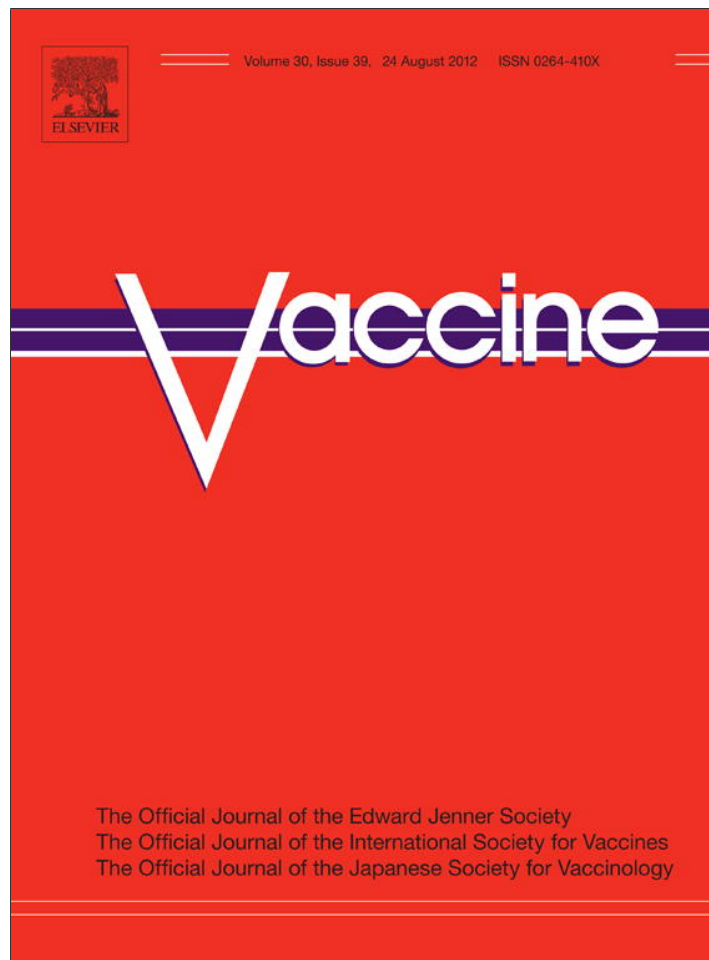


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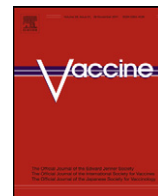


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Gaps in the 2010 measles SIA coverage among migrant children in Beijing: Evidence from a parental survey

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ABSTRACT

China suffers from high incidence of measles partly due to high population mobility and low vaccination rates among migrants. In this study, we assessed the vaccination coverage of the nationwide measles supplementary immunization activity (SIA) of 2010 and its determinants among migrant children in Beijing. Information was collected through face-to-face interviews with the caregivers of 589 migrant children at train and long-distance bus stations in January 2011, when migrants were traveling home for the Chinese New Year holiday. We estimated that 83.4% of migrant children aged 8 months to 14 years received the measles vaccine during the SIA. This estimated coverage is lower than the official report of 96% among all eligible children in Beijing. Factors associated with being unvaccinated through the SIA included children being at home or in the kindergarten, living in a single-child family, and having a parent who was unaware of the SIA or who had a low level of trust in the government-administered measles campaign. We recommend more focused targeting on migrant children in future measles vaccination campaigns, improved immunization service delivery in unregulated migrant-run kindergartens and at the community level, as well as development of more effective communication methods to reach disadvantaged migrants.

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1. Introduction

Despite China's great progress across a range of health indicators [1], measles incidence, though fluctuating in the past two decades, has remained high. In 2009, the average reported rate of measles was 39 cases per million in China, far above the World Health Organization's (WHO) recommended rate of one case per million. Similar to other countries [2], increasing population mobility coupled with low routine vaccination coverage of migrants has been identified as one of the key contributors of measles outbreaks in China [3]. By the end of 2010, there were 261 million migrants in China [4]. The vaccination coverage of migrant children is much lower than that of local children (e.g. 65% vs 96% in Beijing in 2002) mainly as a result of migrants' high mobility, low socioeconomic status, lower level of knowledge and awareness about vaccination, and insufficient access to vaccination services in receiving areas [5–7]. Large cities where the migrant population is concentrated were especially vulnerable to measles outbreaks.

