

# Response rate to the vaccination with hepatitis b vaccine among cardiovascular health staff in Tehran

*Tasa de respuesta a la vacunación con la vacuna contra la hepatitis B entre el personal de salud cardiovascular en Teherán*

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## Abstract

This descriptive cross-sectional study was designed and carried out among 260 hospital personnel working in educational and medical centers of Shahid Mustafa Khomeini hospital, Tehran, Iran in 2013. The demographic data of the subjects and questions related to the history of vaccination were also collected. Hepatitis B surface antibody (Anti-HBs) titration was carried out by ELISA. Finally, the relationships between different variables and hepatitis B antibody levels were evaluated. The results of the present study showed that 83.8% of the hospital personnel in Tehran, as the capital of Iran, showed a good response to hepatitis B vaccination, which was almost similar to the results of other studies conducted in the country. There was a significant relationship between the and smoking, the history of needlestick exposures and lower years of work experience, while anti-HBs titer of the hospital personnel was not statistically associated with BMI, age, gender, educa-

tion level, occupation, interval since last vaccination, and injection method. Enhancing the level of protection in Cardiovascular health staff against hepatitis B virus can lead to a decrease in the incidence of infection cases among the hospital personnel. Therefore, it is essential to perform the primary vaccination followed by an assessment of the responsiveness to it. Therefore, the aim of this study was to investigate the effect of the demographic factors on the response rate to hepatitis B vaccination among hospital personnel in Tehran. The lower response rate to hepatitis B vaccination obtained in the present study compared to the global average necessitates further investigation on the hospital personnel dealing with the patients directly or indirectly in Tehran, therefore, it is essential to design large-scale plans to identify and treat at-risk individuals.

**Keywords:** Cardiovascular health staff, Vaccination, Hepatitis B, Health Care

## Resumen

Este estudio descriptivo de corte transversal se diseñó y se llevó a cabo entre 260 miembros del personal hospitalario que trabajaban en los centros educativos y médicos del hospital Shahid Mustafa Khomeini, Teherán, Irán, en 2013. También se recopilaron datos demográficos de los sujetos y preguntas relacionadas con la historia de vacunación. La titulación del anticuerpo de superficie de la hepatitis B (Anti-HBs) se llevó a cabo mediante ELISA. Finalmente, se evaluaron las relaciones entre las diferentes variables y los niveles de anticuerpos contra la hepatitis B. Los resultados del presente estudio mostraron que el 83.8% del personal del hospi-

tal en Teherán, como capital de Irán, mostró una buena respuesta a la vacunación contra la hepatitis B, que fue casi similar a los resultados de otros estudios realizados en el país. Hubo una relación significativa entre el hábito de fumar y el historial de exposición a pinchazos con agujas y los años de experiencia laboral más bajos, mientras que el título anti-HBs del personal del hospital no se asoció estadísticamente con el IMC, edad, sexo, nivel educativo, ocupación, intervalo desde el último La vacunación, y el método de inyección. Mejorar el nivel de protección en el personal de salud contra el virus de la hepatitis B puede llevar a una disminución en la incidencia

de casos de infección entre el personal del hospital. Por lo tanto, es esencial realizar la vacunación primaria seguida de una evaluación de la capacidad de respuesta a ella. Por lo tanto, el objetivo de este estudio fue investigar el efecto de los factores demográficos en la tasa de respuesta a la vacunación contra la hepatitis B entre el personal del hospital en Teherán. La menor tasa de respuesta a la vacuna contra la hepatitis B obtenida en el presente estudio en comparación con el promedio mundial requiere una mayor investigación sobre el personal del hospital que trata con los pacientes directa o indirectamente en Teherán, por lo tanto, es esencial diseñar planes a gran escala para identificar y tratar Personas en riesgo.

