Evaluation of Vaccine-preventable Disease Immunity and Influencing Factors Among Healthcare Workers: A Cross-sectional Study

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Abstract

Objective: Healthcare workers are at an elevated risk of exposure to vaccine-preventable diseases because of their close contact with patients. Understanding their immunity levels against diseases such as hepatitis A and B is crucial for implementing effective vaccination strategies. This study aimed to assess the immunity status of healthcare workers against certain vaccine-preventable diseases and to identify the factors influencing this immunity.

Methods: In a retrospective, cross-sectional analysis, we evaluated 865 healthcare workers from Prof. Dr. Cemil Taşcıoğlu City Hospital Institutional outpatient clinic in 2019. We collected data on antibody levels [anti-hepatitis A virus immunoglobulin G (anti-HAV IgG), anti-hepatitis B surface (anti-HBs), anti-Rubeola IgG, anti-Rubella IgG, anti-Mumps IgG] alongside demographic and professional information. Statistical analysis was performed using SPSS 26, considering $p<0.05$ as significant.

Results: Among the participants, 64.74% (n=560) were female and 35.26% (n=305) were male. Hepatitis B surface antigen negativity was observed in 99.54% (n=861) of the cohort, with a 92.95% (n=804) positivity rate for anti-HBs. Positivity rates for anti-Rubella IgG, anti-Rubeola IgG, and anti-Mumps IgG exceeded 90%. Of the 249 vaccines administered to 192 workers, 61% were for hepatitis A. Significant differences in anti-HAV IgG levels were noted across educational levels and between genders ($p=0.011$ and $p=0.015$, respectively), with higher positivity in primary school graduates and males. Anti-HBs positivity was significantly higher in females than in males ($p=0.033$), and increased with educational attainment ($p<0.001$).

Conclusion: The study highlights a 56.76% immunity rate against hepatitis A among healthcare workers, underscoring the need for enhanced vaccination efforts, particularly for those in frequent contact with patients or patient fluids. These findings emphasize the importance of targeted vaccination programs within healthcare settings to protect workers from vaccine-preventable diseases, ultimately safeguarding both healthcare personnel and patients.

Keywords: Healthcare personnel, immunity, vaccine, antibodies

INTRODUCTION

Hepatitis A virus (HAV), an enveloped RNA virus with a diameter of 27-32 nm, is classified within the Hepatovirus genus of the *Picornaviridae* family, primarily transmitting through the fecal-oral route. This virus can cause a range of clinical presentations from asymptomatic infections to severe conditions such as fulminant hepatitis (1). Given its public health significance, vaccination against hepatitis A is advocated for individuals at increased risk, including travelers to endemic regions, military and diplomatic personnel, and those working in high-risk settings such as healthcare and food service sectors (2).

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The global burden of hepatitis B virus (HBV) infection remains a significant public health challenge, with over 257 million carriers worldwide and nearly 887,000 deaths annually from complications such as cirrhosis and hepatocellular carcinoma. HBV transmission primarily occurs through contact with infected bodily fluids, highlighting the increased risk faced by healthcare workers. The introduction of vaccination and prophylactic measures post-exposure has substantially reduced HBV infection rates among healthcare professionals (3). In response, Turkey launched a national hepatitis B vaccination program in 1998 targeting newborns and individuals at high risk, with the objective of curtailing the spread of HBV (4).

In addition, the Turkish Ministry of Health incorporated the measles, mumps, and rubella vaccine into the national vaccination schedule in 2006, further underscoring the commitment to controlling vaccine-preventable diseases. The advisory board's recommendation for an additional measles-containing vaccine dose for children in regions prone to outbreaks reflects ongoing efforts to enhance immunization coverage and public health outcomes (5).

This study aimed to assess the immunity status of healthcare workers against certain vaccine-preventable diseases and to explore factors influencing vaccine efficacy. The importance of this research lies in its potential to inform strategies for improving vaccination coverage among healthcare workers, thereby enhancing their protection against infectious diseases and contributing to broader public health goals.

METHODS

Design and Participant Selection

Employing a retrospective and cross-sectional approach, our analysis encompasses data from 865 healthcare workers who underwent periodic examinations at the institutional outpatient clinic of Prof. Dr. Cemil Taşçıoğlu City Hospital from January 1, 2019, to December 31, 2019. Following the acquisition of ethical approval, informed consent was obtained from all participants. The study measured the levels of anti-hepatitis A virus immunoglobulin G (anti-HAV IgG), hepatitis B surface antibody (anti-HBs), anti-Rubeola IgG, anti-Rubella IgG, and anti-Mumps IgG among consenting healthcare workers during their routine periodic health assessments. Ethical approval was obtained from the İstanbul Prof. Dr. Cemil Taşçıoğlu City Hospital Clinical Research Ethics Committee (approval number: E-48670771-514.10, date: 09.04.2021). The study was conducted in line with the principles of the "Helsinki Declaration".