As part of its effort to eliminate measles by the end of 2012, the Chinese government implemented a nationwide measles vaccine supplemental immunization activity (SIA) for children aged 8 months to 14 years old on September 11–20, 2010. This measles

SIA was the first nationwide immunization campaign in China. With the goal of reaching an overall measles coverage of 95%, the public health authority planned to vaccinate or re-vaccinate about one hundred million children through the SIA regardless of their previous measles immunization history. Because of their low immunization coverage via routine vaccination [7,8], migrant children were designated as the main target group of this campaign.

This study aimed to assess the vaccination coverage of migrant children in Beijing during the measles SIA of 2010, and to identify factors associated with their participation in the campaign. Beijing has a migrant population of 7.64 million, accounting for 39% of its total population [9]. In 2010, the reported rate of measles in Beijing was 135 cases per million [10], four times the national average, and out of these the migrant population constituted 65% of the cases [3]. While the official estimate of the coverage during the 2010 measles SIA is 96% for all eligible children in Beijing [11], no migrant-specific data has been reported. Given the importance of reaching migrant children for eliminating measles in China, this study provides useful evidence to effectively target this disadvantaged group in future vaccination campaigns.

2. Materials and methods

2.1. Study population and sampling methods

The study population was composed of primary caregivers of migrant children. Children who were 8 months to 14 years old

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by September 2010 (i.e. born between 1st October 1995 and 31st December 2009), who held a non-resident rural *hukou* status and were staying in Beijing over the period of the SIA were eligible for the study.

Given the high mobility and the lack of registration of migrants, it is difficult to draw a random sample for any study of migrants [12]. Previous studies of migrant children's immunization in Beijing have mainly drawn samples from areas densely populated by migrants [6,7,13]. While this study is based on a convenience sampling method, we established a recruitment procedure to maximize the quasi-randomization of selected respondents under the circumstances. Chinese New Year is the most important festival for family members to get together. During the busiest travel season of the year, bus and train stations in large cities are overflowing with migrants heading home. In order to capture the wide diversity of migrants, we collected the data at the two major train stations (Beijing Train Station and Beijing West Train Station) and seven long-distance bus terminals that are located in the eastern, western, southern, and northern parts of Beijing. The destinations of trains and long-distance buses departing from these stations covered all provinces across China. Data was collected over the two weeks prior to the Chinese New Year's day, the peak travel period for migrants leaving Beijing. Migrants who remained in Beijing during the holidays and who traveled by air or by private cars were not included in the sample.

2.2. Data collection

Between January 12th and 29th, 2011, face-to-face interviews were conducted by trained interviewers in the waiting room of the selected sites. Interviewers conducted the initial screening, and determined the eligibility of respondents on the basis of whether they had brought children or not. During the peak of the holiday travel season, passengers usually arrive at the train/bus station several hours ahead of departure to ensure they will be boarded. This gave respondents plenty of time to finish the 10–15 min interview. A small gift was provided to respondents as an incentive for answering the questions.

The survey collected information on socio-demographic characteristics of migrant children, children's measles vaccination status during the SIA, and parents' knowledge and attitudes towards immunization. As no immunization certificate was required for participation in the measles SIA, children's measles vaccination status during the SIA campaign was based on parents' recall (in some cases with their children's own confirmation/correction).

2.3. Statistical analysis

The outcome measure, children's measles vaccination status, was dichotomized as having participated in the measles SIA of 2010 or not. Since the distribution of the outcome is not rare (i.e. the prevalence is higher than 10%), using odds ratios from logistic regression tends to overestimate the relative risk associated with being unvaccinated. In this analysis, we used robust Poisson regression models to estimate prevalence ratios associated with the risk of being unvaccinated. This analytic approach is more reliable in terms of both relative bias and percentage of confidence interval coverage [14,15]. We first presented the sample distribution of children's socio-demographic characteristics and parental knowledge and attitudes towards immunization. Second, the association between children's socio-demographic characteristics and parental knowledge and attitudes towards immunization and children's vaccination status was assessed using the Pearson's χ^2 test and the *T* test. Finally, we estimated univariate and multivariate Poisson regression models to predict the relative risk (RR) associated with being unvaccinated and 95% confidence intervals (CIs) by

children's socio-demographic characteristics and parental knowledge and attitudes towards immunization. We conducted data analysis using SAS version 9.1.

