and management of recurrent respiratory tract infections in children of 3-5 years old in 2008[2], a child with upper respiratory infection at least 6 times or lower respiratory infection at least 2 times per year was defined as a patient with recurrent respiratory infection. The interval between every two infections should be at least 7 days. If upper respiratory infections were less than 6 times annually, lower respiratory infections could be added to meet the diagnostic criteria.

Data Collection

In the present study, when questioning whether participants had experienced infections, diagnosis was required by a physician according to hospital records. In order to explore the influence factors in preschool children with recurrent respiratory infections, structured questionnaires were addressed the mother or guardians. The questionnaire was designed according to the references[3,4]. The first part of the questionnaire included demographic details, such as age, gender, weight and height. The second part consisted of questions about the associated factors of RRI, including the following item categories: birth characteristics, socioeconomic factors, fostering factors, housing conditions.

A medical doctor and a registered nurse who was familiar with anthropometric measurements (weight, height) of children were trained for 2 days before the questionnaire investigation. The investigation was performed between June 2009 and September 2010. The serum of children was collected after questionnaire investigation. All the guardians who took part in the study gave their informed consent for participation. Trace element and Immunoglobulin in serum of the children were measured by atomic absorption method and immunological turbidity kit (Beijing Pu MB5) respectively. The laboratory results were also recorded.

Statistical Methods

The database was established by Epidata3.0 and analyzed by SPSS16.0 software. Chi square test was used to compare the distribution of some health related factors in preschool children between resident and floating population. If p

value was less than 0.05, then statistical significance was considered.

Risk factor analyses were performed in resident and floating population respectively. Risk factor analyses were carried out using Chi-square test. Based on the results of Chi-square test; a multivariate regression model was constructed by Binary logistic regression. The SPSS16.0 software was used for the Logistic Model, Forward likelihood ratio was chosen as a method of analysis. For inclusion in the model $P=0.05$ was used, whereas $P=0.10$ was chosen for exclusion from the model. In all the analyses, the confidence level was 95%.

Findings

Study Population and Influence Factor Analyses

For resident and floating population respectively, the height of preschool children were 104.6 ± 10.6 cm and 103.6 ± 9.9 cm with no significant difference ($t=1.154$, $P=0.2$); the weight were 17.4 ± 4.5 kg and 16.7 ± 3.7 kg with significant difference ($t=2.190$, $P=0.03$). Childbearing age were 27.5 ± 4.0 years and 26.8 ± 3.9 years respectively with significant difference ($t=0.744$, $P=0.04$); the birth weight

were 3.4 ± 0.6 kg and 3.3 ± 0.6 kg with no significant difference ($t=-0.744$, $P=0.5$).

The prevalence rate for recurrent respiratory infections in resident populations and floating population children were 25.2% and 23.9% respectively with significant difference ($t=2.190$, $P=0.03$). Tables 1, 2 present the comparison of related social factors, fostering factors and living environment factors between resident populations and floating population preschool children in Yiwu, China. When the gender, parents occupation, monthly income were similar, education (father and mother) were significantly different. There were significant differences between resident populations and floating population preschool children on a number of fostering and living environment factors (delivery, vaccination, sleeping habit, taking care).

Risk Factors in Resident Preschool Children with Recurrent Respiratory Infections

The height of children were 104.8 ± 11.0 cm and 103.9 ± 9.5 cm in children with RRIs and control respectively, and there was no significant difference between the two groups ($t=0.949$, $P=0.343$). The weight were 17.5 ± 4.6 kg and 17.1 ± 4.2 kg in the two groups, and there was no significant difference between the two groups ($t=0.958$, $P=0.338$). Childbearing age were 27.7 ± 3.9 years and 27.0 ± 4.2 years in children with

Table1: Comparison of related social factors in preschool children between resident and floating population in Yiwu, China, 2009-2010

