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*Original Article*

# A serological survey of hepatitis B among migrant workers at a construction site in Qingdao, China

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## Abstract

Introduction: Migrant workers are a vulnerable population for hepatitis B virus (HBV) infection. The present study aimed to assess HBV prevalence and identify associated risk factors among migrant workers at a construction site in Qingdao, in order to inform prevention strategies.
Methodology: A random sampling method was used to select 169 migrant workers from a construction site in Qingdao in 2022. Data were collected through questionnaire surveys, and venous blood samples were obtained for serological testing. The electrochemiluminescence method was employed for serological testing to determine the positivity rate of Hepatitis B surface antigen (HBsAg), surface antibody (HBsAb), and core antibody (HBcAb), as well as the overall infection rate of HBV. Multivariate logistic regression analysis was conducted to identify factors associated with HBV infection.
Results: Among the 169 participants, the positivity rates of HBsAg, HBsAb, and HBcAb were 4.73%, 52.07%, and 43.20%, respectively, and the HBV infection rate was 46.75%. Multivariate logistic regression analysis revealed that being male, aged 41 years and above, having 2-5 years of working experience at construction sites, and residing in rural areas were risk factors for HBV infection, while a history of hepatitis B vaccination was a protective factor for HBV infection.
Conclusions: The positivity rate of HBsAg was higher among migrant workers at a construction site in Qingdao. Several risk factors were identified in relation to HBV infection. Strengthening health education and promoting hepatitis B vaccination are recommended to reduce the infection and prevalence of hepatitis B.

**Key words:** Hepatitis B; construction site; migrant workers; serological markers.

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## Introduction

Hepatitis B is a serious infectious disease caused by the hepatitis B virus (HBV), which can manifest as either an acute or chronic infection. It poses substantial threats to human health and remains a major concern in global public health. In 2022, it was estimated that approximately 254 million people worldwide were living with chronic HBV infection [1]. China has the highest global prevalence of hepatitis B virus infection, accounting for over 30% of the world's hepatitis B surface antigen (HBsAg)-positive population [2]. According to national seroepidemiological survey data, the prevalence of HBsAg in the general population of China declined from 9.72% in 1992 to 7.18% in 2006, and further decreased to 5.86% by 2020 [3]. Nevertheless, China remains a region with moderate endemicity for hepatitis B, with an estimated 75 million individuals chronically infected with HBV [3]. As a major coastal central city in China, Qingdao experiences significant population mobility, which complicates the epidemic situation of hepatitis B, and thus, prevention and control efforts remain challenging. Studies have indicated that migrant workers exhibit higher rates of HBV risk behaviors and infection susceptibility, yet demonstrate comparatively lower hepatitis B vaccination coverage [4-6]. Previous studies on HBV infection have primarily focused on the general population, with very limited data available on HBV infection among migrant workers at construction sites. This highlights the necessity to investigate the current seroepidemiological profile of HBV among migrant construction workers in Qingdao, identify associated influencing factors, and develop evidence-based strategies to control HBV transmission within this vulnerable population.

## Methodology

*Study Subjects*

A random sampling method was employed to select 169 migrant workers from a construction site in Qingdao in 2022 for the Survey.

The target subjects were migrant workers who were

(1) 18 years and above, (2) able to understand the questionnaire items, and (3) agreed to participate in this survey by providing informed consent. Individuals who were unable to understand the questionnaire items or refused to participate in the survey were excluded.

*Questionnaire Survey*

Uniformly trained investigators from the Qingdao Municipal Center for Disease Control and Prevention conducted face-to-face surveys with participants using standardized questionnaires, criteria, and methodologies. The survey covered basic information, hepatitis B vaccination history, and potential risk factors associated with HBV infection. Following data collection, a double-check process was performed to identify missing items and logical inconsistencies, followed by revisits and corrections.

*Specimen Collection and Laboratory Testing*

Following the questionnaire survey, 3–5 mL of venous blood was collected from each participant. The blood samples were centrifuged, and the serum was separated and stored at -20°C for subsequent testing. Hepatitis B serological markers (HBsAg, HBsAb, HBeAg, HBeAb, and HBcAb) were quantitatively detected using the electrochemiluminescence method. Testing kits were purchased from Roche Diagnostics (Shanghai) Co., Ltd., and all procedures were strictly followed according to the manufacturer's instructions. Quality control measures were implemented throughout the testing process.