3. Results

A total of 651 children in 576 migrant families were surveyed. After excluding children who themselves or whose parents were registered Beijing residents, or who were not present in Beijing at the time of the SIA, we obtained a sample of 589 eligible children. Respondents were the mother (68.4%), father (28.9%) or other family member (2.7%) of the child. Respondents came from 25 (out of 31) provinces, municipalities, or autonomous regions across China.

Of all 589 children, 80.8% were reported to have received the measles vaccine during the SIA of 2010, 14.1% were reported as not having been vaccinated, and the vaccination status of the remaining 5.1% was "unclear". If we impute half of the children in the "unclear" category as having received the vaccine, the coverage is estimated at 83.4%. The coverage would be 85.9% if children whose vaccination status was "unclear" have all received the dose.

In the following analysis, we excluded children whose measles vaccination status was reported as "unclear" ($n = 30$) and the missing cases on explanatory variables ($n = 14$). Thus the analytic sample consisted of 545 children.

The mean age of surveyed children was 5.1 years old (Table 1). More than half of the children were boys (53.9%), 40.6% lived in a family with two or more siblings,¹ and 65% were born in their hometown. While 38.4% of children enrolled in schools, 34.3% and 27.3% were in kindergartens² or stayed at home, respectively. Two-thirds of parents had attained a junior high school or lower level of education, and 86.8% had lived in Beijing for three or more years.

With regard to parental knowledge and attitudes towards immunization, 17.8% of them reported not having heard about the measles SIA of 2010; only 29% of them had fair knowledge about measles, 16.7% and 54.3% had no or little knowledge, respectively (Table 1). Nonetheless, most parents (94.3%) agreed that "vaccination is useful", believed that immunization services provided by the government were safe and reliable (70.8%), and felt that the government-administered measles SIA was "for the benefit of the public" (90.3%).

Results from the Pearson χ^2 test and the *T* test (Table 2) showed that children's age, sibling size, place of schooling, parental duration of stay in Beijing, their awareness of the measles SIA, their level of knowledge about measles and trust in the government-administered measles campaign were significantly associated with children's vaccination status during the SIA.

The first column of Table 3 presents the crude RR of being unvaccinated on the basis of univariate Poisson regression models. Results from multivariate Poisson regression showed that after adjusting for confounding effects, the RRs associated with children's place of schooling, sibling size, parents' awareness of the measles SIA, and parental trust in government still remained significant. In the adjusted model, a child had a significantly higher risk of being unvaccinated during the SIA if s/he was staying at home (RR = 3.23; 95% CI 1.68, 6.22) or attending kindergarten (RR = 2.21; 95% CI 1.18, 4.14), and if her or his parent had not heard about the measles SIA (RR = 1.71; 95% CI 1.06, 2.76) or had a low level of trust in the government-administered measles campaign (RR = 1.84; 95% CI 1.06, 3.18). Children who lived in a family with

¹ China's "one child" policy has been rigidly enforced in urban areas and in the rural areas of a few provinces. Therefore many migrants of rural origin have two or more children.

² In China, children older than 6 years should go to school. Most kindergartens enroll children 3–5 years old, some also enroll children younger than 3 years.

Table 1
Socio-demographic characteristics of migrant children, parental knowledge and attitude towards immunization, Beijing, 2011 (N=545).

