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ORIGINAL RESEARCH

Factors Affecting Influenza and Pneumococcal Vaccination Rates in Hemodialysis Patients: A Multicenter Study

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Purpose: In patients with end-stage renal disease (ESRD), infections, particularly pneumonias, are the most common cause of hospital admissions and death after cardiovascular diseases. It is recommended that dialysis patients receive the pneumococcal vaccine every five years and the influenza vaccine annually. Our study aims to determine the awareness and factors affecting influenza and pneumococcal vaccination rates in hemodialysis patients.

Patients and Methods: This cross-sectional study was conducted on patients undergoing regular hemodialysis treatment in 10 different hemodialysis centers across 4 cities. After excluding patients with less than one year of hemodialysis duration and those under 18 years of age, 548 patients were included in the study. Patients were administered a 20-item survey via face-to-face interview and electronic medical records.

Results: Out of the 548 patients, only 19 (3.5%) had knowledge about the pneumococcal vaccine, while 238 (43.4%) had knowledge about the influenza vaccine. There were 220 patients (20.1%) who had knowledge about both vaccines. Among the patients, 95 (17.3%) had received the pneumococcal vaccine, with 41.1% of them having received it five years ago or more. A significant proportion (33.7%) of the patients could not recall the timing of their vaccination. While 183 (33.4%) patients had not received the influenza vaccine, only 140 (25.5%) had been vaccinated regularly every year. The reasons for not receiving the influenza and pneumococcal vaccines were stated as "I do not feel the need because I do not get the flu" (25%) and "I do not know about the pneumonia vaccine" (36.7%), respectively. The ROC curve analysis for the influenza questionnaire score showed an AUC of 0.822 (95% CI 0.787–0.856), with a p-value of <0.001. The statistically significant cutoff value for predicting influenza vaccination was determined to be 2.5. In the univariate analysis, dialysis duration (HD duration), diabetes mellitus (DM), and vascular access type were found to be statistically significant. In the multivariate logistic regression analysis, dialysis duration and DM were identified as independent factors predicting a higher level of knowledge about the influenza vaccine (p=0.009, 0.003, and p=0.041). The ROC curve analysis for the pneumococcal questionnaire score showed an AUC of 0.920 (95% CI 0.886–0.955), with a p-value of <0.001. The statistically significant cutoff value for predicting pneumococcal vaccination was determined to be 3.5. In the univariate analysis, residence, dialysis duration, and education level were found to be statistically significant. In the multivariate logistic regression analysis, dialysis duration and education level were identified as independent factors predicting a higher level of knowledge about the pneumococcal vaccine (p=0.038, 0.040, and p=0.010).

Conclusion: It was observed that awareness and vaccination rates regarding influenza and pneumococcal vaccines were lower in our patients than recommended. We believe that educating patients about vaccines and increasing the sensitivity of hemodialysis physicians, nurses and nephrologists on this issue will increase vaccination rates.

Keywords: hemodialysis, influenza, pneumococcal pneumonia, vaccine

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Introduction

Patients with chronic kidney disease (CKD) have a high risk of infections.[1] Infections, especially among patients with end-stage renal disease (ESRD) undergoing hemodialysis (HD) treatment, are the most common cause of hospital admissions and death after cardiovascular diseases.[2] Among deaths due to infections, pneumonia is one of the most frequent causes.[3] The risk of death from pneumonia in dialysis patients is 14 to 16 times higher compared to the general population, with streptococcus pneumoniae being the most common pathogen.[4,5] To reduce the risk of pneumococcal pneumonia, global and national guidelines recommend dialysis patients receive the pneumococcal vaccine every five years and the influenza vaccine annually.[6,7] These vaccines have been shown to reduce hospitalizations and mortality in HD patients, despite having lower antibody titers than in patients without ESRD.[8–10] It has also been reported that pneumococcal and influenza vaccines may have beneficial synergistic effects.[11]

In Turkey, influenza and pneumococcal vaccines (polysaccharide and conjugate) are available. Although not mandatory, they are administered free of charge to risk groups such as HD patients. Influenza vaccine is administered every year in October and November, while pneumococcal vaccine is administered as indicated in Table 1. Patients receive their vaccines at family physicians or HD units. These vaccines are recommended for HD patients by the Ministry of Health of the Republic of Turkey, family physicians, nephrologist, dialysis physicians and nurses.

Studies conducted abroad indicate that awareness of influenza and pneumococcal vaccines among hemodialysis patients is low, and vaccination rates are below the target levels.[12] In this study, we aimed to determine the vaccination awareness vaccination rates, factors affecting vaccination and receiving regular hemodialysis treatment in 10 different hemodialysis centers in four provinces.

Materıals and Methods

There are over 1000 private and public HD centers in Turkey. Our study is a cross-sectional and involving patients from 10 hemodialysis centers in Düzce, Sakarya, Istanbul, and Ankara. The study was approved by the Düzce University Non-Interventional Health Research Ethics Committee (Decision no: 2023/120, 02.10.2023). All participants voluntarily gave an informed consent form that contained information about the study; they also gave a written and signed informed consent after being informed about the study's objective and method.