Characteristics		Resident population	Floating population	χ^2	P. value
Gender	Male	373 (58.4)	114 (55.6)	0.379	0.5
	Female	266 (41.6)	91 (44.4)		
Occupation	Brain work	324 (50.7)	96 (46.8)	1.367	0.5
	Physical force work	88 (13.8)	34 (16.6)		
	Both	227 (35.5)	75 (6.6)		
Monthly income(RMB)	<1000	28 (4.4)	12 (5.9)	3.255	0.4
	>=1000	170 (26.6)	46 (22.4)		
	>=3000	228 (35.7)	68 (33.2)		
	>=6000	213 (33.3)	79 (38.5)		
Education, father	Junior school	134 (21.0)	57 (27.8)	16.673	<0.001
	Senior school	176 (27.5)	76 (37.1)		
	College	329 (51.5)	72 (35.1)		
Education, mother	Junior school	139 (21.8)	82 (40.0)	32.665	<0.001
	Senior school	199 (31.1)	65 (31.7)		
	College	301 (47.1)	58 (28.3)		

Table 2: Comparison of related social factors in preschool children between resident and floating population in Yiwu, China, 2009-2010

Characteristics		Resident population		Floating population		χ^2	P
Gender	Male	373	58.4%	114	55.6%	0.379	0.538
	Female	266	41.6%	91	44.4%		
Occupation	Brain work	324	50.7%	96	46.8%	1.367	0.505
	Physical force work	88	13.8%	34	16.6%		
	Both	227	35.5%	75	36.6%		
Monthly income(RMB)	<1000	28	4.4%	12	5.9%	3.255	0.354
	>=1000	170	26.6%	46	22.4%		
	>=3000	228	35.7%	68	33.2%		
	>=6000	213	33.3%	79	38.5%		
Education, father	Junior school	134	21.0%	57	27.8%	16.673	<0.001
	Senior school	176	27.5%	76	37.1%		
	College	329	51.5%	72	35.1%		
Education, mother	Junior school	139	21.8%	82	40.0%	32.665	<0.001
	Senior school	199	31.1%	65	31.7%		
	College	301	47.1%	58	28.3%		

RRIs and control respectively, and there was significant difference between the two groups ($t=1.969$, $P=0.049$). The birth weight were $3.3\pm0.5\text{kg}$ and $3.4\pm0.7\text{kg}$ in the two groups, and there was no significant difference between the two groups ($t=-1.459$, $P=0.145$).

Tables 3, 4 present the results of the univariate risk factor analyses in resident populations preschool children. A number of factors were significantly associated with recurrent respiratory infections (delivery, asthma, rickets, food preference, snack, drinking water, sleeping habit, trip mode, someone smoking in the same room).

The variables were chosen as those with a p value of less than 0.10 in the univariate analyses. The multivariate equation model consisted of the following variables: childbearing age (OR=0.93, 95%CI: 0.88-0.99, $P=0.01$), asthma (OR=3.20, 95%CI: 1.60-6.45, $P=0.001$), rickets (OR=5.30, 95%CI: 1.99-14.09, $P=0.001$), food preference (OR=1.57, 95%CI: 1.02-2.43, $P=0.04$), snack (OR=1.50, 95%CI: 1.07-2.07, $P=0.02$). There was no significant difference between children with RRIs and control on trace element and immunoglobulin in serum ($P>0.05$) (Table 5).

Risk Factors in Floating Preschool Children with Recurrent respiratory Infections

The height of children were $102.7\pm9.3\text{cm}$ and $105.8\pm10.6\text{cm}$ in children with RRIs and control respectively, and there was no significant

difference between the two groups ($t=-1.945$, $P=0.05$). The weight were $16.2\pm3.3\text{kg}$ and $17.8\pm4.2\text{kg}$ in the two groups, and there was significant difference between the two groups ($t=-2.648$, $P=0.009$). Childbearing age were $27.1\pm3.9\text{years}$ and $26.0\pm3.8\text{years}$ in children with RRIs and control respectively, and there was no significant difference between the two groups ($t=1.718$, $P=0.09$). The birth weight were $3.3\pm0.6\text{kg}$ and $3.4\pm0.6\text{kg}$ in the two groups, and there was no significant difference between the two groups ($t=-1.078$, $P=0.3$).