Variables	n (%) or mean (s.d.)
Socio-demographic characteristics	
Child's age (years)	5.1 (3.1)
Child's sex	
Male	294 (53.9)
Female	251 (46.1)
Child's place of birth	
Beijing	191 (35.1)
Other provinces	354 (65.0)
Child's place of schooling	
At home	149 (27.3)
In kindergarten	187 (34.3)
At school	209 (38.4)
Number of children in the family	
1	324 (59.5)
2+	221 (40.6)
Sex of parent	
Male	155 (28.4)
Female	390 (71.6)
Education of parent	
Primary or less	90 (16.5)
Junior high school	274 (50.3)
Senior high school or above	181 (33.2)
Parent's duration of stay in Beijing	
0–2 years	72 (13.2)
3+ years	473 (86.8)
Knowledge and attitude towards immunization	
Know about the 2010 SIAs	
Yes	448 (82.2)
No	97 (17.8)
Knowledge of measles index ^a	
0	91 (16.7)
1–2	296 (54.3)
3+	158 (29.0)
Attitude towards immunization	
"Useful"	514 (94.3)
"Not useful or unclear"	31 (5.7)
Immunization services are safe and reliable	
Yes	386 (70.8)
No	134 (24.6)
Don't know/missing	25 (4.6)
Trust in government ^b	
Yes	492 (90.3)
No	50 (9.2)

^a A composite measure of parents' knowledge about five aspects of measles: type of the disease, symptom and harm of the disease, means of disease transmission, and the most effective ways of prevention. The measles knowledge index reflects the number of correct answers on these five questions given by respondents.

^b There are three missing cases for this variable.

two or more siblings (RR=0.57; 95% CI 0.34, 0.94) were significantly more likely to be vaccinated relative to those who lived in single child families. However, children's age, parent's duration of stay in Beijing, and their levels of knowledge about measles were no longer significantly associated with children's vaccination status after controlling for confounders.

4. Discussion

Using parental survey data, this study estimated a vaccination coverage of 83.4% for the measles SIA of 2010 among migrant children in Beijing. This figure is lower than the officially reported coverage of 96% for the entire target population in Beijing [16], or the 95% population immunization coverage necessary for herd immunity to measles. Given that migrant children tend to go to school or play together, they may form pockets of low immunity that increase the risk of measles outbreaks in Beijing.

This result also suggests that the conventional method of calculating SIA coverage, which divides the number of administered doses by the estimated number of the target population, may not

Table 2
Percent distribution of migrant children's socio-demographic characteristics and parental knowledge and attitude towards immunization by vaccination status during the measles SIA, Beijing, 2011 (N=545).

Variables	Unvaccinated, n (%)	p-Value ^a
Socio-demographic characteristics		
Child's age (years)	–	0.03
Child's sex		0.88
Male	294 (14.3)	
Female	251 (14.7)	
Child's place of birth		0.667
Beijing	191 (13.6)	
Other provinces	354 (15.0)	
Child's place of schooling		0.002
At home	149 (21.5)	
In kindergarten	187 (16.0)	
At school	209 (8.1)	
Number of children in the family		0.025
1	324 (17.3)	
2+	221 (10.4)	
Sex of parent		0.886
Male	155 (14.8)	
Female	390 (14.4)	
Education of parent		0.545
Primary or less	90 (17.8)	
Junior high school	274 (13.1)	
Senior high school or above	181 (14.9)	
Parent's duration of stay in Beijing		0.046
0–2 years	72 (22.2)	
3+ years	473 (13.3)	
Knowledge and attitude towards immunization		
Know about the 2010 SIAs		<0.001
Yes	448 (12.1)	
No	97 (25.8)	
Knowledge of measles index		0.026
0	91 (23.1)	
1–2	296 (13.9)	
3+	158 (10.8)	
Attitude towards immunization		0.188
"Useful"	514 (14.0)	
"Not useful or unclear"	31 (22.6)	
Immunization services are safe and reliable		0.388
Yes	386 (13.2)	
No	134 (17.2)	
Don't know/missing	25 (20.0)	
Trust in government		0.004
Yes	492 (13.2)	
No	50 (24.0)	

^a Significant difference between unvaccinated and vaccinated children was estimated using a *T* test for continuous variable and the Pearson χ^2 test for categorical variables.

be appropriate for migrant population [17]. The high mobility of migrants makes it difficult to get accurate records for this population [18]. Even though Beijing has adopted measures to register adult migrants, the documentation of migrant children has not been undertaken systematically [19]. These facts call for improved methods to estimate the coverage of public health interventions among the migrant population.