Study Design

The responsible nephrologists in the centers selected in our study are in contact with each other and can easily reach each other. After excluding patients who had been on hemodialysis for less than a year those with a mental status that prevented them from answering the questions and those under 18, 548 patients remained in the study. A 20-question questionnaire was administered to patients via face-to-face interview and electronic medical records immediately before

Table 1 Pneumococcal Vaccination Scheme for Hemodialysis Patients

Patient who has not been vaccinated with CPV13 and PPV23 before/does not remember (19–64 years old)						
CPV13 (19–64 years old)	At least 8 weeks later	PPV23 (19–64 years old)	At least 5 years later	PPV23 (19–64 years old)	At least 5 years later	PPV23 (>64 years old)
Patient (>64 years old) who has not been vaccinated with CPV13 and PPV23 before						
CPV13 (>64 years old)	At least 8 weeks later	PPV23 (>64 years old)				
Patient vaccinated with PPV23 after age >64 years						
PPV23 (>64 years old)	At least 1 year later	CPV13 (>64 years old)				

Note: Control CfD, Prevention. Use of 13-valent pneumococcal conjugate vaccine and 23-valent pneumococcal polysaccharide vaccine for adults with immunocompromising conditions: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morbidity and mortality weekly report. 2012;61(40):816.
Abbreviations: CPV, conjugated pneumococcal vaccine; PPV, polysaccharide pneumococcal vaccine.

the hemodialysis session between March 1 and April 30, 2024. The questionnaires were administered by the responsible nephrologists and dialysis physicians. Participants were asked about sociodemographic characteristics such as age, gender, education level, marital status, and residential area, as well as information on pneumococcal and influenza vaccines (type of vaccine and vaccination timing). The vaccine knowledge and the source of information were queried. Information on the cause of CKD, dialysis duration, and comorbid conditions was obtained through the electronic medical record system. Data were collected and analyzed in the second 2-month period. The study was completed in a total of 4 months.

Statistical Analysis

The research data were uploaded and evaluated using IBM SPSS 21 (IBM Statistical Package for Social Sciences). Descriptive statistics for categorical variables were presented as numbers and percentages. Cross-tabulations, the "Pearson Chi-square test", "Yates Continuity Correction", and "Fisher's exact test" were used for comparing categorical variables. In comparisons of more than two categorical groups, Bonferroni correction was applied, and the resulting p-values were considered. Statistical significance levels were accepted as $p<0.05$, and interpretations were made for $p<0.05$ and $p<0.001$.

A score was obtained for the influenza and pneumococcal vaccine questionnaire by scoring each question (0 for negative information and 1 for positive information). Spearman correlation was applied between the influenza and pneumococcal vaccine questionnaire scores. ROC curve analysis was applied to these scoring scores to predict the likelihood of getting the influenza and pneumococcal vaccines. The threshold value found was accepted as representing a higher level of knowledge about the vaccine, and a multivariable logistic regression analysis was performed to identify factors predicting a better level of knowledge about the vaccine.

Results

The demographic characteristics of the patients are shown in Table 2. Of the total 548 patients, 39.6% (n:217) were female and 60.4% (n:331) were male. Among the patients, 46.2% (n:253) were between the ages of 60 and 74, and

Table 2 Demographic Characteristics of the Patients

Clinical characteristics of all patients n:548 (%)	
Age	
18–44 years	44 (8%)
45–59 years	152 (27.7%)
60–74 years	253 (46.2%)
75 and over	99 (18.1%)
Gender, female/male (female%)	217/331 (39.6%)
Marital status	
Single	149 (27.2%)
Married	399 (72.8%)
Place of residence	
Rural	116 (21.2%)
Urban	432 (78.8%)
Educational background	
Illiterate	63 (11.5%)
literate	92 (16.8%)
Primary school	231 (42.2%)
Middle school	69 (12.6%)
High school	69 (12.6%)
University	24 (4.4%)

(*Continued*)

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Table 2 (Continued).

Dialysis frequency	
2/week	48 (8.8%)
3/week	500 (91.2%)
Dialysis duration	
12–23 months	85 (15.5%)
24–35 months	55 (10%)
36–47 months	56 (10.2%)
48–59 months	82 (15%)
60–119 months	192 (35.4%)
120 months and above	76 (13.9%)
Hemodialysis vascular access	
Catheter	179 (32.7%)
Arteriovenous fistula	369 (67.3%)
Primer hastalık	
Diabetes mellitus	202 (36.9%)
Hypertension	204 (37.2%)
Cronic glomerulonephritis	32 (5.8%)
ADPKD	13 (2.4%)
Other	35 (6.4%)
Unknown	62 (11.3%)
Comorbidity	
Diabetes mellitus	23 (4.2%)
Hypertension	149 (27.2%)
Heart failure	27 (4.9%)
COPD	10 (1.8%)
Ischemic heart disease	53 (9.7%)
Malignancy	11 (2%)

Abbreviations: ADPKD, autosomal dominant polycystic kidney disease, COPD, chronic obstructive pulmonary disease.

72.8% (n:399) were married. A total of 232 patients (42.3%) lived in a district of urban, and 231 patients (42.2%) had an education level of primary school graduate. The majority of patients (35.4%, n:192) had been undergoing hemodialysis for 60 to 119 months. Most patients (67.3%, n:369) used an arteriovenous fistula as their hemodialysis access route. The primary causes of renal failure were hypertensive nephropathy in 37.2% (n:204) and diabetic nephropathy in 36.9% (n:202) of patients. Among comorbidities other than primary renal failure, hypertension was the most common at 27.2%.

The survey results according to gender are shown in Table 3. When patients were grouped by gender, 23.5% of women were illiterate, and 22.1% were literate but had no formal education. Among men, 15.4% were middle school

Table 3 Statistically Significant Differences in Female and Male Patients

	Female (n=217)	**Male (n=331)**	**P**
Educational background			
Illiterate	51 (23.5%)[a]	12 (3.6%)[b]	
Literate	48 (22.1%)[a]	44 (13.3%)[b]	
Primary school	85 (39.2%)[a]	146 (44.1%)[a]	**<0.001**
Middle school	18 (8.3%)[a]	51 (15.4%)[b]	
High school	9 (4.1%)[a]	60 (18.1%)[b]	
University	6 (2.8%)[a]	18 (5.4%)[a]	

(*Continued*)

Table 3 (Continued).