Tables 3, 4 present the results of the univariate risk factor analyses in floating population preschool children rural child. A number of factors were significantly associated with recurrent respiratory infections (infant feeding, rickets, and snake). The variables were chosen as those with a P value of less than 0.10 in the univariate analyses. The multivariate equation model consisted of the following variables: infant feeding (OR=2.24, 95%CI: 1.31-3.81, $P=0.003$), snack (OR=2.06, 95%CI: 1.07-3.98, $P=0.03$), trip mode (OR=2.77, 95%CI: 1.11-6.94, $P=0.03$).

There were significant differences between children with RRIs and control on ferrum and alkaline phosphatase level when detecting trace element and immunoglobulin in serum. Preschool children with recurrent respiratory infection have lower level of ferrum and high level of alkaline phosphatase ($P<0.05$) (Table 5).

Table 3: Risk factors for recurrent respiratory infections in preschool children between resident and floating population in Yiwu, China, 2009-2010

Characteristics		Resident population			Floating population		
		Children with RRs (%)	Control (%)	P. value	Children with RRs (%)	Control (%)	P. value
Age(year)	<=3	24 (14.9)	90 (18.8)	0.09	11 (22.4)	36 (23.7)	0.2
	<=4	57 (35.4)	120 (25.1)		11 (22.4)	45 (29.6)	
	<=5	38 (23.6)	126 (26.4)		9 (18.4)	38 (25.0)	
	>5	42 (26.1)	142 (29.7)		18 (36.7)	33 (21.7)	
Gender	Male	93 (57.8)	279 (58.4)	0.9	25 (51.0)	88 (57.9)	0.4
	Female	68 (42.2)	199 (41.6)		24 (49.0)	64 (42.1)	
Monthly income (RMB)	<1000	6 (3.7)	21 (4.4)	0.09	3 (6.1)	9 (5.9)	0.6
	>=1000	46 (28.6)	124 (25.9)		9 (18.4)	36 (23.7)	
	>=3000	46 (28.6)	186 (38.9)		15 (30.6)	54 (35.5)	
	>=6000	63 (39.1)	147 (30.8)		22 (44.9)	53 (34.9)	
Delivery	Spontaneous labor	78 (48.4)	190 (39.7)	0.048	29 (59.2)	84 (55.3)	0.6
	Abdominal delivery	83 (51.6)	290 (60.7)		20 (40.8)	68 (44.7)	
Vaccination	Yes	146 (90.7)	436 (91.2)	0.8	36 (73.5)	129 (84.9)	0.07
	No	15 (9.3)	42 (8.8)		13 (26.5)	23 (15.1)	
Infant feeding	Exclusively breastfed	75 (46.6)	225 (47.1)	0.9	16 (32.7)	79 (52.0)	0.03
	Partially breastfed	38 (23.6)	117 (24.5)		11 (22.4)	32 (21.1)	
	Not breastfed	48 (29.8)	136 (28.5)		22 (44.9)	41 (27.0)	
Asthma	Yes	23 (14.3)	29 (6.1)	0.001	6 (12.2)	11 (7.2)	0.3
	No	138 (85.7)	449 (93.9)		43 (87.8)	141 (92.8)	
Rickets	Yes	44 (27.3)	133 (27.8)	0.9	7 (14.3)	43 (28.3)	0.04
	No	117 (72.7)	345 (72.2)		42 (85.7)	109 (71.7)	
Food preference	Yes	92 (57.1)	225 (47.1)	0.03	25 (51.0)	60 (39.5)	0.2
	No	69 (42.99)%	253 (52.9)		24 (49.0)	92 (60.5)	
Snack	Occasionally	63 (39.1)	225 (47.1)	0.01	13 (26.5)	70 (46.1)	0.001
	Regularly	77 (47.8)	223 (46.7)		26 (53.1)	75 (49.3)	
	Frequently	21 (13.0)	30 (6.3)		10 (20.4)	7 (4.6)	
Drinking water	Drink	46 (28.6)	122 (25.5)	0.001	11 (22.4)	36 (23.7)	0.5
	Plain boiled water	97 (60.2)	338 (70.7)		33 (67.3)	108 (71.1)	
	Fresh Fruit juice	18 (11.2)	18 (3.8)		5 (10.2)	8 (5.3)	
Sleeping habit	With adults	120 (74.5)	313 (65.5)	0.003	27 (55.1)	84 (55.3)	0.8
	With himself or herself	26 (16.1)	64 (13.4)		9 (18.4)	33 (21.7)	
	Both	15 (9.3)	101 (21.1)		13 (26.5)	35 (23.0)	
Trip mode	Car	97 (60.2)	344 (72.0)	0.005	27 (55.1)	105 (69.1)	0.1
	Walking	44 (27.3)	106 (22.2)		18 (36.7)	33 (21.7)	
	Bicycle	20 (12.4)	28 (5.9)		4 (8.2)	14 (9.2)	
Someone with CRD in the same room	Yes	19 (11.8)	41 (8.6)	0.2	9 (18.4)	12 (7.9)	0.04
	No	142 (88.2)	437 (91.4)		40 (81.6)	140 (92.1)	
Someone smoking in the same room	Yes	90 (55.9)	207 (43.3)	0.006	27 (55.1)	62 (40.8)	0.1
	No	71 (44.1)	271 (56.7)		22 (44.9)	90 (59.2)	
Sweeping the room frequently	Yes	126 (78.3)	404 (84.5)	0.07	38 (77.6)	132 (86.8)	0.2
	No	35 (21.7)	74 (15.5)		11 (22.4)	20 (13.2)	

