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Assessment of illness acceptance and self-management in diabetic patients visiting primary care clinics

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ABSTRACT

Objective: This study aimed to evaluate illness acceptance and diabetes self-management levels in patients with type 2 diabetes presenting to the Family Medicine Outpatient Clinic of Ankara Training and Research Hospital, Health Sciences University, and to examine the relationship between these levels and sociodemographic characteristics.

Methods: This cross-sectional and descriptive study included 412 diabetes patients who visited the outpatient clinic between March 11 and May 17, 2024. Participants completed a sociodemographic data form, the Acceptance of Illness Scale, and the Diabetes Self-Management Scale. Data were analyzed using SPSS 22.

Results: Higher illness acceptance scores were significantly associated with education level ($p=0.002$), physical activity ($p<0.001$), dietary adherence ($p<0.001$), regular hospital visits ($p=0.013$), no history of hospitalization ($p=0.002$), pneumococcal ($p<0.001$) and influenza vaccination ($p=0.017$), no insulin use ($p=0.021$), and absence of complications ($p<0.001$).

Higher self-management scores were significantly related to education ($p<0.001$), physical activity ($p<0.001$), diabetes education ($p<0.001$), dietary adherence ($p<0.001$), hospital visits ($p<0.001$), pneumococcal and influenza vaccination ($p<0.001$), insulin history ($p=0.001$), and absence of chronic diseases ($p=0.006$). A positive medium correlation was found between illness acceptance and self-management ($r=0.448$, $p<0.001$).

Conclusion: Educational level and healthy lifestyle behaviors were associated with higher illness acceptance and diabetes self-management levels in individuals with type 2 diabetes. In primary care, family physicians should consider these factors when supporting diabetes self-management through individualized care plans. Given the cross-sectional design of the study, these findings indicate associations and should not be interpreted as causal relationships.

Keywords: Type 2 diabetes, illness acceptance, acceptance of illness scale, diabetes self-management, self-management scale

Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both, requiring lifelong management and treatment.^[1]

The prevalence of diabetes is rapidly increasing worldwide. In 2024, 589 million adults (aged 20–79 years) are living with diabetes. This number is projected to rise to 853 million by 2050. The vast majority of diabetes cases are type 2, and its increasing prevalence is associated with factors such as urban population growth, sedentary lifestyles, obesity, and ageing.^[2,3]

In the TURDEP-1 study conducted in our country, the prevalence of diabetes was determined to be 7.2%, while in the TURDEP-2 study, this rate rose to 13.7%, showing an approximately 90% increase in the incidence of diabetes. According to the IDF 2025 Atlas, there are approximately 9.6 million adults with diabetes as of 2024, and this number is projected to reach 14.1 million by 2050. These findings indicate that diabetes is spreading faster than expected in Türkiye.^[2,4,5]

Illness acceptance is an important psychosocial concept that refers to an individual's voluntary acceptance of their illness in all its aspects. In chronic diseases such as diabetes, individuals must adhere to complex treatment regimens for long periods of time; this can lead to various restrictions and difficulties in daily life. The literature reports that individuals with diabetes who have a high level of illness acceptance demonstrate better treatment compliance and glycaemic control.^[6-9] Studies conducted on patients using insulin have shown that low illness acceptance levels can negatively affect treatment compliance.^[10] Similarly, a positive relationship has been reported between illness acceptance and adaptation to chronic illness.^[11] In addition, the relationship between diabetes symptoms and

illness acceptance has also been evaluated in individuals with type 2 diabetes.^[12] These findings suggest that illness acceptance is an element that should not be overlooked in diabetes management.

Self-management refers to the active management of the treatment process by the individual using their knowledge, skills and behaviours related to their illness. Diabetes self-management includes many components such as medication use, dietary patterns, physical activity and self-monitoring.^[13,14] Studies have shown that the disease perceptions and self-efficacy levels of individuals with diabetes are related to self-management behaviours; structured education and self-management support programmes may be effective in reducing the risk of complications.^[13,15,16]

There are limited studies in the literature that jointly address the relationship between illness acceptance and diabetes self-management. Existing studies indicate that modifiable factors such as educational level, physical activity, and regular follow-up can positively influence both illness acceptance and self-management behaviours. The long-term and comprehensive monitoring of diabetic patients in family medicine practice presents an important opportunity to assess these psychosocial factors. It is thought that approaches supporting illness acceptance and individualised self-management education, even in short consultations, may have positive effects on treatment compliance and quality of life in diabetic patients attending family medicine clinics. We hypothesized that higher illness acceptance would be independently associated with better diabetes self-management among patients with type 2 diabetes attending a primary care clinic. This study aims to contribute to the literature by examining the relationship between illness acceptance and self-management levels in type 2 diabetes patients attending family medicine clinics and the factors associated with this condition.