*Statistical Analysis*

Survey data were double-checked and entered by Epidata 3.1. All data were analyzed using SPSS software, version 19.0. Rates and proportions were employed for statistical description. Comparisons of rates or proportions were conducted using the Chi-square test or Fisher's exact test. The influencing factors were examined through binary logistic regression analysis (enter method), with odds ratios (ORs) and 95% confidence intervals (CIs) calculated to assess the associations between exposure factors and HBV infection, employing a statistical significance level of $\alpha = 0.05$.

*Ethics Considerations*

This survey was approved by the Ethics Committee of Qingdao Municipal Center for Disease Control and Prevention. All participants signed informed consent forms before the survey.

## Results

*Basic Information*

A total of 169 migrant workers were surveyed, comprising 149 males and 20 females, yielding a male-to-female ratio of 7.45:1. The age distribution was categorized as follows: ≤ 30 years (n = 22, 13.02%), 31-40 years (n = 42, 24.85%), 41-50 years (n = 52,

**Table 1.** Distribution of HBV serological markers among migrant workers at a construction site in Qingdao.

| Factors | Participants (n) | HBsAg Positive cases n (%) | HBsAb Positive cases n (%) | HBcAb Positive cases n (%) | HBV Infections n (%) |
|---|---|---|---|---|---|
| **Type of family residence** | | | | | |
| Urban | 28 | 0 (0.00) | 12 (42.86) | 9 (32.14) | 9 (32.14) |
| Rural | 141 | 8 (5.67) | 76 (53.90) | 64 (45.39) | 70 (49.65) |
| **Age(years)** | | | | | |
| ≤ 30 | 22 | 0 (0.00) | 14 (63.64) | 3 (13.64) | 4 (18.18) |
| 31-40 | 42 | 4 (9.52) | 16 (38.10) | 14 (33.33) | 16 (38.10) |
| 41-50 | 52 | 2 (3.85) | 26 (50.00) | 25 (48.08) | 25 (48.08) |
| ≥ 51 | 53 | 2 (3.77) | 32 (60.38) | 31 (58.49) | 34 (64.15) |
| **Gender** | | | | | |
| Male | 149 | 8 (5.37) | 78 (52.35) | 66 (44.30) | 72 (48.32) |
| Female | 20 | 0 (0.00) | 10 (50.00) | 7 (35.00) | 7 (35.00) |
| **Education level** | | | | | |
| No formal schooling | 6 | 0 (0.00) | 3 (50.00) | 4 (66.67) | 4 (66.67) |
| Primary education | 32 | 2 (6.25) | 15 (46.88) | 14 (43.75) | 16 (50.00) |
| Lower secondary education | 97 | 5 (5.15) | 48 (49.48) | 43 (44.33) | 45 (46.39) |
| Upper secondary education | 19 | 1 (5.26) | 11 (57.89) | 7 (36.84) | 8 (42.11) |
| Tertiary education | 15 | 0 (0.00) | 11 (73.33) | 5 (33.33) | 6 (40.00) |
| **Years of construction site work experience** | | | | | |
| ≤ 2 | 31 | 0 (0.00) | 17 (54.84) | 9 (29.03) | 10 (32.26) |
| 2~5 | 34 | 2 (5.88) | 17 (50.00) | 17 (50.00) | 18 (52.94) |
| 6~10 | 42 | 3 (7.14) | 21 (50.00) | 14 (33.33) | 16 (38.10) |
| ≥ 11 | 62 | 3 (4.84) | 33 (53.23) | 33 (53.23) | 35 (56.45) |
| **History of hepatitis B vaccination** | | | | | |
| Yes | 87 | 3 (3.45) | 53 (60.92) | 31 (35.63) | 31 (35.63) |
| No | 82 | 5 (6.10) | 35 (42.68) | 42 (51.22) | 48 (58.54) |
| Total | 169 | 8 (4.73) | 88 (52.07) | 73 (43.20) | 79 (46.75) |

30.77%), and ≥ 51 years (n = 53, 31.36%). The vast majority (79.8%) of the participants had an education level of lower secondary education or below. More than 80% of the participants live in rural areas. The hepatitis B vaccination coverage rate, defined as the proportion of the population surveyed who have received at least one dose of HepB vaccine, was 51.48%.