CRD: chronic respiratory disease

Table 4: Multivariate analysis on risk factors for recurrent respiratory infections in preschool children between resident and floating population in Yiwu, China,

Characteristics	Resident population					Floating population						
	Mean	SE	Wald	P value	OR	95% CI	Mean	SE	Wald	P value	OR	95% CI
Age	0.004	0.10	0.002	0.9	1.00	0.82 - 1.22	-0.14	0.29	0.27	0.6	0.87	0.51 - 1.47
Gender (Male)	0.24	0.22	1.20	0.3	1.27	0.83 - 1.96	0.55	0.41	1.87	0.2	1.74	0.79 - 3.85
Mother's age at child's birth	-0.07	0.03	6.01	0.01	0.93	0.88 - 0.99						
Infant feeding (Exclusively breastfed)							0.80	0.27	8.77	0.003	2.24	1.31 - 3.81
Without Asthma	1.17	0.36	10.73	0.001	3.21	1.60 - 6.45						
Without Rickets	1.67	0.50	11.17	0.001	5.30	1.99 - 14.09	1.29	0.77	2.84	0.09	3.65	0.81 - 16.46
No Food preference	0.45	0.22	4.15	0.04	1.57	1.02 - 2.43						
Snack (Occasionally)	0.40	0.17	5.67	0.02	1.4	1.07 - 2.07	0.72	0.34	4.64	0.031	2.06	1.07 - 3.98
Trip mode with car							1.02	0.47	4.73	0.03	2.77	1.11 - 6.94

SE: Standard error; CI: Confidence interval

Table5: Laboratory factors for recurrent respiratory infections in preschool children between resident and floating population in Yiwu, China, 2009-2010

	IgE	IgG	IgA	IgM	C3	ALP	Copper	Zinc	Calcium	Magnesium	Iron	Lead	Hgb
Children with RRI													
Resident population	96.8 (146.6)	8.2 (1.5)	0.9 (0.5)	1.2 (0.2)	1.2 (0.2)	247.2 (73.0)	23.5 (4.1)	85.5 (35.6)	1.6 (0.2)	1.6 (0.5)	9.1 (3.1)	41.8 (15.4)	129.0 (7.5)
Control	86.5 (109.3)	8.2 (1.8)	1.0 (0.4)	1.2 (0.2)	1.2 (0.2)	242.9 (64.9)	23.7 (2.7)	84.8 (10.3)	1.7 (0.5)	1.5 (0.2)	8.8 (0.8)	40.6 (15.1)	129.2 (12.1)
t	0.788	0.146	-0.499	-0.381	-0.381	0.665	-0.743	-0.234	-1.197	1.089	0.862	0.889	-0.244
P value	0.431	0.884	0.618	0.703	0.703	0.506	0.458	0.815	0.232	0.276	0.389	0.374	0.807
Children with RRI													
floating population	98.7 (156.6)	8.2 (1.5)	0.9 (0.5)	1.2 (0.4)	1.1 (0.2)	243.92 (54.0)	24.2 (3.1)	85.0 (13.2)	1.6 (0.2)	1.6 (0.2)	8.7 (1.0)	40.7 (15.2)	127.9 (8.7)
Control	70.9 (116.1)	8.2 (1.9)	0.9 (0.4)	1.2 (0.4)	1.1 (0.2)	224.8 (36.7)	23.2 (3.0)	101.3 (15.6)	1.8 (1.1)	1.6 (0.3)	9.2 (2.7)	42.7 (18.4)	126.7 (6.9)
t	1.	-0.039	-0.857	1.041	0.230	2.308	1.966	1.709	-1.822	0.492	-2.010	0.731	0.864
P value	0.3	0.9	0.4	0.3	0.82	0.02	-0.05	0.09	0.07	0.6	0.046	0.5	0.4