	Female (n=217)	Male (n=331)	P
Have you ever had an influenza vaccine?			
No	82 (37.8%)[a]	101 (30.5%)[a]	
Yes, irregular	75 (34.6%)[a]	150 (45.3%)[b]	**0.041**
Yes, regular	60 (27.6%)[a]	80 (24.2%)[a]	
Reasons for not getting influenza vaccine	Missing data=84	Missing data=149	
I do not know the vaccine	32 (14.7%)[a]	29 (8.8%)[b]	
I do not believe in its effect	21 (9.7%)[a]	36 (10.9%)[a]	
I am afraid of side effects	33 (15.2%)[a]	24 (7.3%)[b]	**0.008**
I do not need it because I do not have influenza.	23 (10.6%)[a]	56 (16.9%)[b]	
I missed the vaccination time	23 (10.6%)[a]	36 (10.9%)[a]	
I did not know it was free	1 (0.5%)[a]	1 (0.5%)[a]	
Reason for not getting pneumococcal vaccine	Missing data=50	Missing data=78	
I do not know the vaccine	70 (32.3%)[a]	97 (29.3%)[a]	
I do not believe in its effect	23 (10.6%)[a]	53 (16%)[a]	
I am afraid of side effects	28 (12.9%)[a]	21 (6.3%)[b]	**0.046**
I do not need it because I do not have pneumonia.	40 (18.4%)[a]	76 (23%)[a]	
I did not know it was free	6 (2.8%)[a]	6 (1.8%)[a]	

Note: Different supercharacters ([a] and [b]) represent significant differences between groups. Those with p<0.05 are indicated in bold.

graduates, and 18% were high school graduates. There was a statistically significant difference in education levels between men and women, favoring men (p<0.001). There was no difference in influenza vaccination between genders; however, men were less consistent than women in getting the influenza vaccine (45.3% vs 34.6%, p=0.041). The reasons for not getting the influenza vaccine differed between genders (p=0.008), with women being less aware of the vaccine (14.7% vs 8.8%), more fearful of its side effects (15.2% vs 7.3%), while men more often said they did not feel the need because they do not get the flu (16.9% vs 10.6%). The reasons for not getting the pneumococcal vaccine also differed between genders (p=0.046), with more women citing fear of side effects (12.9% vs 6.3%).

The survey results according to urban/rural residence are shown in Table 4. When grouped by residence, the 18–44 age group was more likely to live in urban areas (9.7% vs 1.7%), while the 60–74 age group was more likely to live in

Table 4 Statistically Significant Differences in Rural and Urban Patients

	Rural (n=116)	Urban (n=432)	p
Age			
18–44 years	2 (1.7%)[a]	42 (9.7%)[b]	
45–59 years	27 (23.3%)[a]	125 (28.9%)[a]	**0.012**
60–74 years	63 (54.3%)[a]	190 (44%)[b]	
75 and over	24 (20.7%)[a]	75 (17.4%)[a]	
Educational background			
Illiterate	22 (32%)[a]	41 (9.5%)[b]	
Literate	32 (27.6%)[a]	60 (13.9%)[b]	
Primary school	51 (44%)[a]	180 (41.7%)[a]	**<0.001**
Middle school	5 (4.3%)[a]	64 (14.8%)[b]	
High school	6 (5.2%)[a]	63 (14.6%)[b]	
University	0 (0%)[a]	24 (5.6%)[b]	

(*Continued*)

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Table 4 (Continued).

	Rural (n=116)	Urban (n=432)	p
Have you ever had the pneumococcal vaccine, Yes/No (Yes%)	21/95 (18.1%)	78/358 (17.1%)	0.806
Reason for not getting pneumococcal vaccine	Missing data=27	Missing data=101	
I do not know the vaccine	26 (29.2%)[a]	141 (42.6%)[b]	
I do not believe in its effect	13 (14.6%)[a]	63 (19%)[a]	
I am afraid of side effects	14 (15.7%)[a]	35 (10.6%)[a]	**0.002**
I do not need it because I do not have pneumonia.	29 (32.6%)[a]	87 (26.3%)[a]	
I did not know it was free	7 (7.9%)[a]	5 (1.5%)[b]	

Note: Different supercharacters ([a] and [b]) represent significant differences between groups. Those with p<0.05 are indicated in bold.

Table 5 The Patients' Knowledge of the Pneumococcal and Influenza Vaccines and Their Source of Information

	Pneumococcal	Influenza	Pneumococcal and Influenza
Vaccine knowledge Had knowledge	19 (3.5%)	238 (43.4%)	220 (20.1%)
Source of information about the vaccines 1. No source 1. By patient and their relatives 1. Dialysis nurses 1. Family doctor 1. Dialysis physician 1. Nephrologist	34 (6.2%) 13 (2.4%) 179 (32.7%) 41 (7.5%) 199 (36.6%) 82 (15%)		

rural areas (54.3% vs 44%) (p=0.012). Patients living in urban areas were more educated than those in rural areas (p<0.001). There was a difference in the reasons for not getting the pneumococcal vaccine between the groups (p=0.002). Patients in urban areas were less aware of the pneumococcal vaccine compared to those in rural areas (42.6% vs 29.2%), while those in rural areas were less aware of its free availability compared to those in urban areas (7.9% vs 1.5%).

Only 19 patients (3.5%) were aware of the pneumococcal vaccine, while 238 patients (43.4%) were aware of the influenza vaccine. The number of patients who were aware of both vaccines was 220 (20.1%). Patients most frequently obtained information about both vaccines from their dialysis doctors and dialysis nurses (36.6% (n:199) and 32.7% (n:179), respectively) (Table 5).

Ninety-five patients (17.3%) had received the pneumococcal vaccine, with 41.1% of them having been vaccinated five or more years ago. A significant portion (33.7%) of the patients could not recall the timing of their vaccination. While 183 patients (33.4%) had not received the influenza vaccine, only 140 patients (25.5%) were vaccinated regularly every year (Table 6).