**Palabras clave:** Personal de salud cardiovascular, Vacunación, Hepatitis B, Cuidado de la Salud.

## Introduction

**Introduction and the Aim of the Study:** Hepatitis B virus (HBV) is one of the most common pathogens afflicting humans and it is a serious and potentially lethal disease with the incidence at global level. The disease course varies from an acute infection to a chronic disease, and its chronic type ranges from asymptomatic infection to chronic hepatitis, cirrhosis and hepatocellular carcinoma<sup>1</sup>. According to the World Health Organization<sup>1</sup>, it is estimated that about 2 billion people suffer from HBV worldwide. Among which, about 350 million people are the carriers of the virus<sup>2</sup> and a total of 500 to 700 thousand people die annually, as a result of the acute and chronic consequences of the virus infection. The results of the several studies show that Iran is among the countries with a moderate incidence rate of HBV<sup>3</sup>. The most effective way to prevent the development and transmission of hepatitis B infection is to immunize people by the vaccine before being exposed to the virus. Immunization needs to be carried out at a global level in order to reduce the transmission of the disease<sup>1</sup>. Carrying out the vaccination with surface antigens of the virus (HBsAg) can prevent the infection since it produces anti-HBs antibodies as well as specific T cells against this virus<sup>4,5</sup>. Individuals whose bloods' post-vaccination anti-HBs antibody level is equal to or greater than 10 IU/ml are protected and those whose anti-HBs titer is below this limit, are non-responders even after receiving six doses of the vaccine<sup>6</sup>. In Iran, at the national level, the vaccination of hepatitis B virus for infants, and high-risk individuals, especially Cardiovascular health staff began since 1993, and the vaccination for teenagers under the age of 18 years old has been added to the program since 2006<sup>7,8</sup>. Many studies show that the incidence of hepatitis B virus has declined dramatically worldwide after the implementation of the vaccination program for infancy, adolescence, and adulthood at global level<sup>9</sup>. Infection transmission occurs due to use of common needle tip in injection drug users, occupational contacts between patients and hospital personnel, contaminated surgical instruments and sharp tools, needlestick injury and transmission from mother to child<sup>1</sup>. Hospital personnel is more at increased risk of affecting with hepatitis B disease than normal population due to the occupational exposure to

## Materials and methods

blood and infectious body fluids<sup>10</sup>. The incidence of hepatitis B infection and full coverage of hepatitis B vaccination among Iranian Cardiovascular health staff was reported to be by 0.4% and 70%, respectively<sup>11,12</sup>. Although it is expected that 90% of people show appropriate immune response after completion of vaccination course, various studies have reported different response rates to the HBV vaccine. Therefore, it is necessary to investigate factors influencing antibody titers such as age, gender, race, underlying diseases, smoking, body mass index, immunodeficiency, chemotherapy, organ transplantation, stress, and liver failure in this group<sup>13,14</sup>. The duration of the vaccine-induced protection is still unknown, which should be investigated in the long-term follow-up programs<sup>15</sup>. The results of the previous domestic studies reported an immunogenicity rate of 67-99% for hepatitis B vaccine among Cardiovascular health staff<sup>16</sup>. Studies have been carried out in specific geographical areas as well as on the limited number of individuals. Therefore, there is an urgent need for access to the indigenous data collected from a wider range of personnel (physicians, nurses, laboratory personnel and cleaning staff). The existing challenge indicates the necessity or lack of necessity to prescribe a booster dose of the vaccine in people with a normal immune system, especially for high-risk individuals, such as Cardiovascular health staff who are at risk for the exposure to hepatitis B virus. Considering the foregoing and the importance regarding the level of the protection in the Cardiovascular health staff who are involved in the continuous contact with suspected individuals, the present study investigated not only the rate of hepatitis B antibody titer in the Cardiovascular health staff, but also investigated its relationship with some epidemiological characteristics of the personnel working in Shahid Mostafa Khomeini Hospital, Tehran, Iran, in order to be more careful regarding the immune control of hepatitis B virus by identifying the factors causing non-responsiveness to the HBV vaccine, as well as identifying the non-responders.

