

Survey of coverage, strategy and cost of hepatitis B vaccination in rural and urban areas of China*

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Abstract

AIM In order to understand the coverage, immunization strategy and cost of hepatitis B (HB) vaccination of China in recent years.

METHODS A two-stage household random sampling method was used in the survey.

RESULTS The survey carried out at 112 Disease Surveillance Points (DSPs) of 25 provinces, autonomous regions and municipalities of China in 1996, showed that the coverage rates of HB vaccination among neonates were 96.9% in the urban DSPs and 50.8% in the rural DSPs in 1993-1994, while in students aged 7-9 years, they were 85.8% and 31.5% in 1994, respectively. Up to 1994, 97.5% of the urban DSPs and 73.9% of the rural DSPs on a neonate vaccination against HB program were included in EPI. About 93% of the urban DSPs and 44% of the rural DSPs did HBsAg and HBeAg screening for all or part of pregnant women. The neonates received the regimen of high-dose HB vaccine in combination with hepatitis B immune globin (HBIG) if their mothers were HBsAg and/or HBeAg positive in pregnancy, otherwise they received the low-dose vaccine (10 μ g \times 3). Part of DSPs had a lower neonate coverage due to unreasonable allocation of the vaccines (used for adults not at risk) or higher cost or insufficient supply of the vaccines. It is necessary to evaluate the quality of serological lab test to HBVMs in the maternal prescreening.

CONCLUSION Remarkable achievements have been made according to the national planning and policy of HB immunization in China.

INTRODUCTION

Some studies demonstrated that HBsAg and anti-HBc-positive rates of the immunized populations after hepatitis B (HB) vaccination were significantly lower than those of a parallel or a historical control population, and the efficacy or effectiveness of protection against HBsAg was over 85% 1-12 years after infancy vaccination^[1,2]. Since the 1990s hepatitis B vaccination has become a principal strategy for the control of HB in China^[3], however, special attention should be paid to the rational use of HB vaccine and the improvement of coverage rate of vaccination in the implementation of national HB immunization program. At present, there has been few data on national coverage of infancy vaccination, immunization strategy and regimen, allocation and cost of HB vaccine because of lack of the corresponding survey in the whole country. To improve the benefit of the national vaccination program and to provide the evidences relative to immunization compliance used for the evaluation of effectiveness of this HB control program, we conducted an epidemiological survey in the national disease surveillance points (DSPs) between December 1995 and January 1996 in China.

MATERIALS AND METHODS

Definition of terms

Coverage rate of hepatitis B vaccination: this rate means the percentage of immunized individuals with hepatitis B vaccine among infants and children aged 7-9 years, and is estimated through the sampling survey.

Reported coverage rate of infant hepatitis B vaccination: this rate means the percentage of immunized individuals with hepatitis B vaccine among all infants of the rural counties or the urban districts in 1994, and is reported by the local anti-epidemic stations according to the routine communicable disease reporting system.

Immunization strategy and regimen: the strategy is referred to the selection of target population for immunization, hepatitis B vaccine integrated with or without EPI, screening hepatitis B surface antigen and eantigen or not to mothers before delivery, and in conjunction with or without hepatitis B immune globin (HBIG); and regimen is referred to dosage of vaccine and schedule of

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vaccination.

Allocation of vaccine: allocation of vaccine means the proportion of vaccine amount allocated to different populations of immunization.

Cost of vaccination: the cost is the fee used for injection of HB vaccine or/and HBIG in each infant as well as the fee for predelivery screening of mothers.

Subjects

All infants born in the period from January 1, 1993 to December 31, 1994 and children aged 7-9 years: all children born between January 1, 1986 and December 31, 1988 among the identified eligible households were selected as eligible subjects for interview.

Sampling methods

Two-stage random sampling method with a same sample size was used to determine eligible villages or neighbourhood committees and households for the survey in each DSP. The procedure is as follows: ① making first-stage sampling frame that all villages or neighbourhood committees in each DSP are defined as first-stage sampling unit for coding, then 20 sampling units are randomly drawn in terms of a table of random number (if the sampling unit less than 20, then only 10 sampling units drawn); ② making second-stage sampling frame that all households in each village or neighbourhood committee drawn in the first-stage sampling are referred to as second-stage sampling unit, 50 or 100 households (if only 10 units drawn in the first-stage, then sampling 100 units) are randomly sampled, and 20% of households as candidates for the replacement of non responders or families lost to follow-up.

Method of data collection

Household survey and schooling interview were carried out for the collection of the data of individuals from the families, schools and clinics according to a standardized questionnaire. The data relative to status of infancy HB vaccination of the eligible children were collected through interviewing their parents or caretakers and checking the Immunization Record Card; the information of the children aged 7-9 years were provided by their parents, and the validity was determined after checking with their teachers and health workers if necessary. The data on reported coverage of HB vaccination and the status of allocation of the vaccines were provided by three departments, EPI, epidemiology and disease surveillance in an anti epidemic station in terms of the standardized questionnaire.