The reasons for not getting the influenza and pneumococcal vaccines are shown in Table 7. There was a difference in the reasons for not getting the vaccines between the groups (p<0.001). The most common reason for not getting the

Table 6 Information About Pneumococcal and Influenza Vaccination

	Pneumococcal Vaccine	Influenza Vaccine
Vaccination injection Yes or No	Yes: 95 (17.3%) No: 453 (82.7%)	Yes, irregular: 225 (41.1%) Yes, regular: 140 (25.5%) No: 183 (33.4%)

(*Continued*)

Table 6 (Continued).

	Pneumococcal Vaccine	Influenza Vaccine
Timing of vaccination		
Last 1 year	7 (7.3%)	232 (42.3%)
1-<3 years	4 (4.2%)	
3-<5 years	13 (13.7%)	
5 years or longer	39 (41.1%)	
Not remember	32 (33.7%)	

Table 7 Reasons for Not Vaccinating for Influenza and Pneumococcal Vaccine

	Influenza n:316 (%100)	Pneumococcus n:453 (%100)	p
I do not know the vaccine	61 (19.3%)[a]	166 (36.7%)[b]	**<0.001**
I do not believe in its effect	57 (18.1%)[a]	76 (16.8%)[a]	
I am afraid of side effects	46 (14.6%)[a]	49 (10.8%)[a]	
I do not need it because I do not have the flu	79 (25%)[a]	116 (25.6%)[a]	
I did not know it was free	2 (0.6%)[a]	12 (2.6%)[b]	
I missed the vaccination time	58 (18.3%)[a]	13 (2.9%)[b]	
Others	13 (4.1%)[a]	21 (4.6%)[a]	

Note: Different supercharacters ([a] and [b]) represent significant differences between groups. Those with p<0.05 are indicated in bold.

influenza vaccine was "I do not feel the need because I do not get the flu" (25%), while the most common reason for not getting the pneumococcal vaccine was "I do not know about the vaccine" (36.7%). Among the reasons for not getting the influenza vaccine, missing the vaccination time was more common compared to the reasons for not getting the pneumococcal vaccine (18.3% vs 2.9%). Conversely, the lack of knowledge about the free availability of the vaccine was more common among those who did not get the pneumococcal vaccine compared to those who did not get the influenza vaccine (2.6% vs 0.6%).

Each question in the influenza and pneumococcal vaccine survey was assigned a score (0 for negative information, 1 for positive information) to obtain a total score. The ROC curve for the influenza questionnaire score showed an AUC of 0.822 (95% CI 0.787–0.856), with a p-value of <0.001. According to the ROC analysis, the statistically significant cutoff value for predicting influenza vaccination was 2.5 (sensitivity 64.1%, specificity 85.2%) (Figure 1).

Univariate and multivariate logistic regression analyses were conducted to identify the factors predicting a higher level of knowledge about the influenza vaccine (with a questionnaire score >2.5) (Table 8). In the univariate analysis, dialysis duration, DM, and vascular access type were found to be statistically significant. In the multivariate logistic regression analysis, dialysis duration and DM were identified as independent factors predicting better knowledge about the influenza vaccine (p=0.009, 0.003, and p=0.041).

The ROC curve for the pneumococcal questionnaire score showed an AUC of 0.920 (95% CI 0.886–0.955), with a p-value of <0.001. According to the ROC analysis, the statistically significant cutoff value for predicting pneumococcal vaccination was 3.5 (sensitivity 92.6%, specificity 71.5%) (Figure 2).