Methodology

The evaluation of antibody levels involved comparison with predefined reference values to determine the immune status of the participants. Healthcare workers with antibody levels below these reference benchmarks underwent subsequent re-evaluation of their vaccination status and control antibody levels during their subsequent periodic examination. Additionally, the study incorporated demographic information of the participants, including gender, age, education level, blood group, known diseases, occupation, and lifestyle factors such as smoking and alcohol consumption. Demographic data were retrieved from archived recruitment and periodic examination forms.

Statistical Analysis

The SPSS 26 software (Statistical Package for the Social Sciences, version 26) facilitated our statistical analysis. Descriptive statistics calculated for numerical data included mean, minimum, maximum, and standard deviation values, whereas categorical data were summarized using frequencies and percentages. Comparative analyses of qualitative data were conducted using the chi-square and Fisher's exact tests, with a significance threshold set at $p < 0.05$.

RESULTS

Participant demographics revealed an average age of 29.72 ± 8.29 years, with 64.74% (n=560) identifying as female, 35.26% (n=305) as male, and a majority, 74.57% (n=645), holding university degrees. Among these, 35.84% (n=310) were physicians, predominantly working in internal medicine, accounting for 58.5% (n=506) of the cohort (Table 1).

Table 1. Sociodemographic and occupational characteristics of the participants			
		n	%
Gender	Female	560	64.74%
	Male	305	35.26%
Education level	Primary care	22	2.54%
	High school	198	22.89%
	University	645	74.57%
Occupation	Doctor	310	35.84%
	Nurse	251	29.02%
	Other	304	35.14%
Branch of employment	Internal	506	58.50%
	Surgical	293	33.87%
	Other	66	7.63%
Smoking status	Smoker	186	21.53%
	Non-smoker	678	78.47%

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Investigation into hepatitis markers showed that 99.54% (n=861) of participants were negative for hepatitis B surface antigen (HBsAg), whereas 92.95% (n=804) exhibited positivity for anti-HBs antibodies. Additionally, the presence of antibodies against Rubella, Rubeola, and Mumps was notably high, exceeding 90% for each (n=835, n=804, and n=808, respectively), contrasting with a 56.76% (n=491) positivity rate for anti-HAV IgG (Table 2).

Of the 865 healthcare workers studied, 413 (47.74%) had positive antibody tests. Institutional vaccination was provided to 22.89% (n=198) of the participants, culminating in the administration of 249 vaccines, with hepatitis A vaccines constituting 61% (n=152) of these immunization (Table 3).

A detailed analysis of the distribution of anti-HBs antibodies indicated a significantly higher positivity among female healthcare workers than among their male counterparts. The rate of anti-HBs positivity also escalated with higher educational attainment and was particularly elevated among doctors and nurses compared with other professional groups. Employees in internal and surgical departments similarly showcased greater antibody positivity rates than those in other areas (p<0.05) (Table 4).

Conversely, anti-HAV IgG positivity was statistically lower in females than in males, with those having primary education showing higher positivity rates than individuals with secondary or higher education levels. Workers in surgical departments exhibited lower anti-HAV IgG positivity than colleagues in other specialties (p<0.05) (Table 5).

Table 2. Antigen-antibody status of the participants

		n	%
HbsAg	Positive	4	0.46%
	Negative	861	99.54%
Anti-HBs	Positive	804	92.95%
	Negative	61	7.05%
Anti-HAV IgG	Positive	491	56.76%
	Negative	374	43.24%
Anti-Rubella IgG	Positive	835	96.53%
	Negative	30	3.47%
Anti-Rubeola IgG	Positive	804	92.95%
	Negative	61	7.05%
Anti-Mumps IgG	Positive	808	93.41%
	Negative	57	6.59%

HBsAg: Hepatitis B surface antigen, Anti-HBs: Hepatitis B surface antibody, Anti-HAV IgG: Anti-hepatitis A virus immunoglobulin G

Table 3. Examination of vaccines administered to participants

		Administered		Total %
		n	%	
Vaccine name	**Hepatitis A**	152	61.0%	76.8%
	Hepatitis B	39	15.7%	19.7%
	Measles, mumps, and rubella	58	23.3%	29.3%
Total		249	100.0%	125.8%

Table 4. Comparison of anti-HBs results with sociodemographic and occupational characteristics of participants

		Anti-HBs				p-value
		Positive		Negative		
		n	%	n	%	
Gender	Female	528	94.29%	32	5.71%	0.037
	Male	276	90.49%	29	9.51%	
Education level	Primary care	13	59.09%	9	40.91%	0.000
	High school	169	85.35%	29	14.65%	
	University	622	96.43%	23	3.57%	
Occupation	Doctor	297	95.81%	13	4.19%	0.000
	Nurse	246	98.01%	5	1.99%	
	Other	261	85.86%	43	14.14%	
Branch of employment	Internal	486	96.05%	20	3.95%	0.000
	Surgical	276	94.20%	17	5.80%	
	Other	42	63.64%	24	36.36%	
Smoking status	Smoker	167	89.78%	19	10.22%	0.058
	Nonsmoker	636	93.81%	42	6.19%	