**T**his descriptive cross-sectional study was designed and carried out among 260 hospital personnel working in educational and medical centers of Shahid Mostafa Khomeini hospital, Tehran Iran in 2009. The participants included cleaning staff, paramedic assistant, paramedic, nurse, administrative employees and other personnel of the hospital. Sampling was carried out using the convenience sampling method from different wards of the hospital. Inclusion criteria were working in healthcare-related affairs of the hospital, having informed consent to participate in the study, and the history of a full three-day vaccination course against hepatitis B virus according to the country's clinical guidelines for the last 5 years. Individuals with a history of affection with hepatitis B virus or immunodeficiency and those who did not consent to participate in the study were excluded.

ed from the study. A researcher-made checklist was first used to record the demographic data of the participants as well as collecting data on the questions related to the history of the vaccination. Venous blood sample with a total amount of 2 ccs was taken from each participant and anti-HBS titration was performed using a Mono Binde laboratory kit and ELISA. Protected individuals were those with antibody titers equal to or above the cut-off points and unprotected individuals were those with titers below the cut-off points. Data analysis was carried out using SPSS software version 20. Mean and standard deviations were calculated for quantitative variables and frequency and frequency percentages were calculated for qualitative variables. Chi-square, independent t-test, and Fisher tests were used to evaluate the relationships between different variables and hepatitis B antibody level, and P value at  $<0.05$  was considered as the significant level. All patients have assured the confidentiality of their information and research data, then, the participants signed the informed consent form. The present study was approved by the Ethics Committee of Shahid University, and all stages were implemented under the supervision of the ethics committee and were in accordance with the Helsinki Treaty on the ethics in the research.

were considered to be unprotected against hepatitis B virus and 218 (83.8%) had anti-HBS titer above than 10 IU / ml and thus were considered to be the protected subjects. Totally, there were 14 (17.3%) unprotected cases out of 81 male patients and 28 (15.6%) unprotected cases out of 179 female patients. There was no statistically significant relationship between gender and antibody titer. The mean age of the participants was equal to  $37.86 \pm 3.27$  years old and age was not significantly correlated with the antibody titer. The mean work experience of the personnel was equal to  $37.86 \pm 3.27$  years and it was significantly correlated with the antibody titer ( $P=0.004$ ). Also, a higher odds ratio of non-seroprotective titer was observed in people with the work experience of more than 10 years ( $OR=2.97$ ). Most of the participants had academic education (51.15%), but this variable was not significantly correlated with the antibody titer. With respect to the participants' occupations, paramedic assistants had the highest odds ratio of non-seroprotective titer ( $OR=3.03$ ), but there was no significant relationship between job ranking and the antibody titer. There was also no statistically significant relationship between interval since last vaccination and its injection method with the antibody titer. The odds ratio of non-seroprotective was also higher among the smokers than the non-smokers ( $OR=4.55$ ), as well as those with the history of needlestick exposure compared to normal subjects ( $OR=2.51$ ). There was also a significant correlation between antibody titer and smoking as well as the history of needlestick exposure ( $P=0.002$  and  $P=0.011$ ). There was also a significant correlation between body mass index and the antibody titer (Table 1).

**A**mong 260 subjects participated in the present study, 42 (16.2%) had anti-HBS titer below than 10 IU / ml and

**Table 1. Frequency of study variables and their relationship with anti-HBs titer**

Variable	Frequency	Protective titer	Non-protective titer	P-value	Odds Ratio 95%CI
Gender	Female	179 (68.85%)	151 (84.4%)	0.72 (Fisher test)	0.88
	Man	81 (31.15%)	67 (82.7%)		1.12
Age	30>	52 (20%)	46 (88.5%)	0.386 (Mann-Whitney U Test)	0.62
	30-50	(73.08%)	(82.6%)		1.42
	50<	18 (6.92%)	15 (83.3%)		1.04
Work experience	5>	64 (24.6%)	59 (92.2%)	0.004 (Mann-Whitney U Test)	0.36
	5-10	51 (19.6%)	46 (90.2%)		0.5
	10<	145 (55.8%)	113 (77.9%)		2.97
Personnel's education level	Elementary	28 (10.77%)	23 (81.3%)	0.639 (Mann-Whitney U Test)	1.11
	Middle school	18 (6.92%)	13 (72.2%)		2.13
	High school	81 (31.16%)	70 (86.4%)		0.75
	Academic	133 (51.15%)	112 (84.2%)		0.94
Job	Cleaning staff	39 (15%)	33 (84.6%)	0.064 (Chi square test)	0.93
	Paramedic assistant	27 (10.39%)	18 (66.7%)		3.03
	Paramedic	48 (18.46%)	41 (85.4%)		0.86
	Nurse	123 (47.21%)	103 (83.7%)		1.01
	Administrative employee	13 (5%)	13 (100%)		0
	Others	10 (3.84%)	10 (100%)		0
interval since previous vaccination	3 years	165 (63.46%)	135 (81.8%)	0.295 (Fisher test)	1.53
	3 years>	95 (36.54%)	83 (87.4%)		0.65
Injection method	Intramuscular	173 (66.54%)	150 (86.7%)	0.107 (Fisher test)	0.54
	Subcutaneous	87 (33.46%)	68 (78.2%)		1.82
BMI	Normal	135 (51.9%)	115 (85.2%)	0.702 (Mann-Whitney U Test)	0.81
	Less than normal	10 (3.8%)	8 (0.80%)		1.31
	More than normal	115 (44.3%)	95 (82.6%)		1.17
Smoking	Yes	24 (9.23%)	14 (58.3%)	0.002 (Fisher test)	4.55
	No	236 (90.77%)	204 (86.4%)		0.21
History of needlestick exposure	Yes	83 (31.92%)	62 (74.7%)	0.011 (Fisher test)	2.51
	No	177 (68.08%)	156 (88.1%)		0.39

