

Risk factors of the efficacy of hepatitis B vaccine in health-care workers

Hassan Salehi¹, Marzieh Salehi², Nader Kalbasi³, Maryam Salehi⁴, Jalil Sharifian⁵, Mohammad Mahdi Salehi⁴

¹Infectious Diseases and Tropical Medicine Research Center, Isfahan University of Medical Sciences, Isfahan, Iran, ²Department of Infectious Diseases, Medical School, Isfahan University of Medical Sciences, Isfahan, Iran, ³Department of Oral and Facial Pathology, Dentistry Faculty, Khoraskan University, Isfahan, Iran, ⁴Dentistry Student Research Center, Dentistry School, Isfahan University of Medical Sciences, Isfahan, Iran, ⁵Oral Surgery Department, Dentistry School, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Background: Conventional hepatitis B virus vaccination fails to achieve efficient protection in about 5%–10% of the world population. Different factors influence the immunogenicity of hepatitis B vaccine. This study aimed to evaluate these factors in health-care workers. **Materials and Methods:** This was a descriptive study which was implemented among 140 of medical and dental staff working as health-care workers who were low responder after vaccination entered the study. **Results:** Age (>40 years), weight (body mass index >25), immunodeficiency diseases, (primary immune deficiency and immunosuppressant drugs), diabetes mellitus, and smoking were the important factors. **Conclusion:** In the high-risk group of hepatitis B disease, the risk factors of immunogenicity must be evaluated at vaccination and check titers of antibody after vaccination.

Key words: Health-care workers, hepatitis B, vaccine efficacy

How to cite this article: Salehi H, Salehi M, Kalbasi N, Salehi M, Sharifian J, Salehi MM. Risk factors of the efficacy of hepatitis B vaccine in health-care workers. *J Res Med Sci* 2020;25:15.

INTRODUCTION

Immunogenicity of hepatitis B vaccine (HBV) is 90% in health-care workers.^[1]

Various factors such as obesity, aging, male gender, immunodeficiency, renal failure, intragluteal vaccine administration, chronic diseases, as well as some human leukocyte antigen II, chemokine receptor 5, and chemokine ligand 13 significantly contribute to this failure.^[2,3]

HBV vaccination provides low rates of protection (<50%) among children with HIV exposed, infected and/or older children.^[4]

The immune system becomes less effective with age, and older age is associated with an increased susceptibility to the disease and reduces responses to vaccination.^[5]

Obese individuals' body mass index [BMI] ≥ 30 kg/m² and older age were significantly more likely to be nonresponders following two doses of recombinant HBV (rHBV).^[6]

Patients with diabetes mellitus (DM) and patients undergoing maintenance dialysis show dissatisfactory responses to vaccination, including HBV.^[7]

Due to the lack of immunity in about 10% of vaccine recipients, we decided to perform this study in or health-care worker population.

MATERIALS AND METHODS

This descriptive study was carried out on 1400 health-care workers in Alzahra hospital and dental faculty of Isfahan University of Medical Sciences, Isfahan, Iran, in 2016–2017.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

Access this article online

Quick Response Code:



Website:
www.jmsjournal.net

DOI:
10.4103/jrms.JRMS_1054_18

Address for correspondence: Dr. Mohamad Mahdi Salehi, Student Research Center, Dentistry School, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: mahdi_salehi1024@yahoo.com

Submitted: 22-Dec-2018; **Revised:** 19-May-2019; **Accepted:** 18-Nov-2019; **Published:** 20-Feb-2020

Table 1: Distribution of risk factors in low responders

Risk factor	Age >40	BMI >25	Immune deficient disease and corticosteroid usage	DM	Smoking	HIV infection	Intracutaneous injection
n (%)	59 (40)	52 (37)	10 (7)	8 (6)	7 (5)	0	0

BMI=Body mass index; DM=Diabetes mellitus

Each individual has received three doses of common HBV and the antibody (AB) titer was checked 3–6 months after the last dose of vaccine. One hundred and forty (10%) of samples were low responders (hepatitis B surface antibody ≤ 10 IU/ml), who were enrolled in the study.

Age, weight, route of vaccine administration, HIV state, DM, immunocompromised factors (primary immunodeficiency by history and the usage of immunosuppressant drugs such as corticosteroids and smoking were evaluated.

RESULTS

Ages of low responders ranged from 22 to 60 years.

Ninety-eight (70%) of them were female. The mean age of vaccinated samples with insufficient titer of AB was 41 years. Fifty-two (37%) had BMI >25 and were overweight. Ten (7%) had immunodeficiency status such as primary immunodeficiency and consumption of immune suppressant drugs.

DM was present in 8 (6%) individuals and 7 (5%) of the samples were smokers.

Neither HIV-infected cases nor intracutaneous vaccine injection recipients were included in the study [Table 1].

DISCUSSION

It is known that four most common factors associated with vaccine nonresponsiveness include: age, BMI or obesity, male gender, and smoking.^[8-10] This study was to answer the question whether these factors and some other factors were associated with vaccine efficacy, using a known efficacious rHBV, in health-care providers (HCP).

Some HCP refuse to be immunized. In one study of medical school clinical employees, for example, only 77% completed the HBV series.^[11]

Vaccination is both safe and effective with seroprotection being achieved in 92% of HCP aged <40 years and 84% aged ≥ 40 years.^[12] Old age was associated with lower seroprotection rates in our study which was in accordance with the study of Averbhoff *et al.*^[6]

In Chaturanga in Sri Lanka observed that HBV immune response was much higher in women than men.^[1,13]

In Azami *et al.*'s study, it was observed that smoking and usage of immunosuppressant drugs are the risk factors for immunogenicity of HBV which is consistent with our study.^[1]

Lower rates of seroconversion were associated with increasing age, greater immune compromise, current smoking, and higher BMI in Alimonos *et al.*'s study^[14] which was consistent with our study.