The study identified several factors associated with migrant children's vaccination status through the measles SIA. Firstly, the risk of being unvaccinated for stay-at-home children were more than two times higher than children who enrolled in schools, even after controlling for parental characteristics. In this study, most stay-at-home children were not old enough to go to kindergarten. While the finding underscores the important role played by schools in promoting immunization as in other settings [20,21], it also points to the weak institutional intervention targeting children in the community. Existing studies show [5–7] that children between 0 and 3 years old living in migrant communities have low coverage of routine immunization, due to low level of parental knowledge and awareness towards immunization and insufficient outreach service delivery. Therefore effective SIAs can play an important role

Table 3

Poisson regression analysis of the relative risk of being unvaccinated during the measles SIA by socio-demographic characteristics of migrant children, parental knowledge and attitude towards immunization, Beijing, 2011 ($N = 545$).

Variables	Crude RR (95% CI)	Adjusted RR (95% CI)
Socio-demographic characteristics		
Child's age (years)	0.93 (0.86–1.00)	1.05 (0.97–1.13)
Child's sex		
Male	0.97 (0.65–1.45)	1.04 (0.70–1.56)
Female	1.00	1.00
Child's place of birth		
Beijing	1.00	1.00
Other provinces	1.10 (0.71–1.70)	0.96 (0.60–1.54)
Child's place of schooling		
At home	2.64 (1.49–4.68)	3.23 (1.68–6.22)
In kindergarten	1.97 (1.10–3.54)	2.21 (1.18–4.14)
At school	1.00	1.00
Number of children in the family		
1	1.00	1.00
2+	0.60 (0.37–0.99)	0.57 (0.34–0.94)
Sex of parent		
Male	1.00	1.00
Female	0.97 (0.61–1.53)	0.90 (0.57–1.42)
Education of parent		
Primary or less	1.19 (0.65–2.18)	1.15 (0.56–2.35)
Junior high school	0.88 (0.55–1.41)	0.84 (0.53–1.33)
Senior high school or above	1.00	1.00
Parent's duration of stay in Beijing		
0–2 years	1.67 (1.00–2.79)	1.41 (0.81–2.45)
3+ years	1.00	1.00
Knowledge and attitude towards immunization		
Know about the 2010 SIAs		
Yes	1.00	1.00
No	2.14 (1.38–3.32)	1.71 (1.06–2.76)
Knowledge of measles index		
0	2.14 (1.16–3.97)	1.75 (0.90–3.43)
1–2	1.29 (0.74–2.25)	1.17 (0.67–2.05)
3+	1.00	1.00
Attitude towards immunization		
“Useful”	1.00	1.00
“Not useful or unclear”	1.61 (0.80–3.25)	0.98 (0.43–2.22)
Immunization services are safe and reliable		
Yes	1.00	1.00
No	1.30 (0.82–2.06)	1.22 (0.76–1.95)
Don't know/missing	1.51 (0.67–3.42)	0.76 (0.29–2.00)
Trust in government		
Yes	1.00	1.00
No	1.82 (1.04–3.17)	1.84 (1.06–3.18)

in increasing immunization coverage among stay-at-home children. However, the measles SIA of 2010 did not seem to reach its goal at the community level.

In addition, migrant children in kindergartens were more than twice as likely to be unvaccinated as those in schools. In this study, 85.6% of vaccinated pupils received a dose in schools compared to 28% of the vaccinated kindergarteners who received the vaccine in kindergartens. The weaker role played by kindergartens may be due to the fact that many of migrant-run kindergartens did not organize on-site vaccinations as their regulated counterparts did. A majority (65.5%) of children between 3 and 5 years old in the sample attended unregulated migrant-run kindergartens. Thus, place of schooling corresponding with children's differential exposures to measles vaccine during the SIA, reflects another aspect of the institutional barriers for migrant children's immunization.

Consistent with existing literature [7,13,22], parents who were unaware of the campaign were significantly less likely to have their children vaccinated. Further analysis indicated that parents who knew about the measles SIA were more likely to have better education, better knowledge about measles, and to have more positive attitudes towards immunization. Furthermore, better-educated parents tended to receive health information from public media, while less-educated migrants were more likely to rely on word-of-mouth through informal networks. Other studies also found that

the social networks are related to migrant children's immunization [7]. Thus, in order to distribute health information to less educated migrants more effectively, it is important to mobilize informal migrant networks.