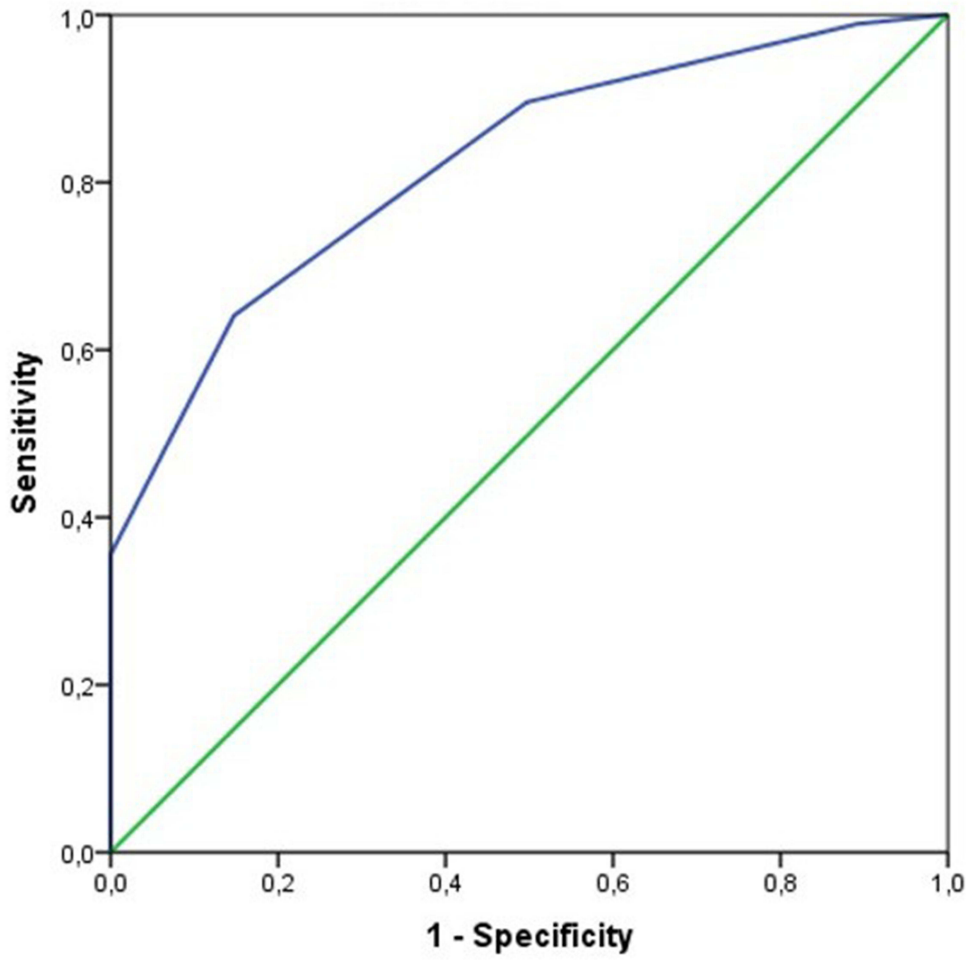

Figure 1 ROC curve for influenza questionnaire score. AUC 0.822 (CI 95% 0.787–0.856) and p<0.001. Statistically significant cut-off value 2.5 (sensitivity 64.1%, specificity 85.2%).

Univariate and multivariate logistic regression analyses were conducted to identify the factors predicting a higher level of knowledge about the pneumococcal vaccine (with a questionnaire score >3.5) (Table 9). In the univariate analysis, residence, dialysis duration, and education level were found to be statistically significant. In the multivariate logistic regression analysis, dialysis duration and education level were identified as independent factors predicting better knowledge about the pneumococcal vaccine (p=0.038, 0.040, and p=0.010).

Table 8 Univariate and Multivariate Logistic Regression Analysis for Influenza Vaccination

	Univariate LR			Multivariate LR		
	B	**CI 95%**	**p**	**B**	**CI 95%**	**p**
Age						
18–44 years	References					
45–59 years	0.856	0.436–1.677	0.650			
60–74 years	0.694	0.365–1.321	0.266			
75 and over	0.694	0.340–1.417	0.316			

(*Continued*)

Table 8 (Continued).

	Univariate LR			Multivariate LR		
	B	**CI 95%**	**p**	**B**	**CI 95%**	**p**
Gender						
Female	References					
Male	1.011	0.717–1.424	0.951			
CKD etiology						
DM	0.904	0.509–1.607	0.731			
HT	1.402	0.791–2.485	0.247			
Cronic GN	2.160	0.901–5.179	0.084			
ADPKD	2.074	0.609–7.060	0.243			
Others	1.224	0.533-0.2.812	0.633			
Unknown	References					
Marital status						
Single	References					
Married	0.800	0.549–1.166	0.246			
Place of Residence						
Rural	References					
Urban	0.968	0.642–1.458	0.875			
Hemodialysis duration						
12–23 months	References					
24–35 months	1.631	0.804–3.308	0.175	1.531	0.750–3.128	0.242
36–47 months	2.113	1.051–4.247	**0.036**	1.989	0.980–4.038	0.057
48–59 months	2.760	1.464–5.203	**0.002**	2.387	1.248–4.564	**0.009**
60–119 months	2.733	1.591–4.696	**<0.001**	2.333	1.328–4.097	**0.003**
120 and over	1.837	0.963–3.505	0.065	1.551	0.790–3.043	0.202
Educational Status						
Illiterate	References					
Reading	0.874	0.454–1.682	0.686			
Primary school graduate	1.649	0.938–2.900	0.082			
Secondary school graduate	1.304	0.655–2.598	0.450			
High school graduate	1.095	0.548–2.186	0.798			
University graduate	1.682	0.653–4.334	0.282			
DM	0.292	0.107–0.798	**0.016**	0.344	0.124–0.957	**0.041**
HT	0.772	0.528–1.128	0.181			
Heart failure	0.874	0.401–1.903	0.734			
COPD	0.465	0.119–1.818	0.271			
Malignancy	1.327	0.400–4.401	0.644			
Ischemic heart disease	0.901	0.510–1.591	0.719			
Vascular access						
Catheter	References					
AVF	1.508	1.051–2.165	**0.026**	1.317	0.895–1.939	0.163

Note: Those with p<0.05 are indicated in bold.

Abbreviations: CKD, Chronic Kidney Disease; GN, Glomerulonephritis; DM, Diabetes Mellitus; HT, Hypertension; ADPKD, Autosomal Dominant Polycystic Kidney Disease; HD, Hemodialysis; COPD, Chronic Obstructive Pulmonary Disease; AVF, Arteriovenous Fistula.

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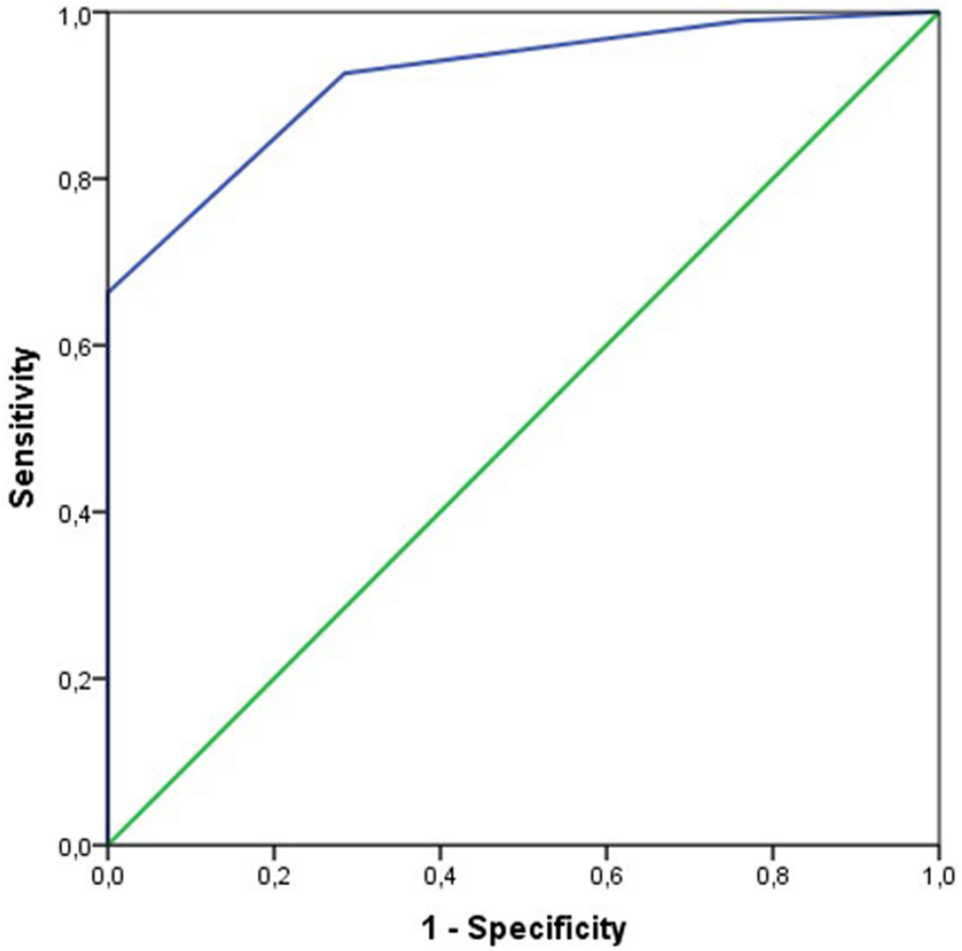

