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Improved timely birth dose coverage of hepatitis B vaccine narrows the socio-economic inequality in western China in 2011–2016

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ABSTRACT

Objective: To compare timely birth dose (TBD) coverage of hepatitis B vaccine and socio-economic inequality distribution of TBD coverage between 2011 and 2016 in rural areas of western China.

Methods: In western China, using multi-stage probability proportion to size sampling, 2633 and 1929 children aged 0–35 months with an immunization card were selected from 14 rural counties in 2011 and 2016, respectively. Socio-economic characteristics were obtained from face-to-face questionnaire survey and copies of vaccination certificates. We performed multivariate logistic regression models to identify the determinants of TBD coverage of hepatitis B vaccine. We grouped TBD coverage by wealth quintiles, calculated inequality using the difference base on coverage in richest (quintile 5) and poorest (quintile 1) household wealth quintiles.

Findings: From 2011 to 2016, the overall TBD coverage of hepatitis B vaccine among children aged 0–35 months in rural areas of western China increased from 52.8% (95% confidence interval, CI: 42.4–62.8) to 80.2% (95% CI: 69.5–87.8). The absolute difference in TBD coverage between richest and poorest quintiles was 20.6 (95%CI: 9.4–31.8) and 15.8 (95%CI: 1.4–30.2) in 2011 and 2016, respectively.

Conclusion: The socioeconomic inequality in TBD coverage decreased over the study period, but such inequality still existed in 2016. To improve inequality in TBD, the government should pay more attention to the disadvantaged groups, especially the children who were delivered at home, or whose caregivers were ethnic minority or who have a lower level of education.

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1. Introduction

Hepatitis B virus (HBV) infection is a significant public health problem. HBV attacks the liver and can lead to both acute and chronic hepatitis diseases, especially when infection is acquired in childhood [1]. China has a high prevalence of HBV, with over 120 million HBV carriers and about 300,000 deaths per year due to HBV infection and HBV related diseases [2]. From 16,051,850 rural Chinese women aged 15–49 years, a cross-sectional study found a high-intermediate burden of chronic HBV infection: 5.2% of women were infected with chronic hepatitis B virus [3]. Mother-to-child transmission (MTCT) is a major mode of HBV transmission in the world, and up to 50% of new HBV infections are acquired through MTCT in China [4]. Hence, newborns in rural China are

therefore at higher risk of HBV infection. In addition, due to the recent release of two-child policy, China may experience a baby boom in the coming years [5,6]. Therefore, controlling MTCT and reducing hepatitis B infection in newborns are urgently needed in rural areas of China.

Timely birth dose (TBD), the first dose of hepatitis B vaccine received within 24 h after birth, has been considered as the key strategy in preventing hepatitis B from MTCT [7,8]. Untimely vaccination poses a threat to susceptible children. However, there is limited nation-wide data on the TBD coverage of hepatitis B vaccine in children in China. Previous studies in Eastern China have revealed that TBD coverage of hepatitis B vaccine is 70.8% in Guangdong and 55.2% in Fujian [9,10]. However, most studies in China have focused on the urban children in eastern China and there have been a lack of studies of rural children in western China.

Since 2005, the Chinese government has committed to provide government-purchased hepatitis B vaccine at no cost to parents for all newborns. Starting from 2009, the National Health and Family

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Planning Commission of the People's Republic of China started the National Basic Public Health Services programme, providing public health services free of charge, and hepatitis B vaccination has been included [11]. These interventions were designed to promote the equality of the health services among vulnerable groups: every member of society has equal access to health services. However, to our knowledge, it remains unclear whether the inequality on TBD coverage in western China has been improved and the extent to which inequality has been reduced after these interventions [11].

Therefore, this study aims to compare the TBD coverage of hepatitis B vaccine between 2011 and 2016 among children aged 0–35 months in rural areas of western China. We sought to evaluate the socio-economic inequalities in TBD coverage of hepatitis B vaccine between 2011 and 2016. We hypothesized that the socio-economic inequalities in TBD coverage of hepatitis B vaccine decreased over time.