Furthermore, this study showed that parent's level of trust in the government-administered measles campaign is positively related to children's vaccination status during the SIA, which is similar to findings from other countries [22]. In this study, only 6.5% of unvaccinated children were due to parents having concerns over the quality of the vaccine or the side effects of vaccination. Similarly, rumors, frequently found to hamper vaccination [23,24], were not mentioned by migrants as a factor stopping them from participating in the SIA. The high level of trust in the government from migrants, or people of rural origin in general [25,26] may give China an advantage of administering effective public health campaigns.

Finally, our data showed that sibling size had a positive association with children's vaccination outcome. The relationship between sibling size and children's likelihood of being vaccinated can be positive, negative, or non-existent according to existing literature [22,27–29]. A study on migrant children in China found that children who live in larger families have negative routine vaccination outcomes [7]. In the case of SIA, however, we suspect that multiple children may translate into parents being notified repeatedly about vaccination-related information, which may in turn lead to a greater parental inclination to get their children vaccinated. However, this finding could be due to sample bias and should be interpreted with caution.

Risk factors commonly reported in existing literature (i.e. children's birth place, parental education, knowledge of measles, and length of migration) [13,20,30,31,8] were not associated with children's vaccination during the SIA. The findings may suggest that the Beijing government has been successful in making the measles SIA services accessible to migrant populations in general. However, our study also revealed some weaknesses in the SIA implementation. For instance, “child was sick at the time” was the most common reason for children not receiving the vaccination, which pointed to the necessity of providing make-up vaccination. Some parents reported in open-ended questions that they were unable to find make-up vaccination services after the 10-day campaign period. Others reported that they were refused a vaccination for their children when they failed to present the immunization card, even though the policy stipulated that children should get SIA regardless.

5. Limitations

Among the key strengths of the study, it is one of a few studies of the coverage of the mass immunization campaign among migrant children in China that uses rigorous analytic methods to estimate the risk factors associated with being unvaccinated. However, our study also has several limitations. First, the study is based on a convenience sample, and the results cannot be generalized to the entire migrant population in Beijing. Second, this study only surveyed migrants who left Beijing for the Chinese New Year by train or bus; those who stayed in Beijing during the holidays or went home by air/private cars were excluded from the sample. While those who traveled by air/private cars may be better off, there are many reasons for migrants to stay in Beijing over the New Year holidays. To our knowledge, there is no study showing systematic differences between those who stay and those who travel during the Chinese New Year holiday. Therefore, we are unable to assess the potential bias of the sample and its impact on the results. Third, the cross-sectional analysis does not allow us to determine the causal relationship between some of the explanatory variables and child vaccination status. However, the central objective of this

study was to identify factors associated with being unvaccinated so as to inform future immunization campaigns targeting migrant children.

6. Conclusion

While China has successfully controlled measles, the next step – eliminating measles in China by the end of 2012 – is a more difficult task. This study revealed a particular set of challenges. The findings indicated that, despite the fact that the 2010 nationwide measles SIA managed to cover a majority (83.4%) of migrant children, who are the main target of the campaign, it was not yet able to reach the pre-established goal of 95% coverage. Migrant children who stayed at home and who attended unregulated migrant-run kindergartens, and those with parents who were unaware of the SIA or who had a low level of trust in the government-administered measles SIA were significantly less likely to receive the measles vaccine during the campaign.

The study has several policy implications. First, the relatively low coverage of the measles SIA among migrant children underscores the need to keep measles vaccination for the migrant population a high priority on China's public health agenda. Instead of launching campaigns covering the entire population, efforts targeting migrants could be more cost-effective. Second, extra effort should be devoted to children in the community or in migrant-run kindergartens. Two possible means to support this effort include integrating unregulated migrant-run kindergartens into the public health system, and strengthening the role of the community in providing health education and services. Third, health education efforts should develop more effective communication methods to reach migrants of low socioeconomic status and raise their awareness of immunizations. Better outreach may be achieved through organizing peer-education and publicizing public health events within informal migrant networks. Fourth, health authorities should pay more attention to details in implementing public health campaigns, such as ensuring that local level health providers fully understand the regulations and make make-up vaccination available after the SIA.

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