*Distribution of Hepatitis B Serological Markers*

HBV infection was defined as positivity for either HBsAg, HBsAb, or HBcAb, excluding cases with HBsAb positivity solely due to vaccination [7]. Among the 169 study participants, the positivity rates for HBsAg, HBsAb, and HBcAb were 4.73%, 52.07%, and 43.20%, respectively, with an overall HBV infection rate of 46.75% (Table 1).

The HBsAg positivity rates among participants with urban and rural household registration were 0.00% and 5.67%, respectively (Fisher's exact test, $p = 0.355$), HBsAb positivity rates were 42.86% and 53.90%, respectively ($\chi^2 = 1.14$, $p = 0.285$), HBcAb positivity rates were 32.14% and 45.39%, respectively ($\chi^2 = 1.67$, $p = 0.196$), and HBV infection rates were 32.14% and 49.65%, respectively ($\chi^2 = 2.88$, $p = 0.090$). No statistically significant differences were observed in the positivity rates of HBsAg, HBsAb, or HBcAb, or in the HBV infection rates between participants from urban and rural areas (Table 1).

The HBsAg positivity rates among participants aged ≤ 30 years, 31-40 years, 41-50 years, and ≥ 51 years were 0.00%, 9.52%, 3.85%, and 3.77%, respectively (Fisher's exact test, $p = 0.444$). The HBsAb positivity rates were 63.64%, 38.10%, 50.00%, and 60.38%, respectively ($\chi^2 = 6.02$, $p = 0.111$), while the HBcAb positivity rates were 13.64%, 33.33%, 48.08%, and 58.49%, respectively ($\chi^2 = 15.06$, $p = 0.002$) across these age groups. HBV infection rates were 18.18%, 38.10%, 48.08%, and 64.15%, respectively ($\chi^2 = 14.96$, $p = 0.002$) in these age groups. Statistically significant differences were observed in HBcAb positivity rates and HBV infection rates across different age groups ($p < 0.05$) (Table 1).

The HBsAg positivity rates in males and females participants were 5.37% and 0.00%, respectively (Fisher's exact test, $p = 0.598$), HBsAb positivity rates were 52.35% and 50.00%, respectively ($\chi^2 = 0.04$, $p = 0.843$), HBcAb positivity rates were 44.30% and 35.00%, respectively ($\chi^2 = 0.62$, $p = 0.431$), and HBV infection rates were 48.32% and 35.00%, respectively ($\chi^2 = 1.26$, $p = 0.262$). No statistically significant differences were observed in the positivity rates of HBsAg, HBsAb, or HBcAb, or in the HBV infection rates between male and female participants (Table 1).

The HBsAg positivity rates among participants with no formal schooling, primary education, lower secondary education, upper secondary education, and tertiary education were 0.00%, 6.25%, 5.15%, 5.26%, and 0.00%, respectively (Fisher's exact test, $p = 1.00$). The HBsAb positivity rates were 50.00%, 46.88%, 49.48%, 57.89%, and 73.33%, respectively ($\chi^2 = 3.59$, $p = 0.464$). The HBcAb positivity rates were 66.67%, 43.75%, 44.33%, 36.84%, and 33.33%, respectively ($\chi^2 = 2.31$, $p = 0.679$). The HBV infection rates were 66.67%, 50.00%, 46.39%, 42.11%, and 40.00%, respectively ($\chi^2 = 1.54$, $p = 0.820$). No statistically significant differences were observed in the positivity rates of HBsAg, HBsAb, or HBcAb, or in the HBV infection rates across different levels of educational attainment (Table 1).

The HBsAg positivity rates among participants with ≤ 2 years, 2-5 years, 6-10 years, and ≥ 11 years of work experience at construction sites were 0.00%, 5.88%, 7.14%, and 4.84%, respectively (Fisher's exact test, $p = 0.585$). The HBsAb positivity rates were 54.84%, 50.00%, 50.00%, and 53.23%, respectively ($\chi^2 = 0.26$, $p = 0.968$). The HBcAb positivity rates were 29.03%, 50.00%, 33.33%, and 53.23%, respectively ($\chi^2 = 7.38$, $p = 0.060$). The HBV infection rates were 32.26%, 52.94%, 38.10%, and 56.45%, respectively ($\chi^2 = 6.75$, $p = 0.080$). No statistically significant differences were observed in the positivity rates of HBsAg, HBsAb, or HBcAb, or in the HBV infection rates among participants with varying durations of work experience at the construction sites (Table 1).