RRI: respiratory tract infection Ig: Immunoglobulin; Alk ph: Alkaline phosphatase; Cu: Hgb; Hemoglobin

Discussion

In the present study, child characteristics such as age, gender, birth characteristics; socioeconomic factors, fostering factors and housing conditions associated with childhood recurrent respiratory infections were studied in resident and floating population respectively. There were significant differences on parents' education, delivery, vaccination, sleeping habit, taking care between resident and floating population. These differences may be related to the influence of social and environmental factors, health behaviors, and level of awareness concerning certain health conditions.

Child bearing age was associated with the recurrent respiratory infection. Consisted with the findings in Infante-Rivard C's study^[11], childbearing age was a slight protective factor for recurrent respiratory infections with OR of 0.93 in resident children in this study, but probably due to Socio-economic differences and health awareness, maternal age was not found to be an influence factor in floating population.

Nutritional factors take up an important role for recurrent respiratory infections by influencing body immune status. The global child disease burden attributable to maternal and child undernutrition has recently been quantified ^[12]. Approximately 9 million children less than 5 years old die every year in the world. Acute lower respiratory tract infections (ALRI) account for approximately 20% of these deaths^[13,14].

Vitamin D plays an important role for human immune system ^[15]. Vitamin D deficiency could result to abnormal metabolism of calcium and phosphor, and could be harmful to body immune functions. Vitamin D deficiency is now presumptively linked to a range of infectious inflammatory diseases throughout the life course and around the world ^[16]. On the contrary, recurrent respiratory infections could result to the body stimulus status with nutrition storage exhausted; and with medicine for infection treatment, child had decreased appetite and limited outdoor exercises. These factors are also presumptively result to the deficient intake of vitamin D and calcium. In the present study, rickets was a risk factor for recurrent respiratory infections both in resident population with OR of 5.30. Also, we found that in floating population,

preschool children with recurrent respiratory infection have high level of alkaline phosphatase; Alkaline phosphatase suggested Vitamin D deficiency. So interventions to improve child vitamin D status to improve the immune function could prevent recurrent respiratory infections and reduce the global burden of recurrent respiratory infections^[17].

Malnutrition is the underlying cause of approximately half of these fatal ALRIs. Four key nutritional risk factors for ALRI disease burden have been identified. These are macronutrient undernutrition, low birthweight, zinc deficiency and suboptimal breastfeeding^[18]. In floating population, preschool children with recurrent respiratory infection have lower level of ferrum. This finding was probably due to socio-economic status such as family income, parent education and their awareness of nutrition et al in floating population. We also found non-breastfeeding was a risk factor for recurrent respiratory infections both in resident population with OR of 2.24. Probably due to maternal nutritional status, working and living pressure as well as education, floating population used to select non breastfeeding. A lack of exclusive breastfeeding in the first 6 months of life increases the frequency and severity of ALRI, and the risk of death from ALRIs^[19-21]. Secondly, breastfeeding enhances the infant's antibody responses to respiratory pathogens and influences maturation of the immune system^[22,23].

In our study, snacks tend to be a risk factor for recurrent respiratory infections with OR of 1.50 and 2.06 in resident and floating pre-children respectively probably because of the component or additives in the snack other than protein. Food preference was found to be a risk factor for recurrent respiratory infections with OR of 1.57 only in resident children. Food preference could result to macronutrient undernutrition or overweight which depends on the preferred food. Both macronutrient undernutrition and overweight could be the key risk factors^[24].