Anti-HBs: Hepatitis B surface antibody

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Table 5. Comparison of anti-HAV IgG results with the sociodemographic and occupational characteristics of the participants						
		Anti-HAV IgG				p-value
		Positive		Negative		
		n	%	n	%	
Gender	Female	301	53.75%	259	46.25%	0.015
	Male	190	62.30%	115	37.70%	
Education level	Primary care	19	86.36%	3	13.64%	0.011
	High school	117	59.09%	81	40.91%	
	University	355	55.04%	290	44.96%	
Occupation	Doctor	183	59.03%	127	40.97%	0.091
	Nurse	128	51.00%	123	49.00%	
	Other	180	59.21%	124	40.79%	
Branch of employment	Internal	304	60.08%	202	39.92%	0.000
	Surgical	138	47.10%	155	52.90%	
	Other	49	74.24%	17	25.76%	
Smoking status	Smoker	106	56.99%	80	43.01%	0.960
	Nonsmoker	385	56.78%	293	43.22%	
Anti-HAV IgG: Anti-hepatitis A virus immunoglobulin G						

No significant differences were observed in the sociodemographic and occupational profiles of participants when correlated with anti-Rubella and anti-rubeola IgG outcomes (p>0.05). However, the anti-mumps IgG positivity rate was significantly lower among nurses than in other professional groups (p<0.05). Additionally, no discernible relationship was established between the Rh blood groups of the healthcare workers and their antigen-antibody statuses (p>0.05).

DISCUSSION

The transmission risk of HBV, a critical blood-borne pathogen in healthcare settings, to healthcare workers post-exposure to fluids from HBsAg-positive patients is estimated to be between 5% and 30% (6). The primary revelation of this study was the high anti-HBs positivity rate of 92.95% among participants, with only 0.46% testing positive for HBsAg. Our institution vaccinated 39 individuals against hepatitis B, achieving adequate antibody formation in all cases.

Comparatively, anti-HBs positivity rates in prior Turkish studies were lower: 63.8% as reported by Tekin and Deveci (7), 68.4% by Uzun et al. (8), and 75.7% by Öksüz et al. (9). The elevated rates observed in our study may be attributed to the predominance of doctors in our sample and the increasing awareness and accessibility to hepatitis B vaccination over the years. Notably, anti-HBs positivity correlated with educational attainment, being highest among physicians and nurses, indicating an educational

influence on vaccine uptake, consistent with findings by Ciliz et al. (10) and Apaydın et al. (11).

Regarding HAV, known as the leading agent of acute viral hepatitis globally, transmitted through contact with infected individuals or contaminated resources (12), our findings showed a 56.76% seropositivity for anti-HAV IgG. This was lower than the seropositivity rates found in other Turkish studies, potentially due to reduced exposure risks in İstanbul's urban setting. Köse and Temoçin (13) and Apaydın et al. (11) reported varying seropositivity rates, reflecting the impact of socioeconomic status, hygiene practices, and demographic factors on HAV exposure.

Healthcare workers' risk of droplet-transmitted infections, in addition to fluid-borne diseases, underscores the importance of vaccinations for this group. Our study found a 92.95% anti-Rubeola IgG positivity rate among healthcare workers, with no significant differences across sociodemographic or occupational characteristics (p>0.05). The history of measles vaccination in Turkey and the recent surge in cases highlight the critical need for ongoing vaccination efforts among healthcare professionals to prevent potential nosocomial outbreaks (14,15).

The retrospective and cross-sectional design of this study introduces potential biases, including recall bias, and may limit the ability to establish causality. The specific focus on healthcare workers and the high prevalence of vaccinated physicians may also affect the generalizability of our findings.

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The results emphasize the importance of educational level and professional status in influencing vaccination rates and immunity levels among healthcare workers. Our findings align with previous research, suggesting that targeted vaccination strategies are essential for protecting healthcare workers and their patients from vaccine-preventable diseases.

CONCLUSION

The study indicates that while immunity against HBV is high among healthcare workers, hepatitis A immunity levels are concerningly low, highlighting the need for increased vaccination efforts. The hepatitis B vaccine was the most frequently administered vaccine among the healthcare workers surveyed. These findings underscore the necessity of enhanced vaccination strategies to bolster healthcare workers' immunity and curb disease transmission. Further randomized controlled trials are required to confirm these results and address the identified gaps in vaccination coverage and immunity.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the İstanbul Prof. Dr. Cemil Taşcıoğlu City Hospital Clinical Research Ethics Committee (approval number: E-48670771-514.10, date: 09.04.2021).

Informed Consent: Informed consent was obtained from all participants.

Authorship Contributions

Surgical and Medical Practices: S.A., Concept: B.E., S.A., Design: B.E., S.A., Data Collection or Processing: S.A., Analysis or Interpretation: F.E., N.Ç.A., Literature Search: B.E., F.E., N.Ç.A., Writing: F.E., N.Ç.A.

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