**H**epatitis B vaccination is one of the main ways of preventing this deadly disease with high complications, and it is commonly applied. The strategy of hepatitis B vaccination is done based on the geographic and epidemiological differences of hepatitis B virus and WHO recommendations should be taken into account in case of all high-risk infants and groups such as healthcare personnel, injection drug users, people with multiple sexual partners, homosexual men, personnel working in centers for caring of mentally retarded individuals, the prisoners and prison officers, people who had family contacts with the chronic carriers or those with acute hepatitis B infection<sup>17,18</sup>. One of the groups exposed to hepatitis B virus is hospital personnel dealing with the blood and its derivatives. According to the Centers for Disease Control and Prevention in United States, a total of 100-200 Cardiovascular health staff die annually due to the occupational complications of hepatitis B<sup>19</sup>. A high level of protection among personnel employed in hospitals and healthcare centers can lead to a decrease in the incidence of infection among these individuals. Therefore, it is essential to carry out primary vaccination and investigate the response rate. Therefore, the aim of this study was to investigate the effect of demographic characteristics on the response rate to hepatitis B vaccination among hospital personnel in Tehran. Overall, the results of this study showed that out of the 260 subjects participated in the present study, 42 (16.2%) had anti-HBs titer below 10 IU / ml and were considered to be unprotected against hepatitis B virus and 218 (83.8%) had anti-HBs titer above 10 IU / ml and thus were considered to be the protected subjects. According to the results of the similar studies conducted in other countries, the non-seroprotective levels of antibody were reported to be as follows: 1% in India, 9.1% in Sri Lanka, and 4.3% in Brazil<sup>20,22</sup>. According to the results of a meta-analysis study conducted previously in Iran, the response rate to hepatitis B vaccination among hospital personnel was equal to 86.7% (with 95% of confidence interval: 80.9 ± 92.6), and the highest and lowest response rate was reported to be by 99.2% and 70.6%, respectively in Yazd, the center of Iran, and in Tehran, the capital of Iran<sup>23,24</sup>. In the meantime, other studies carried out in Tehran showed that the response rate of 86.1%<sup>25</sup> and 85.3%<sup>18</sup> among hospital personnel. The response rate in different parts of Iran was as follows: 87.3% in Yasuj<sup>26</sup>, 87.2% in Qom<sup>27</sup> and 89.2% in Kashan<sup>28</sup> as other cities located in the center of Iran, for northern cities of Iran such as Babol, Amol and Shahrood, the response rate was reported to be by 91.7%<sup>29</sup>, 86.52%<sup>30</sup> and 79%, respectively<sup>31</sup>, and also for the western cities of Iran such as Kurdistan, Shahr -e-Kord and Khuzestan, the response rate was reported to be by 87%<sup>32</sup>, 97.2%<sup>33</sup>, and 95.6%, respectively, and finally for<sup>5</sup> Tabriz, located in northwestern of Iran and Shiraz, located