So we should promote breastfeeding, and integrate nutrition into other aspects of well child care, and increase both public and health professional nutritional knowledge as essential components of policy development.

Although asthma and recurrent respiratory infections has different mechanism, asthma was

reported to be a risk factor for respiratory infection in early life and the atopic or asthmatic background is a severe enough predisposing factor for the development of later recurrent respiratory infection^[25]. Our study does find asthma associated with the risk of recurrent respiratory infections in resident preschool children, and probably because of airway hyper reactivity in asthma children. While in floating population, this association was not found, probably because of the awareness of disease and the medical counseling behavior of their parents.

Nitrogen oxides, sulfur dioxide, carbon monoxide, particulate pollutants in the air could be important threats for respiratory system^[26-28]. John D. Spengler found the relationship between housing characteristics and respiratory health^[29, 30]. In the present study, trip mode was significant in multivariate analysis in floating preschool children with OR of 2.77. An explanation could be that going out by car could avoid the traffic-related pollution. But trip mode was not found to be significant in resident population probably because of the living behavior and living condition to avoid the traffic-related air pollution.

Conclusion

childbearing age, asthma, rickets, food preference and snack were risk factors for recurrent respiratory infection in resident preschool children; infant feeding, snack, trip mode were risk factors for recurrent respiratory infection in floating preschool children. In floating population, preschool children with recurrent respiratory infection have lower level of ferrum and high level of alkaline phosphatase. These findings suggest a number of measures should be taken to reduce the effects of risk factors on children's health. Nutrition status especially vitamin D early surveillance should be taken, and integrate nutrition should be integrate into other aspects of well child care in both resident and floating population. Breastfeeding should be promoted and nutritional knowledge should be considered as essential components of policy development, and outdoor air pollution should be avoided by

improve their living conditions in floating population.

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Conflict of Interest: None

References

1. Black RE, Cousens S, Johnson HL, et al. Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality in 2008: a systematic analysis. *Lancet* 2010;375(9730):1969-87.
2. The Subspecialty Group of Respiratory Diseases, the Society of Pediatrics, Chinese Medical Association, the Editorial Board, Chinese Journal of Pediatrics. Clinical concept and management of recurrent respiratory tract infections in children (revised). *Zhonghua Er Ke Za Zhi* 2008;46(2):108-10.
3. Mathew JL, Patwari AK, Gupta P, et al. Acute respiratory infection and pneumonia in India: a systematic review of literature for advocacy and action: UNICEF-PHFI series on newborn and child health, India. *Indian Pediatr* 2011;48(3):191-218.
4. Kirkwood BR, Gove S, Rogers S, et al. Potential interventions for the prevention of childhood pneumonia in developing countries: a systematic review. *Bull World Health Organ* 1995;73(6):793-8.
5. Singh MP, Nayar S. Magnitude of acute respiratory infections in under five children. *J Commun Dis* 1996;28(4):273-8.
6. Acharya D, Prasanna KS, Nair S, et al. Acute respiratory infections in children: a community based longitudinal study in south India. *Indian J Public Health* 2003;47(1):7-13.
7. Varon E, Levy C, Rocque F, et al. Impact of antimicrobial therapy on nasopharyngeal carriage of streptococcus pneumonia, haemophilus influenza, and branhamella catarrhalis in children with respiratory tract infections. *Clin Infect Dis* 2000; 31(2):477-81.
8. Lee NY, Song JH, Kim S, et al. Carriage of antibiotic-resistant pneumococci among Asian children: a multinational surveillance by the Asian Network for Surveillance of Resistant Pathogens (ANSORP). *Clin Infect Dis* 2001;32(10):1463-9.
9. Peerbooms PG, Engelen MN, Stokman DA, et al. Nasopharyngeal carriage of potential bacterial pathogens related to day care attendance, with