Figure 2 ROC curve for pneumococcal questionnaire score. AUC 0.920 (CI 95% 0.886–0.955) and p<0.001. Statistically significant cut-off value 3.5 (sensitivity 92.6%, specificity 71.5%).

Discussion

This multicenter study on influenza and pneumococcal vaccinations in hemodialysis patients provided insights into vaccination rates and associated factors. Overall, the vaccination rates among patients were below 50%. Patients were unaware of these vaccines, feared side effects, or did not feel the need to get vaccinated as they believed they were not sick. The level of knowledge regarding both influenza and pneumococcal vaccines increased with the duration of HD. It

Table 9 Univariate and Multivariate Logistic Regression Analysis for Pneumococcal Vaccination

	Univariate LR			Multivariate LR		
	B	CI 95%	p	B	CI 95%	p
Age						
18–44 years	References					
45–59 years	0.983	0.499–1.936	0.961			
60–74 years	0.805	0.421–1.539	0.511			
75 and over	0.785	0.381–1.617	0.512			

(*Continued*)

Table 9 (Continued).

	Univariate LR			Multivariate LR		
	B	**CI 95%**	**p**	**B**	**CI 95%**	**p**
Gender						
Female	References					
Male	1.209	0.851–1.720	0.290			
CKD etiology						
DM	0.904	0.509–1.607	0.731			
HT	1.402	0.791–2.485	0.247			
Cronic GN	2.160	0.901–5.179	0.084			
ADPKD	2.074	0.609–7.060	0.243			
Others	1.224	0.533-0.2.812	0.633			
Unknown	References					
Marital status						
Single	References					
Married	1.000	0.681–1.469	1.000			
Place of Residence						
Rural	References					
Urban	1.602	1.035–2.482	**0.035**	1.304	0.820–2.072	0.262
Hemodialysis duration						
12–23 months	References					
24–35 months	0.764	0.382–1.526	0.446	0.794	0.392–1.607	0.521
36–47 months	0.928	0.470–1.832	0.829	0.935	0.466–1.874	0.849
48–59 months	1.837	0.993–3.395	0.053	1.940	1.038–3.626	**0.038**
60–119 months	0.623	0.370–1.050	0.075	0.663	1.328–4.097	0.130
120 and over	0.442	0.227–0.860	**0.016**	0.491	0.390–1.128	**0.040**
Educational Status						
Illiterate	References					
Reading	1.016	0.515–2.005	0.963	0.890	0.444–1.787	0.744
Primary school graduate	1.122	0.623–2.021	0.702	0.934	0.509–1.714	0.826
Secondary school graduate	1.632	0.805–3.308	0.175	1.243	0.596–2.592	0.563
High school graduate	1.943	0.960–3.932	0.065	1.465	0.700–3.066	0.311
University graduate	4.857	1.744–13.527	**0.002**	3.953	1.382–11.309	**0.010**
DM	0.410	0.150–1.122	0.082			
HT	0.760	0.514–1.124	0.170			
Heart failure	1.974	0.906–4.303	0.087			
COPD	1.017	0.284–3.647	0.979			
Malignancy	1.066	0.148–2.157	0.404			
Ischemic heart disease	1.295	0.732–2.290	0.374			
Vascular access						
Catheter	References					
AVF	0.810	0.563–1.164	0.255			

Note: Those with p<0.05 are indicated in bold.

Abbreviations: CKD, Chronic Kidney Disease; GN, Glomerulonephritis; DM, Diabetes Mellitus; HT, Hypertension; ADPKD, Autosomal Dominant Polycystic Kidney Disease; HD, Hemodialysis; COPD, Chronic Obstructive Pulmonary Disease; AVF, Arteriovenous Fistula.

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was observed that patients with a diagnosis of DM had lower knowledge about the influenza vaccine, while university-educated patients had higher knowledge about the pneumococcal vaccine.