in southern part of Iran, the response rate was reported as 90.6%<sup>34</sup> and 87.3%, respectively<sup>35</sup>. In a 2-year study conducted on constant population size, the response rate dropped from 96.7% to 75.6% in Lar, located in southern part of Iran, which justifies the effect of the passage of time on the decrease in the immunization of the hepatitis B vaccine<sup>36</sup>. In other studies, increased post-vaccination period leads to a decrease in the level of antibody titer, but there is no clear reason for interpretation of this non-uniform reduction<sup>30,37</sup>. There is no significant relationship between gender of hospital personnel and their level of anti-HBs. In this regard, the results of a study conducted in southern part of Iran, and the results of the meta-analysis study by Azami et al. as well as a study carried out in India all were consistent with those of the present study<sup>5,16,38</sup>. While other studies carried out abroad showed that female gender was considered to be a factor causing the increase in the response rate to hepatitis vaccination<sup>39,40</sup>. The results of the present study showed no statistically significant relationship between age and response rate to vaccination. Heydari et al., in a study in Khuzestan<sup>5</sup> and Afzali et al. in a study in Kashan<sup>28</sup> found no relationship between the age and anti-hepatitis antibody titer, which is consistent with the results of the present study; while in the studies by Vafaeimanesh et al. in Qom and Bonanni et al, it was shown that the response rate to the hepatitis B vaccine decreased significantly with an increase in the subjects' age<sup>27,41</sup>. The results of this study showed that the injection method had no effect on the anti-HBs titration, which is inconsistent with the results of the study by Chen et al., showed that intramuscular injection is significantly more effective than intradermal injection on immunologic responses to the vaccine<sup>42</sup>. In this study no significant difference was observed in the antibody titration over the time passed since the last vaccination. Afzali et al. also showed that there is no significant change in the anti-HBs titration over time, which is consistent with the results of the present study<sup>28</sup>. However, Heydari et al. and Afkari et al. showed that immunization rate significantly reduced<sup>5,6</sup> since the last vaccination, which is consistent with the results of the present study. Also, in our study, the response rate to hepatitis vaccine was significantly higher in people with work experience more than 10 years than those with lower work experience. There was no significant relationship between the type of hospital occupation as well as the education level of the personnel and the response rate to the vaccine. BMI and smoking were two other factors investigated among personnel in this study. The results of this study showed no statistically significant difference between BMI and the level of anti-HBs titration among Cardiovascular health staff. Meigooni et al. and Afzali et al. showed that BMI does not influence the response rate to hepatitis vaccine<sup>28,43</sup>, which was consistent with the results of the present study; however, the results of the study by Heydari et al are inconsistent with those of the present study<sup>5</sup>. The present study revealed a significant relationship between anti-HBs titration and smoking, and the rate of non-responsiveness among the smokers was 4.55 fold higher than the non-smokers. The

findings of other studies also indicated that smoking leads to a decrease in the level of anti-HBs titration, which was consistent with the results of the present study<sup>27,32,41,44-48</sup>. The results of the present study also showed that the history of needlestick exposure led to the increase in the rate of non-seroprotective antibody by 2.51 fold compared to the normal individuals, indicating the importance regarding paying attention to this issue and training personnel how to work with the hazardous tools such as infected needle tip while dealing with the blood and its derivatives. The limitations of the present study included the inability to conduct a successive investigation over a sufficient period of time so that the participants are followed up over a long time period. Also, the history of alcohol use or the history of high-risk behaviors was not investigated in this study due to the cultural constraints; therefore, it is recommended to investigate them in future studies by considering the patient privacy. However, the strengths of this study included the opportunity for the investigation of more demographic variables and larger sample size compared to other studies conducted in Iranian society.

**T**he results of this study demonstrated that 83.8% of hospital personnel in the capital of Iran showed a good response to hepatitis vaccination, which was almost similar to other studies conducted in Iran. There was a significant relationship between and smoking, as well as the history of needlestick exposure and lower years of work experience; while there was no statistically significant relationship between anti-HBs level of hospital personnel and the factors such as BMI, age, gender, education level, occupation, interval since the last vaccination, and injection method. The lower response rates to hepatitis B vaccination obtained in this study, compared to the global average, implies the need for further investigation of Cardiovascular health staff working in healthcare centers of Tehran who are directly or indirectly dealing with the patient. Therefore, it is essential to design large-scale plans to identify unprotected individuals and find a treatment approach for treating them.

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