The HBsAg positivity rates among participants with and without a history of hepatitis B vaccination were 3.45% and 6.10%, respectively (Fisher's exact test, $p = 0.486$). Statistically significant differences were observed in HBsAb positivity rates (60.92% vs. 42.68%; $\chi^2 = 5.63$, $p = 0.018$), HBcAb positivity rates (35.63% vs. 51.22%; $\chi^2 = 4.18$, $p = 0.041$), and HBV infection rates (35.63% vs. 58.54%; $\chi^2 = 8.90$, $p = 0.003$) between the vaccinated and unvaccinated groups (Table 1).

*Analysis of Influencing Factors Associated with HBV Infection*

A binary logistic regression analysis was conducted with HBV infection status as the dependent variable, with region, age, education level, duration of work at construction sites, and history of hepatitis B vaccination as independent variables. The results indicated that being male (OR = 4.02, 95% CI: 1.22-13.29), being aged ≥ 41 years (41-50 years: OR = 7.22, 95% CI: 1.38-

37.67; ≥ 51 years: OR = 15.24, 95% CI: 2.70-86.02), residing in rural areas (OR = 3.16, 95% CI: 1.10-9.07), and having 2–5 years of work experience at construction sites (OR = 4.18, 95% CI: 1.24-14.03) were significantly associated with an increased risk of HBV infection. In contrast, a history of hepatitis B vaccination was identified as a protective factor (OR = 0.44, 95% CI: 0.22-0.89) (Table 2).

## Discussion

In China, migrant workers play an indispensable role in urban economic development. However, most originate from remote rural regions and have limited educational backgrounds, resulting in insufficient awareness of hepatitis B. Their knowledge regarding hepatitis B vaccination and infection prevention remains inadequate, which is further compounded by a lack of preventive healthcare consciousness. Studies have revealed that the HBsAg positivity rate among migrant workers in Jinan (2014) was 8.1% [8], which was significantly higher than the 2.49% HBsAg positivity rate observed in the general population of Shandong Province during the same period [9]. This study identified a 4.73% HBsAg positivity rate among migrant workers at construction sites in Qingdao, indicating that hepatitis B prevalence remains relatively high in this population, and the prevention and control situation remains concerning.

HBsAb serves as a protective antibody against hepatitis B in the human body. This survey demonstrated that individuals with a history of hepatitis B vaccination had a significantly higher HBsAb positivity rate compared to those without such a vaccination history, and the difference was statistically significant. Furthermore, analysis of HBV infection risk factors revealed that a history of hepatitis B vaccination acts as a protective factor against HBV infection, which is consistent with the finding that HBV vaccination is effective for prevention [10,11]. The survey revealed a hepatitis B vaccination coverage rate of 51.48% among migrant construction workers, with particularly low coverage (33.96%) observed in individuals aged 51 years and above. Consistent with prior research [5], vaccination rates demonstrated an inverse correlation with age, which may be attributable to China's national neonatal hepatitis B immunization program initiated in 1992, as a portion of the participants exceeded the target age range for this immunization initiative. These findings highlight the critical importance of strengthening immunization efforts and enhancing vaccination coverage among this demographic group to enhance the effectiveness of hepatitis B prevention and control.

HBcAb is a specific antibody produced following HBV infection, which persists in serum for an extended period and serves as a key marker of HBV exposure. The current seroepidemiological survey revealed an HBcAb seropositivity rate of 43.20% among migrant construction workers. Both the overall HBcAb positivity rates and HBV infection prevalence show an