In Young *et al.*'s study, BMIs particularly over 30 kg/m² are associated with an increased risk of nonresponsiveness to the rHBV,^[15] which is in agreement with findings of our study.

Obesity is increasingly being recognized as a low-grade chronic inflammatory condition,^[16,17] and it is possible that obese individuals exist in a pro-inflammatory state, which interferes with immunogenicity in vaccine candidates.

It is possible that differences in dietary intake may have an effect on the gastrointestinal microbial, and this, in turn, can affect the "Leakiness" of the gut leading to bacterial translocation and increased levels of immune activation.^[18,19]

CONCLUSION

In light of this study, the authors proposed that the risk factors of immunogenicity must be evaluated at vaccination and that titers of AB be checked after vaccination in the high-risk group.

Financial support and sponsorship

We are thankful to the support of the Infectious diseases research center, Isfahan University of Medical Sciences, Isfahan, Iran.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Azami M, Hafeziahmadi MR, Sayehmiri K. Hepatitis B vaccination efficacy in Iranian Healthcare workers: A meta-analysis study. *Hepat Mon* 2017;17:e37781.
2. Zaffina S, Marcellini V, Santoro AP, Scarsella M, Camisa V, Vinci MR, *et al.* Repeated vaccinations do not improve specific immune defenses against Hepatitis B in non-responder health care workers. *Vaccine* 2014;32:6902-10.
3. Duan Z, Chen X, Liang Z, Zeng Y, Zhu F, Long L, *et al.*

- Genetic polymorphisms of CXCR5 and CXCL13 are associated with non-responsiveness to the hepatitis B vaccine. *Vaccine* 2014;32:5316-22.
4. Njom Nlend AE, Nguwoh PS, Ngounouh CT, Tchidjou HK, Pieme CA, Otélé JM, *et al.* HIV-Infected or -Exposed Children Exhibit Lower Immunogenicity to Hepatitis B Vaccine in Yaoundé, Cameroon: An Appeal for Revised Policies in Tropical Settings? *PLoS One* 2016;11:e0161714.
 5. Van Der Meeren O, Crasta P, Chevart B, De Ridder M. Characterization of an age-response relationship to GSK's recombinant hepatitis B vaccine in healthy adults: An integrated analysis. *Hum Vaccin Immunother* 2015;11:1726-9.
 6. Averhoff F, Mahoney F, Coleman P, Schatz G, Hurwitz E, Margolis H. Immunogenicity of hepatitis B Vaccines. Implications for persons at occupational risk of hepatitis B virus infection. *Am J Prev Med* 1998;15:1-8.
 7. Fabrizi F, Tarantino A, Castelnovo C, Martin P, Messa P. Recombinant Hepatitis B Vaccine Adjuvanted With AS04 in Dialysis Patients: A Prospective Cohort Study. *Kidney Blood Press Res* 2015;40:584-92.
 8. Estévez ZC, Betancourt AA, Muzio González V, Baile NF, Silva CV, Bernal FH, *et al.* Immunogenicity and safety assessment of the Cuban recombinant hepatitis B vaccine in healthy adults. *Biologicals* 2007;35:115-22.
 9. Adkins JC, Wagstaff AJ. Recombinant hepatitis B vaccine: A review of its immunogenicity and protective efficacy against hepatitis B. *BioDrugs* 1998;10:137-58.
 10. Mast EE, Weinbaum CM, Fiore AE, Alter MJ, Bell BP, Finelli L, *et al.* A comprehensive immunization strategy to eliminate transmission of hepatitis B virus infection in the United States: recommendations of the Advisory Committee on Immunization Practices (ACIP) Part II: Immunization of adults. *MMWR Recomm Rep* 2006;55:1-33.
 11. Paticia L, Peter F, Jennifer M. Immunization for Health Care Provider. Up To Date; 2017.
 12. Schillie S, Murphy TV, Sawyer M, Ly K, Hughes E, Jiles R, *et al.* CDC guidance for evaluating health-care personnel for hepatitis B virus protection and for administering postexposure management. *MMWR Recomm Rep* 2013;62:1-9.
 13. Chathuranga LS, Noordeen F, Abeykoon AM. Immune response to hepatitis B vaccine in a group of health care workers in Sri Lanka. *Int J Infect Dis* 2013;17:e1078-9.
 14. Alimonos K, Nafziger AN, Murray J, Bertino JS Jr. Prediction of response to hepatitis B vaccine in health care workers: whose titers of antibody to hepatitis B surface antigen should be determined after a three-dose series, and what are the implications in terms of cost-effectiveness? *Clin Infect Dis* 1998;26:566-71.
 15. Young KM, Gray CM, Bekker LG. Is obesity a risk factor for vaccine non-responsiveness? *PLoS One* 2013;8:e82779.
 16. Beasley LE, Koster A, Newman AB, Javaid MK, Ferrucci L, *et al.* Body Composition measures from CT and inflammation. *Obesity* 2012;17: 1062-9.
 17. Ziccardi P, Nappo F, Giugliano G, Esposito K, Marfella R, Cioffi M, *et al.* Reduction of inflammatory cytokine concentrations and improvement of endothelial functions in obese women after weight loss over one year. *Circulation* 2002;105:804-9.
 18. Hullar MA, Lampe JW. The gut microbiome and obesity. *Nestle Nutr Inst Workshop Ser* 2012;73:67-79.
 19. Turnbaugh PJ, Ridaura VK, Faith JJ, Rey FE, Knight R, Gordon JI. The effect of diet on the human gut microbiome: A metagenomic analysis in humanized gnotobiotic mice. *Sci Transl Med* 2009;1:6ra14.