RESULTS

Status of hepatitis B vaccination

Coverage rates of infant hepatitis B vaccination and children aged 7-9 years Among the 112 DSPs of 25 provinces, autonomous regions and municipalities (PARMs), except for 2 DSPs of the Tibet Autonomous Region and 1 DSP of the Gansu Province which did not carry out the hepatitis B vaccination, the remaining 109 DSPs had the hepatitis B vaccination program up to 1994. We interviewed a total of 10900 families of the 109 DSPs in the survey, including 8248 children and 17883 junior students. The coverage rate of HB vaccine immunization is shown in Table 1.

Table 1 Coverage rates of hepatitis B vaccine immunization among infants and primary school students in 109 DSPs of China

Target population	Areas	No. of DSPs	Sample size	Coverage		Coverage with 3 doses	
				No. of vaccinees	%	No. of vaccinees	%
Infants	Total	109	8248	5376	65.2	5190	96.5
	Urban	40	2572	2492	96.9	2434	97.7
	Rural	69	5676	2884	50.8	2756	95.6
Students	Total	108	17883	8143	45.5	7815	96.0
	Urban	40	4621	3965	85.8	3933	99.2
	Rural	68 ^a	13262	4178	31.5	3882	92.9

^aIn one DSP, no hepatitis B vaccination for primary school students was conducted in 1994.

It can be seen from Table 1, that the coverage rate of infant HB vaccine immunization in the urban areas was 96.9%, significantly higher than that in the rural areas (50.8%) during the period of 1993-1994 ($\chi^2 = 1655.9$, $P < 0.01$). The coverage of students aged 7-9 years was 85.5% in the urban, significantly higher than 31.5% in the rural ($\chi^2 = 4074.3$, $P < 0.01$). The coverage with 3 doses of HB vaccine was over 92% in both.

The reported coverage rates of hepatitis B vaccination by the local anti-epidemic stations

According to the reported coverage of the anti-epidemic stations of the 112 DSPs (41 in the urban and 71 in the rural) in 1994, 92.7% of the urban DSPs and 45.1% of the rural DSPs, had a coverage rate of over 60% for neonatal HB vaccination, the difference between the two areas was statistically significant ($\chi^2 = 25.1$, $P < 0.01$).

Status of the implemented strategies of hepatitis B vaccine immunization

Selection of target population for HB immunization

Up to 1994, 97.3% (109/112) of the anti-epidemic stations located in the surveyed DSPs had implemented the infant HB vaccine immunization program. The number of DSPs without HB vaccination for preschool children, primary school students and middle school students was 18 (6 in the urban and 12 in the rural), 41 (15 in the urban and 26 in the rural) and 68 (22 in the urban and 46 in the rural), respectively, and the number of DSPs conducting HB vaccination for adults at risk, even for the general population, was 43 (18 in the urban and 25 in the rural) and 34 (13 in the urban and 21 in the rural), respectively.

Status of hepatitis B vaccination integrated with EPI Totally 82.6% of 109 DSPs integrated infant HB vaccine immunization into EPI program in 1994. This percentage was 97.5% in the urban, significantly higher than 73.9% in the rural ($\chi^2=9.8, P<0.01$).

Pattern and quality of maternal predelivery HBeAg and HBsAg screening Of 40 urban DSPs the proportion of DSPs with the predelivery screening for all pregnant women or a part of pregnant women and the proportion without the predelivery screening was 60.0%, 32.5% and 7.5% in 1994, respectively. However, the corresponding proportion was 5.8%, 37.7% and 55.1% in 69 rural DSPs. The former two proportions of the urban DSPs were significantly higher than that of the rural DSPs ($\chi^2=25.7, P<0.01$). The results of the predelivery screening obtained from the household survey in the urban and rural DSPs are shown in Table 2.

Table 2 Results of predelivery screening HBeAg and HBsAg among mothers of 2 252 infants in 1994

	Urban	Rural
Number of screening	1775	477
Isolated HBsAg-positive	13	14
Isolated HBeAg-positive	5	0
HBeAg- and HBsAg-positive	7	0
HBsAg-positive rate	1.1%(20/1775)	2.9%(14/477)
HBeAg-positive rate	0.7%(12/1775)	0.0%

The results of Table 2 showed that HBsAg-positive and HBeAg-positive rates were 1.1% and 0.7% in the urban, and 2.9% and 0% in the rural.

Dosage and regimen of infant HB vaccination and in combination with HBIG The regimen of immunization, 0, 1, 6 months schedule, was used for infancy vaccination in all 109 DSPs. The status

of regimen for infant HB vaccination and in combination with HBIG in the DSPs with the predelivery screening in all pregnant women (14 DSPs), a part of pregnant women (18 DSPs) and without screening (39 DSPs) is shown in Table 3.