**Table 2.** Binary Logistic Regression Analysis of Factors Associated with HBV Infection.

| Variables | β | $\chi^2$ | *p* | OR | 95% CI |
|---|---|---|---|---|---|
| **Gender** | | | | | |
| Female | | | | | |
| Male | 1.39 | 5.22 | 0.022* | 4.02 | 1.22-13.29 |
| **Age (years)** | | | | | |
| ≤ 30 | | | | | |
| 31-40 | 1.37 | 2.77 | 0.096 | 3.94 | 0.78-19.85 |
| 41-50 | 1.98 | 5.5 | 0.019* | 7.22 | 1.38-37.67 |
| ≥ 51 | 2.72 | 9.52 | 0.002* | 15.24 | 2.70-86.02 |
| **Education level** | | | | | |
| No formal schooling | | | | | |
| Primary education | -0.39 | 0.15 | 0.697 | 0.68 | 0.09-4.84 |
| Lower secondary education | -0.02 | 0 | 0.985 | 0.98 | 0.14-6.75 |
| Upper secondary education | -0.57 | 0.27 | 0.604 | 0.56 | 0.07-4.92 |
| Tertiary education | 1.62 | 1.62 | 0.204 | 5.04 | 0.42-60.87 |
| **Years of construction site work experience** | | | | | |
| ≤ 2 | | | | | |
| 2~5 | 1.43 | 5.34 | 0.021* | 4.18 | 1.24-14.03 |
| 6~10 | 0.09 | 0.02 | 0.883 | 1.09 | 0.35-3.35 |
| ≥ 11 | 0.52 | 0.96 | 0.328 | 1.68 | 0.60-4.71 |
| **Type of family residence** | | | | | |
| Urban | | | | | |
| Rural | 1.15 | 4.55 | 0.033* | 3.16 | 1.10-9.07 |
| **History of hepatitis B vaccination** | | | | | |
| No | | | | | |
| Yes | -0.83 | 5.19 | 0.023* | 0.44 | 0.22-0.89 |

*Statistically significant ($p < 0.05$); OR: Odds ratio; 95% CI: 95% Confidence Interval.

age-dependent increasing trend, consistent with previous studies [12,13]. This pattern may be associated with lower vaccination coverage in older age groups, time-dependent decline in HBsAb titers, and age-related immune senescence. Multivariate analysis identified significantly elevated HBV infection risks, with the 41-50 and ≥ 51 age groups exhibiting 7.22-fold and 15.24-fold higher probabilities of infection, respectively, compared to the ≤ 30 reference group. These findings indicate that construction workers aged ≥ 41 years represent a high-risk population that requires prioritized implementation of enhanced HBV prevention and control measures.

The multivariate analysis further indicated that male sex, rural household registration, and 2-5 years of work experience at construction sites were independent risk factors for HBV infection. The elevated infection risk among males may be associated with unhealthy lifestyle behaviors (such as smoking, alcohol consumption, and male homosexual practices) and hormonal profiles [14,15]. Migrant workers with rural registration exhibited higher susceptibility, potentially attributable to underdeveloped socioeconomic conditions in rural regions, limited health literacy regarding hepatitis B prevention, and suboptimal vaccination coverage [16]. The increased risk observed in participants with 2-5 years of working experience at construction sites might reflect cumulative opportunities for HBV contact. Notably, no significant elevation in infection risk was detected among participants with more than 5 years of service, which may indicate stabilized behavioral patterns and established immunity within this cohort.

There are some limitations to the present study. First, we selected a single construction site, which may limit the representativeness of all migrant workers at construction sites. Second, the vaccination history was self-reported by participants, and the medical record was not available, which could introduce recall bias. Third, there was no age-matched general population control group in this study, so it was impossible to accurately assess whether migrant workers genuinely exhibit a higher HBV infection rate, independent of the confounding influence of age. Fourth, we analyzed only a subset of factors influencing HBV infection; other unmeasured confounders may remain. These issues still require more in-depth research.

## Conclusions

In conclusion, this study revealed a relatively high HBsAg positivity rate among migrant workers at the construction site in Qingdao. Notably, the hepatitis B vaccination rate showed a declining trend with increasing age, while concurrent increases were observed in both HBcAb seropositivity and HBV infection rates. Multiple risk factors for HBV infection were identified within this population. These findings highlight the urgent need for targeted interventions, including enhanced health education on hepatitis B and systematic promotion of vaccination programs. Improving immunization coverage is critical for effectively preventing hepatitis B infection and controlling its transmission within this high-risk group. Moreover, such measures carry important public health implications for hepatitis B prevention in the broader population.

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## Conflict of interest

No conflict of interest is declared.

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