In addition to protecting against flu infections, several studies worldwide have shown that the influenza vaccine reduces the risk of various diseases. A study in Taiwan demonstrated the beneficial effects of the influenza vaccine in reducing the risk of stroke. This study showed that even a single influenza vaccination significantly reduced the risk of hospitalization due to ischemic stroke, decreasing the risk by up to 24% in one season.[13] Similar findings have been confirmed by other studies observing a reduction in the risk of ischemic stroke during the epidemic season.[14,15] Another favorable aspect of the influenza vaccine is its impact on cardiovascular events. A significant relationship was found between influenza vaccination and reduced risk of myocardial infarction in patients aged 50 and over. In a study by Siriwardena et al, influenza vaccination was associated with a 19% reduction in the rate of acute myocardial infarction.[16]

According to our study, 25.5% of patients received the influenza vaccine regularly every year, while 41.1% received it irregularly. In a similar study by Gilbertson et al, influenza vaccination rates were found to be below 50% among hemodialysis and peritoneal dialysis patients when examined separately.[17] Another study conducted in 2021, which included 193 hemodialysis patients, found a regular influenza vaccination rate of 45%.[18] These rates are well below the World Health Organization's target of vaccinating 75% of key risk groups for influenza.[19]

There are two types of pneumococcal vaccines available globally: the 13-valent conjugate pneumococcal vaccine (PCV-13) and the 23-valent polysaccharide pneumococcal vaccine (PPSV23). It has been shown that administering both pneumococcal vaccines provides stronger protection compared to a single vaccine. Therefore, the PCV13 vaccine, in combination with the PPSV23 vaccine, has been included in vaccination schedules designed for immunosuppressive individuals, including patients with chronic kidney disease.[20,21] (Table 1) In our study, the pneumococcal vaccination rate was 17.3%, and according to the vaccination schedule, patients were under-vaccinated. Of those who had been vaccinated at least once in their lifetime, 84.2% did not know the type of vaccine they received.

Looking at the literature, Mutlu et al reported a pneumococcal vaccination rate of 14.4% in a study involving 360 hemodialysis patients. Wilmore et al found a rate of 22% in a study conducted in the UK, and Saran et al reported a rate of 23% in a study conducted in the USA, all of which are similar to our findings.[12,22,23]

In our study, only 20.1% (n=220) of patients had knowledge about both vaccines. The knowledge about both vaccines was low, and those who were informed obtained the information primarily from dialysis physicians and dialysis nurses (36.6% (n=199), 32.7% (n=179), respectively). It is noteworthy that nephrologists were the third source of information at 15%. This may be due to the insufficient number of nephrologists and their heavy workload, preventing them from providing comprehensive care in this issue.[24]

When examining the reasons for not getting vaccinated against influenza and pneumococcal infections, the most common reasons were the belief that they were not sick and a lack of information about the vaccines. Comparing the responses about influenza and pneumococcal vaccines, patients missed the influenza vaccination timing while their knowledge about the pneumococcal vaccine was lacking, or they were unaware that it was free. Particularly, patients living in urban areas had less knowledge about the pneumococcal vaccine compared to those in rural areas. This might be due to the high workload of doctors and healthcare personnel in urban areas, leaving insufficient time for preventive health services. Similar to our findings, a study by Johnson et al found that the most common reasons for patients not wanting to get vaccinated were the belief that they were healthy and did not see the need for it.[25] Patients need to be repeatedly informed that influenza and pneumococcal vaccines are preventive measures, not treatments, even if they feel healthy.

When examining the patients' knowledge levels regarding influenza and pneumococcal vaccines and the factors influencing this, it was found that the level of knowledge for both vaccines increased with the duration of HD. The increased awareness and interaction with dialysis physicians, nurses, and nephrologists due to the longer HD duration may have played a role in this process. We found that patients with DM had lower knowledge about the influenza vaccine. Additionally, we observed that university-educated patients had higher knowledge about the pneumococcal vaccine. While an increase in education level, as seen in our study, can lead to higher vaccination rates, there are also studies in the literature showing unexpectedly opposite effects.[26,27]

Unlike the vaccination rates for pneumococcal and influenza vaccines, nearly all Hepatitis B seronegative hemodialysis patients are vaccinated. In many dialysis units worldwide and in our country, hepatitis serologies and vaccination statuses of patients in chronic dialysis programs are meticulously monitored, whereas pneumococcal and influenza vaccinations are overlooked. The widespread acceptance and routine application of the Hepatitis B vaccine might explain this difference. Making the routine administration of not only the Hepatitis B vaccine but also other vaccines in hemodialysis centers and informing patients about them can increase the vaccination rates.

It is important to highlight some limitations of our study. Due to the cross-sectional study design, patients' views on vaccination were obtained only during the survey, and their opinions may change over time. There may be a subjective element in understanding and responding to the questions in the survey used in the research. Since our data were collected from 10 hemodialysis centers, it may not be representative of the entire hemodialysis population in our country.

Conclusion

Awareness and vaccination rates for the influenza vaccine were low among our patients, while awareness and vaccination rates for the pneumococcal vaccine were very low. Educating doctors and nurses responsible for managing hemodialysis treatment about vaccination programs is a crucial step in ensuring accurate information reaches patients. We believe that a comprehensive program for both the public and professionals will help overcome barriers against vaccination. We think that patient education about vaccines and increased sensitivity of hemodialysis doctors, nurses, and nephrologists in this matter will increase vaccination rates.

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Ethics Statement

This study was conducted in line with the principles of the Helsinki declaration. The study protocol was approved by the The study was approved by the Düzce University Non-Interventional Health Research Ethics Committee (Decision no: 2023/120, 02.10.2023). Participants gave informed, written consent.