- special reference to molecular epidemiology of haemophilus influenza. *J Clin Microbiol* 2002;40(8): 2832-6.
10. Sá-Leão R, Nunes S, Brito-Avô A, et al. High rates of transmission of and colonization by *Streptococcus pneumoniae* and *Haemophilus influenzae* within a day care center revealed in a longitudinal study. *J Clin Microbiol* 2008;46(1): 225-34.
 11. Infante-Rivard C. Young maternal age: a risk factor for childhood asthma? *Epidemiology* 1995;6(2): 178-80.
 12. Black RE, Allen LH, Bhutta ZA, et al. Maternal and Child Undernutrition Study Group. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008;371(9608): 243-60.
 13. Wardlaw T, Salama P, Johansson EW, et al. Pneumonia: the leading killer of children. *Lancet* 2006;368(9541):1048-50.
 14. Williams BG, Gouws E, Boschi-Pinto C, et al. Estimates of world-wide distribution of child deaths from acute respiratory infections. *Lancet Infect Dis*. 2002;2(1):25-32.
 15. Liu PT, Stenger S, Li H, et al. Toll-like receptor triggering of a vitamin D-mediated human antimicrobial response. *Science* 2006;311(5768): 1770-3.
 16. Roth DE, Shah R, Black RE, et al. Vitamin D status and acute lower respiratory infection in early childhood in Sylhet, Bangladesh. *Acta Paediatr* 2010; 99(3):389-93.
 17. Wagner CL, Greer FR; American Academy of Pediatrics Section on Breastfeeding; American Academy of Pediatrics Committee on Nutrition. The selection on breastfeeding and committee on nutrition. Prevention of rickets and vitamin D deficiency in infants, children, and adolescents. *Pediatrics*. 2008;122(5):1142-52.
 18. Roth DE, Caulfield LE, Ezzati M, et al. Acute lower respiratory infections in childhood: opportunities for reducing the global burden through nutritional interventions. *Bull World Health Organ* 2008;86(5): 356-64.
 19. Black RE, Allen LH, Bhutta ZA, et al. Maternal and Child Undernutrition Study Group. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008;371(9608), 243-60.
 20. Victora CG, Kirkwood BR, Ashworth A, et al. Potential interventions for the prevention of childhood pneumonia in developing countries: improving nutrition. *Am J Clin. Nutr* 1999;70(3): 309-20.
 21. Newburg DS, Walker WA. Protection of the neonate by the innate immune system of developing gut and of human milk. *Pediatr Res* 2007;61(1):2-8.
 22. Silfverdal SA, Ekholm L, Bodin L. Breastfeeding enhances the antibody response to Hib and Pneumococcal serotype 6B and 14 after vaccination with conjugate vaccines. *Vaccine* 2007;25(8):1497-502.
 23. Moore SE, Collinson AC, N'Gom PT, et al. Maternal malnutrition and the risk of infection in later life. *Nestle Nutr Workshop Ser Pediatr Program* 2005;55: 153-67.
 24. Roth DE, Caulfield LE, Ezzati M, et al. Acute lower respiratory infections in childhood: opportunities for reducing the global burden through nutritional interventions. *Bull World Health Organ* 2008;86(5): 356-64.
 25. Simões EA, Carbonell-Estrany X, Rieger CH, et al. The effect of respiratory syncytial virus on subsequent recurrent wheezing in atopic and nonatopic children. *J Allergy Clin Immunol* 2010;126(2):256-62.
 26. Herbarth O, Fritz G, Krumbiegel P. Effect of sulfur dioxide and particulate pollutants on bronchitis in children- A risk analysis. *Environ Toxicol* 2001; 16(3):269-276.
 27. Pikhart H, Bobak M, Kriz B, et al. Outdoor air concentration of nitrogen dioxide and sulfur dioxide and prevalence of wheezing in school children. *Epidemiology* 2000;11(2):153-60.
 28. Brauer M, Hoek G, Van Vliet P, et al. Air pollution from traffic and the Development of respiratory infections and asthmatic and allergic symptoms in children. *Ame J Respir Crit Care Med* 2002;166(8): 1092-8.
 29. Spengler JD, Jaakkola JJ, Parise H, et al. Housing characteristics and children's respiratory health in the Russian federation. *Am J Public Health* 2004; 94(4): 657-62.
 30. Künzli N, Kaiser R, Medina S, et al. Public-health impact of outdoor and traffic-related air pollution: a European assessment. *Lancet* 2000;356(9232): 795-801.