



# Maternal work conditions, socioeconomic and educational status, and vaccination of children: A community-based household survey in Japan

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## ABSTRACT

**Objective:** This study examined how maternal work-related factors, including the availability of paid maternal leave, affect childhood vaccination status. Relatively little is known about the association between the employment status of mothers and the vaccination status of their children.

**Method:** We examined data from the Japanese Study on Stratification, Health, Income, and Neighborhood (J-SHINE), an ongoing epidemiologic household panel study in Japan. We used surveys taken in 2010–2011 in this study.

**Results:** We found that mothers who returned to work after giving birth were much less likely to follow recommended vaccine schedules for their children compared with mothers who stayed at home and those who had left the workforce by the time of childbirth. However, taking parental leave significantly reduced the risk of not being up-to-date with the vaccination schedule at 36 months of age. We also found that children whose mother was younger and less educated, and those from an economically deprived family were at a high risk of not being up-to-date with the vaccination status at 36 months of age.

**Conclusion:** Because vaccination is free and widely available in Japan, our findings indicate that provision of free vaccinations is not sufficient to achieve high vaccination rates.

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## Introduction

Vaccination is one of the most acclaimed public health achievements in history. Most of the vaccine-preventable diseases (VPDs) that once threatened the lives of many people are at historically low levels in many high- and middle-income countries. However, Japan is one of the few countries that still experience frequent outbreaks of VPDs. Japan experienced large outbreaks of measles and pertussis in 2007 and 2008, and adult and adolescent incidences of pertussis have increased by forty times over the past decade (National Institute of Infectious Diseases, 2012). The public-health consequences of such VPD outbreaks can be far-reaching, potentially resulting in international transmission of the diseases (Gautret et al., 2012). Indeed, Japanese travelers infected with measles virus have caused several measles outbreaks in the United States, where the disease is no longer endemic (Centers for Disease Control and Prevention, 1999, 2008).

Identifying groups who are less likely to be vaccinated is crucial for the prevention of VPD outbreaks. Many studies conducted in high-income countries have repeatedly found that lower socioeconomic

status of mothers and certain demographic characteristics of children are associated with failed vaccination (Centers for Disease Control and Prevention, 2012; Luman et al., 2003; Middleton and Baker, 2003; Wooten et al., 2007; Zhao and Smith, 2013). Other factors that are likely to be crucial for children's vaccination status are maternal employment status and maternity leave, because early childhood vaccinations are concentrated within 1 year of birth. There is some evidence to suggest that countries with longer paid maternity leave tend to have higher vaccination rates (Daku et al., 2012, but see also Tanaka, 2005). However, there is a dearth of micro-level studies on the association between utilization of maternal leave and children's vaccination status. A study conducted in the United States found that the children of mothers who returned to work within 12 weeks of giving birth were less likely to receive certain vaccines (Berger et al., 2005). However, the United States maternity leave policy is exceptional for its short period and limited pay provisions, and it is not clear whether these findings are applicable to other countries with more generous maternal leave policies.

Using data from a recent population-based survey, this study examined how maternal work-related factors, including the utilization of maternal leave, as well as socioeconomic factors affect the vaccination status of children in Japan. Little is known about unvaccinated children and their households in Japan, owing to the lack of a population-based immunization registry that keeps track of immunization records.

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Previous authors surveyed participants in a public health checkup for infants and children at a local health center, and reported that children with employed or young mothers were more likely to be unvaccinated (Kato and Takahashi, 1999; Matsumura et al., 2005). However, they failed to account for the level of maternal education, family economic status, and job-protected paid maternity leave status. In Japan, provision of maternity leave for 8 weeks is mandatory to all employers under the Labor Standard Law. However, payment is not mandated, and 70% of work places do not pay during maternity leave (Ministry of Health, Labour, and Welfare (Japan), 2008). Only those under public employee health insurance, which mainly covers full-time employees at larger companies, can enjoy a subsidy representing 60% wage replacement. The Child Care and Family Care Leave Law, enacted in 1995, encourages employers to allow their employees to take parental leave, but only until the child reaches 1 year of age (with certain exceptions). During parental leave, employers have no duties for salary payment, and the government pays workers a compensation comprising 50% wage replacement. Consequently, the utilization of parental leave has mainly become prevalent among full-time female workers at larger firms, and those with part-time status at smaller workplaces have been left behind (Ikeda, 2010; Ministry of Health, Labour, and Welfare (Japan), 2012). Although Japan offers free vaccinations for all children, the current unequal conditions of parental leave in Japan may cause gaps in children's vaccination status and subsequent inequality in health risks.