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Disclosure

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References

1. Haddiya I. Current knowledge of vaccinations in chronic kidney disease patients. *Int J Nephrol Renovasc Dis*. 2020;13:179–185. doi:10.2147/IJNRD.S231142
2. Reddy S, Chitturi C, Yee J. Vaccination in chronic kidney disease. *Adv Chronic Kidney Dis*. 2019;26(1):72–78. doi:10.1053/j.ackd.2018.10.002
3. Troeger C, Forouzanfar M, Rao PC, et al. Estimates of the global, regional, and national morbidity, mortality, and aetiologies of lower respiratory tract infections in 195 countries: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet Infect Dis*. 2017;17:1133–1161. doi:10.1016/S1473-3099(17)30396-1
4. Sarnak MJ, Jaber BL. Pulmonary infectious mortality among patients with end-stage renal disease. *Chest*. 2001;120:1883–1887. doi:10.1378/chest.120.6.1883
5. Viasus D, Garcia-Vidal C, Cruzado JM, et al. Epidemiology, clinical features and outcomes of pneumonia in patients with chronic kidney disease. *Nephrol Dial Transplant*. 2011;26:2899–2906. doi:10.1093/ndt/gfq798
6. Levin A, Stevens PE, Bilous RW, et al. Clinical practice guideline for the evaluation and management of chronic kidney disease. *Kidney Int Suppl*. 2012;2013(3):1–150.
7. (RotACoIP ACIP). Guidelines for vaccinating kidney dialysis patients and patients with chronic kidny disease. Available From: https://wwwcdcgov/dialysis/guidelines/. Accessed december 25, 2024
8. Litjens NH, Huisman M, van den Dorpel M, et al. Impaired immune responses and antigen-specific memory CD4+ T cells in hemodialysis patients. *J Am Soc Nephrol*. 2008;19:1483–1490. doi:10.1681/ASN.2007090971
9. Jain S, Self WH, Wunderink RG, et al. Community-Acquired Pneumonia Requiring Hospitalization among U.S. Adults. *N Engl J Med*. 2015;373(5):415–427. doi:10.1056/NEJMoa1500245

10. Bond TC, Spaulding AC, Krisher J, McClellan W. Mortality of dialysis patients according to influenza and pneumococcal vaccination status. *Am J Kidney Dis*. 2012;60(6):959–965. doi:10.1053/j.ajkd.2012.04.018
11. Gilbertson DT, Guo H, Arneson TJ, Collins AJ. The association of pneumococcal vaccination with hospitalization and mortality in hemodialysis patients. *Nephrol Dial Transplant*. 2011;26(9):2934–2939. doi:10.1093/ndt/gfq853
12. Saran R, Robinson B, Abbott KC, et al. US Renal Data System 2017 Annual Data Report: epidemiology of Kidney Disease in the United States. *Am J Kidney Dis*. 2018;71(3):A7. doi:10.1053/j.ajkd.2018.01.002
13. Hui-Chen L, Hui-Fen C, Shu-Chen H, et al. Association of Influenza Vaccination and Reduced Risk of Stroke Hospitalization among the Elderly: a Population-Based Case-Control. *Int J Environ Res Public Health*. 2014;11:3639–3649. doi:10.3390/ijerph110403639
14. Grau AJ, Fischer B, Barth C, et al. Influenza vaccination is associated with a reduced risk of stroke. *Stroke*. 2005;36:1501–1506. doi:10.1161/01.STR.0000170674.45136.80
15. Lee KR, Bae JH, Hwang IC, et al. Effect of Influenza Vaccination on Risk of Stroke: a Systematic Review and Meta-Analysis. *Neuroepidemiology*. 2017;48:103–110. doi:10.1159/000478017
16. Siriwardena AN, Gwini SM, Coupland CAC. Influenza vaccination, pneumococcal vaccination and risk of acute myocardial infarction: matched case–control study. *Can Med Assoc J*. 2010;15:182.
17. Gilbertson DT, Unruh M, McBean AM, et al. Influenza vaccine delivery and effectiveness in end-stage renal disease. *Kidney Int*. 2003;63(2):738–743. doi:10.1046/j.1523-1755.2003.00787.x
18. Gawryś A, Gołębiowski T, Zielińska D, et al. Knowledge, Attitudes and Practices of Flu Vaccination in Hemodialysis Patients. *Vaccines*. 2021;9(2):77. doi:10.3390/vaccines9020077
19. World Health Organization. Influenza (Seasonal). Available from: http://www.euro.who.int/en/health-topics/communicable-diseases/influenza/vaccination/seasonal-vaccination-policies-and-coverage-in-the-european-region. Accessed december 25, 2024
20. Kosmadakis G, Albaret J, Correia EDC, et al. Vaccination practices in dialysis patients: a narrative review. *Semin Dial*. 2018;31(5):507–518. doi:10.1111/sdi.12709
21. Vandecasteele SJ, Ombelet S, Blumental S, et al. The ABC of pneumococcal infections and vaccination in patients with chronic kidney disease. *Clin Kidney J*. 2015;8(3):318–324. doi:10.1093/ckj/sfv030
22. Mutlu A, Şengül E, Boz G. A cross-sectional survey study on influenza and pneumococcal vaccination rates and the factors affecting vaccination rates in hemodialysis patients in Kocaeli Province of Turkey. *Ther Apher Dial*. 2022;26(3):640–648. doi:10.1111/1744-9987.13744
23. Wilmore SM, Philip KE, Cambiano V, et al. Influenza and pneumococcal vaccinations in dialysis patients in a London district general hospital. *Clin Kidney J*. 2013;7(1):27–32. doi:10.1093/ckj/sft138
24. Kapoian T, Meyer KB, Johnson DS. Infection prevention and the medical director: uncharted territory. *Clin J Am Soc Nephrol*. 2015;10(5):863–874. doi:10.2215/CJN.06050614
25. Johnson DR, Nichol KL, Lipczynski K. Barriers to adult immunization. *Am J Med*. 2008;121(7 Suppl 2):S28–35. doi:10.1016/j.amjmed.2008.05.005
26. Endrich MM, Blank PR, Szucs TD. Influenza vaccination uptake and socioeconomic determinants in 11 European countries. *Vaccine*. 2009;27(30):4018–4024. doi:10.1016/j.vaccine.2009.04.029
27. Trepanowski R, Drążkowski D. The Vaccine-Education Paradox in a Cross-Country Analysis: education Predicts Higher and Lower Vaccination Rates. *Sage Open*. 2024;14:2. doi:10.1177/21582440241253326