2. Methods

2.1. Data source and study design

In Western China, we conducted a community-based, cross-sectional survey in 14 rural counties from seven provinces (Gansu, Guizhou, Qinghai, Yunnan, Sichuan, Tibet and Xinjiang). Two separate surveys were carried out in 2011 and 2016. The methodology of the 2016 survey were in line with 2011 [23]. The survey was conducted by research staff and students from Peking University and United Nations International Children's Emergency Fund (UNICEF) staff working with local health authorities. The survey was approved by Peking University Health Science Center's ethics committee. In our study, the 14 counties were selected, a priori, by the national health department. We used the population proportional to size (PPS) sampling method recommended by Multiple Indicator Cluster Surveys (MICS) in each of the surveyed counties [32]. In China, there are many villages in each county, and each village has many groups that are naturally formed and have natural boundaries. Moreover, there are some distances between different groups, and some are far away. Considering China's geographical location, topography, manpower, material resources, and financial resources for investigation as well as the representativeness of the survey, this study adopted a three-stage sampling method to select target populations. First, 15 villages as the primary sampling units were selected with PPS sampling method [24], a sampling procedure under which the probability of a unit being selected is proportion to the size of the ultimate unit [25], and two groups, one segment of the village that spontaneously and naturally exists within village, were also selected in same method in each village. In each sampled group, 10 households with children under 3 years old in 2011 and 8 households with children under 5 years old in 2016 were randomly selected, using the list of children under 3 years old in 2011 or under 5 years old in 2016 provided by the village doctors. In sparsely populated Tibet, only two or three households with children under 3 were randomly selected in each group. Interviews with caregivers were conducted using a structured questionnaire based on a slightly modified version of Multiple Indicator Cluster Surveys (MICS) questionnaire [22]. In order to fill data gaps for monitoring the situation of children and women, UNICEF assists countries in collecting and analyzing data through its international household survey initiative the MICS. MICS questionnaires are designed in a modular fashion that can be easily customized to the needs of a country. They consist of five questionnaires such as a household questionnaire, a questionnaire for women aged 15–49 and a questionnaire for children under the age of five. Information pertaining to the socio-demographic char-

acteristics of children based on the MICS questionnaire were collected. The questions related to socio-economic were originally designed based on the MICS questionnaire, and were later revised after reference to relevant literatures, on-site pre-survey, and expert opinions. Date of hepatitis B vaccine vaccination was received from the card.

2.2. Measures

In this study, the primary outcomes were The TBD coverage of hepatitis B vaccine, defined as received the first dose of hepatitis B vaccine within 24 h of birth among children with an immunization card. The untimely birth dose coverage of hepatitis B vaccine was defined as received the first dose of hepatitis B vaccine over 24 h of birth or missed hepatitis B vaccination among children with an immunization card. The annual net income of household is equal to total household income for the year minus the expenses incurred on production, operations, etc. Total household income included salary, family production income (produced gain, poultry being sold, etc.), income from working, and government funding. Household expenses included agricultural productive expenses (seeds, fertilizers, pesticides, feed, etc.), living expenses (clothing, food, household appliance, etc.), health care expenses, and tax. The annual net income of household divided by the total population of the family made per capita net income of household. In our study, the income level was defined based on the quintiles in the distribution of household per capita income in surveyed areas. The households in the lowest quintile were assigned to household income group 1 (Quintile 1), while households in the richest quintile were assigned to household income group 5 (Quintile 5).

2.3. Analysis

In our analysis, we used PPS method to select children under 3 years old in 2011 and children under 5 years old in 2016 which described in details in the methodology, and then resulting data were clustered with a hierarchical structure (households nested within groups, and groups nested within villages). The important consequence of clustering was that measurement on units within a cluster were more similar than measurements on units in different clusters resulting in misleading standard errors. So the clustering effect of the survey design was taken into account [26]. We first examined the characteristics of children aged 0–35 months with and without an immunization card in 2011 and 2016 using the Pearson chi-square test. We calculated the proportion of timely birth dose of hepatitis B vaccine among children with an immunization card in 2011 and 2016. We computed the change of TBD coverage between 2011 and 2016 along with 95% confidence intervals (CIs). We also compared the TBD coverage in 2011 and 2016 using the Pearson chi-square test. Then, we used logistic regression models to assess if there was an association between determinants and untimely birth dose coverage of hepatitis B vaccine. Adjusted variables for untimely birth dose coverage of hepatitis B vaccine were child's gender, child's age, birth order of child, birth place of child, caregiver's education, caregiver's ethnicity and per capita income of household [27–29]. We reported the unadjusted odd ratios (Crude OR), the adjusted odds ratios (adjusted OR) and 95% CIs.

Data for TBD coverage were grouped by wealth quintile. We calculated the difference measures based on TBD coverage of hepatitis B vaccine in richest (quintile 5) and poorest (quintile 1) in each year to show the status of inequality and the change in income-related inequality between 2011 and 2016 [30,31]. Difference is an expression of absolute inequality (quintile5–quintile1) [30]. The trend of equality of TBD coverage is mainly explained by look-

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