Table 3 Regimen of infant HB vaccination or/and in combination with HBIG in 71 DSPs

Screening	Maternal HBVMs	Regimen	No. of DSPs			
			Total	Urban	Rural	
Yes	HBeAg- and HBsAg-positive	30 μ g+10 μ g \times 2	6	5	1	
		HBIG \times 1+30 μ g+10 μ g \times 2	10	2	8	
		30 μ g \times 3	7	3	4	
	Isolated HBsAg-positive	30 μ g+10 μ g \times 2	Others	9	7	2
			30 μ g+10 μ g \times 2	11	9	2
			HBIG \times 1+30 μ g+10 μ g \times 2	9	2	7
		10 μ g \times 3	30 μ g \times 3	6	3	3
			10 μ g \times 3	2	0	2
			Others	4	2	2
HBeAg- and HBsAg-negative	10 μ g \times 3	25	12	13		
	HBIG \times 1+10 μ g \times 3	1	1	0		
	30 μ g+10 μ g \times 2	6	3	3		
No	10 μ g \times 3	36	3	33		
	HBIG \times 1+30 μ g \times 3	1	0	1		
	30 μ g+10 μ g \times 2	2	0	2		

Table 3 showed that among the DSPs with the maternal predelivery screening, the regimen of first dose of 30 μ g, second and third doses of 10 μ g-HB vaccine was adopted for the infants whose mothers were HBeAg or/and HBsAg-positive in the majority of DSPs, next was the regimen of three doses of 30 μ g; combination with HBIG only in 18 DSPs, and the regimen of three doses of 10 μ g was used for the infants of mothers with negative screening results and in the DSPs without the maternal screening. Almost all the DSPs used China-made plasma-derived HB vaccines.

Allocation of vaccines

Based on the reported infancy coverage rates from anti-epidemic stations where DSPs were located in 1994, a total amount of HB vaccines and the proportion of the vaccines allocated to various populations and the pattern of the vaccine allocation were analyzed. The results showed that of 109 DSPs, 22 DSPs where the coverage rate of infant HB vaccination was not up to 60% in 1994 allocated less than 80% of the vaccines to infants for HB vaccination integrated with EPI, indicating that a considerable amount of the vaccines was unreasonably allocated to other populations, leading to the lower coverage of infant vaccination against HB in these DSPs. This phenomenon often occurred in the rural DSPs. In addition, although over 80% of HB vaccines was allocated to infants, the infant

coverage was still less than 60% in 7 DSPs, suggesting that the amount of the vaccines ordered for that year was not enough for infant vaccination.

Cost of vaccination

It was found that there was a big difference in the vaccination fee for each child and maternal predelivery screening, even in a same DSP, the rate was different. In a few DSPs, families had to pay very high fee for their baby immunization. Among 63 DSPs with the regimen of three doses of 10 μ g vaccine, 8 DSPs (12.7%) charged over 50 yuan RMB, 2 DSPs of which over 100 yuan per infant, approximately 2 - 5 times higher than the common standard of 21 yuan. Of 18 DSPs using combined HBIG, 4 DSPs charged a fee over 60 yuan, the highest being up to 140 yuan.

DISCUSSION

The results of this survey showed that the coverage rate of infant HB vaccine immunization in the urban areas was 96.9%, significantly higher than in the rural areas (50.8%) during the period of 1993 - 1994; the coverage of students aged 7 - 9 years was 85.5% in the urban, also significantly higher than in the rural (31.5%), indicating that these coverage rates in 1994 met with the expected standard in "the National Hepatitis B Vaccine Immunization Protocol"^[4]. On the other hand, the data from this survey are similar to the results reported by the local anti epidemic stations, which basically reflected the real status of HB vaccination in China, and may be recommended as evidence related to the compliance in the evaluation of effectiveness of hepatitis B immunization prevention in the future. Because HBsAg-positive rate declined to 1% - 2% 1-9 years after HB vaccination^[2], further raising the coverage of infant immunization, especially in the rural areas, is a crucial factor to control the prevalence of hepatitis B. It was found in this study that the unreasonable allocation of the vaccines was one of the causes leading to less than 60% of the coverage in infant HB vaccination in some DSPs. The short of vaccine supply was another important problem in some DSPs.

The high HB vaccination fee (including maternal prescreening) is probably one of the reasons for lower coverage of infant immunization. We, therefore, suggest that ① vaccines must be allocated rationally so as to insure a coverage of

85% and over for neonates in the rural areas first, and then for adults at high risk; ② a national standard payment for HB vaccination should be implemented; ③ infant hepatitis B vaccine immunization should be integrated into EPI for a better administration in the rural areas. In addition, we recommend that the HB vaccination for adult should be discontinued at present so as to avoid the waste of health resources.

The maternal predelivery HBsAg and HBeAg screening is of great significance to select a valuable regimen of HB vaccination for infants and to interrupt the transmission of HBV between mother and infant. The fact that only 5.8% and 37.7% of DSPs conducted the maternal prescreening for all and a part of pregnancy women is mainly attributable to a poor lab condition, technician training and lack of fund. On the other hand, there might be some problems with the quality of the screening in some areas, especially in the rural areas, which was also demonstrated by Liu PB *et al*^[5] in their studies. Thus, it is necessary to investigate the quality of the maternal HBsAg and HBeAg prescreening by the local health institutions of our country. In addition, it is also found in our survey that there were the multiple strategies and regimens of infant HB immunization, therefore, their cost-effectiveness and cost-benefit should be evaluated as soon as possible, so as to recommend an optimum strategy and regimen for areas with different HBV infection and economic status.

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