## Methods

### Study design

We examined data from the Japanese Study on Stratification, Health, Income, and Neighborhood (J-SHINE), an ongoing epidemiologic household panel study. The sample was taken from a random sample of individuals aged 25–50 years residing in four municipalities in urban or suburban settings of the greater Tokyo metropolitan area. The survey conducted a supplemental survey for children aged under 18 years and their primary caregivers in 2011, of which the data were used for this study (version 20130822). The J-SHINE was conducted using computer-assisted personal interviewing (CAPI). A more detailed overview of the design and methods used in the J-SHINE is described elsewhere (Takada et al., 2014). In the following analysis, only the answers provided by the children's biological mothers and fathers (98.3% of the cases) were used. We dropped cases if the child's biological mother differed from their current mother.

### Data on vaccination status

The survey asked the primary caregiver to provide each child's immunization status and dates of immunization by referring to the records in a booklet called the Mother and Child Health Booklet (*boshi kenko techo*). This booklet is officially issued by the municipality at the time of pregnancy, and is used to record information regarding infant routine developmental checkups and vaccination status by pediatricians.

This study analyzed the vaccination status for Bacille Calmette–Guérin (BCG), oral polio vaccine (OPV), and diphtheria, tetanus toxoid, and acellular pertussis (DTaP) vaccines. For the birth cohorts included in our study (children born between 1993 and 2008, or age of 36 months to 18 years), the routine vaccines recommended in the national immunization program were BCG, OPV, DTaP, monovalent measles, and rubella vaccines (until March 2006), or an MR combined vaccine (since April 2006) and Japanese encephalitis (until 2005). The government recommendations for measles, rubella, and Japanese encephalitis have been drastically and frequently revised during this period. Therefore, owing to the potential confusion among parents caused by the policy

changes, the vaccination status for these vaccines was not considered in our analysis.

The recommended doses and schedules for the BCG, OPV, and DTaP vaccines are shown in Table 1. For each of the vaccines, children were considered to be up-to-date (UTD) if their parents reported that they had received all of the recommended doses and if the doses were completed by 36 months of age. Otherwise, they were considered to be not up-to-date (NUTD). In addition, if children were NUTD for any of the vaccines, we classified them as “undervaccinated”. Finally, children were considered to be “fully vaccinated” if they were UTD for all three vaccinations.

We excluded samples if the parents refused to provide the children's entire vaccine history or answered “don't know” to all of the vaccine-related questions. Re-categorization of the “don't know” cases to NUTD did not considerably affect the results reported below. In the end, our analysis included 1727 children from 1097 households who were aged between 36 months and 18 years for whom complete vaccine uptake information was available for the BCG, OPV, and DTaP vaccines.

### Data on maternal, child, and household characteristics

We estimated a logistic regression model that examined the effects of maternal, child, and household characteristics on the vaccination status. The data for maternal and household characteristics were taken from the J-SHINE wave 1 and spouse/partner surveys conducted in 2010 and 2011, respectively (version 20130529). The maternal characteristics were measured by age at birth of the child, education level, employment status, and parental leave status defined as leave from work beyond the mandatory 8-week maternity leave period until the time the child reached 1 year of age. The household characteristics were based on self-reports of the amount of help available for the mother from the child's father and grandmothers when the child was less than 3 years of age, and the level of financial hardship during pregnancy. The vaccination status was taken from the children survey conducted in 2011. The child characteristics included sex and birth order.

Because unobserved events, such as sporadic VPD outbreaks and changes in vaccine availability, may have affected the vaccination status of particular cohorts, we also included birth-year fixed effects in the model. In addition, we included city dummy variables to account for any potential regional policy differences. All analyses were conducted using Stata/SE software (version 12; StataCorp, College Station, TX).

## Results

Table 2 shows the sample characteristics (N = 1727). The majority of the children in our sample had a mother who had graduated from college after 2 or 4 years, but 25.8% of them had a mother with only a high school diploma. About 26% of the sample had a mother who quit her job after giving birth and 22% of them had a mother who continued to work, either with or without maternity leave (12% and 9.2%, respectively).

Regarding the vaccination status in our sample, 1.3% (N = 23) and 5.8% (N = 100) of the children were considered to be NUTD for BCG and OPV, respectively. The rate of NUTD for the four-dose DTaP series reached as high as 22.9% (N = 396) of the sampled children at 36 months of age. Among the children in our sample, 25.4% (N = 439) were considered to be undervaccinated.

Table 3 summarizes the results of the logistic regression. The first column shows the results of a series of logistic regressions in which each group of variables (age, education, work status, help from grandmother(s) and father, living standards, sex, and birth order) was separately regressed on the vaccination status. We found that children with a mother who was less educated, young, and employed and those from a family that was struggling financially were at a higher

**Table 1**

Recommended vaccine schedules and numbers of recommended doses in Japan for the birth cohorts born between 1993 and 2008.

Vaccine	No. of recommended doses	Recommended schedules
BCG (Bacille Calmette–Guérin vaccine)	1	1 dose before 6 (from April 2005) or 12 months (until March 2005) of age
OPV (oral polio vaccine)	2	2 doses before 18 months of age
DTaP (diphtheria, tetanus toxoid, acellular pertussis vaccine)	4	3 doses between 3 and 12 months of age and 1 dose between 12 and 18 months

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