Materials and Methods

Our study is a descriptive and cross-sectional study conducted between 11 March 2024 and 17 May 2024 on patients aged 18 years and older who were diagnosed with diabetes, were able to communicate, and volunteered to participate in the study, who made planned visits to the Family Medicine Outpatient Clinic of Family Medicine Outpatient Clinic of Ankara Training and Research Hospital, Health Sciences University. Participants were recruited using a convenience sampling method among patients who attended the family medicine outpatient clinic during the study period. Patients presenting for routine examination, prescription renewal, laboratory testing, or follow-up were asked whether they had a diagnosis of diabetes. Eligible patients who agreed to participate after being informed about the study were included. Ethical approval for this study was obtained from the Ethics Committee of Ankara Training and Research Hospital, Health Sciences University, on March 06, 2024 (approval number: 2451). For a population of unknown size, a sample size of at least 384 was calculated with a 95% confidence interval and an assumed diabetes prevalence of 50%; as a result of the interviews conducted, a total of 412 patients were reached. Patients with no communication barriers who agreed to participate in the study were included. Patients younger than 18 years, those who did not consent to participate, those with communication barriers, and those with a duration of diabetes of less than one year were excluded from the study. Written and verbal informed consent was obtained from all participants after explaining the purpose of the study. Sociodemographic and clinical data were collected using a structured questionnaire developed by the researchers, including age, sex, body mass index, marital and educational status, income level, smoking status, duration of diabetes,

comorbid chronic diseases, diabetes education and its source (including education on foot care, medication use, nutrition, and physical activity), medication use, history of insulin use, hospital admission due to diabetes, diet adherence, pneumococcal and influenza vaccination status, and the presence of diabetes-related complications (including diabetic neuropathy, nephropathy, retinopathy, and cardiovascular complications). Physical activity was recorded as a dichotomous variable (yes/no) based on self-report of engaging in at least 150 minutes of moderate-intensity physical activity per week. Illness acceptance and diabetes self-management were assessed using the Acceptance of Illness Scale and the Diabetes Self-Management Scale.

The Acceptance of Illness Scale (AIS) was developed by Felton and Reverson and adapted for individuals in Turkish society by Büyükkaya Besen and Esen. The scale is a 5-point Likert-type measure consisting of 8 items. This scale measures patients' attitudes towards diabetes, and an increase in scores indicates increased illness acceptance. The scale's internal validity ($t=22.139$, $p<0.001$), stability over time ($r=0.71$, $p<0.001$) and internal consistency (Cronbach's Alpha= 0.79) were found to be high. In the study by Besen and Esen, the Cronbach's alpha reliability coefficient was determined to be 0.771 .^[7]

The Diabetes Self-Management Scale (DSMS), developed by Eda Koç, is a 5-point Likert-type scale consisting of 19 questions. The scale assesses diabetes self-management through three subscales (healthy lifestyle behaviours, blood glucose management, and use of healthcare services), with higher scores indicating better self-management. The overall Cronbach's alpha value of the scale was 0.86 , and 0.86 was also found for standardised items. The content validity index was above 0.80 , ranging from 0.83 to 1.00 .^[17]

Statistical analyses were performed using the SPSS 22 programme. Descriptive data were presented as frequency and percentage for categorical variables and as mean $\pm$ standard deviation for continuous variables. The normal distribution of continuous variables was assessed using the Kolmogorov-Smirnov test; parametric tests (Student's t-test, One-Way ANOVA) were used for normally distributed variables. The relationships between continuous variables were examined using Pearson's correlation test. Linear regression analysis was performed using the Enter method to determine the predictors of the total scores of the Acceptance of Illness Scale (AIS) and the Diabetes Self-Management Scale (DSMS). Variables considered clinically relevant based on the literature and clinical judgment, as well as variables found to be significant in pairwise comparisons, were included in the regression model. The assumptions of multiple linear regression were evaluated prior to the analysis. The normality of residuals was assessed through visual inspection, and multicollinearity was examined using the Variance Inflation Factor (VIF). VIF values ranged between 1.10 and 2.75, remaining below the commonly accepted threshold of 5. Autocorrelation was assessed using the Durbin-Watson test, and no significant violation was detected (DW = 1.821 and 1.695). The significance level was set at $p < 0.05$.

Results

The study included 412 patients with type 2 diabetes, 57.3% of whom were women ($n=236$). The mean age of the patients was 61.4 ± 11.7 years, and the mean body mass index was 29.4 ± 5.5 kg/m². Ninety-one percent of participants were married ($n=375$), and 36.2% had a high school education or higher ($n=149$). Forty-four point four percent were housewives ($n=183$), and 45.1% reported that

their income was less than their expenses ($n=186$). Thirty-four point five percent of participants engaged in regular physical activity ($n=142$), 64.1% used oral antidiabetic medication ($n=264$), and 78.6% had visited a hospital in the past year ($n=324$). Furthermore, 14.3% had received the pneumococcal vaccine ($n=59$), and 30.8% had received the annual influenza vaccine ($n=127$). Sixty-one point seven percent of participants had received diabetes education ($n=254$), 71.1% reported following a diabetes-related diet ($n=293$), and 22.6% had developed diabetes-related complications ($n=93$) (Table 1).

The mean AIS score was 26.6 ± 8.1 , and the mean DSMS score was 61.6 ± 12.4 . The subscale mean scores of the DSMS were 38.4 ± 7.3 for healthy lifestyle behaviours, 12.7 ± 3.8 for blood glucose management, and 10.5 ± 4.0 for healthcare utilisation (Table 2).

Participants who were male, had a high school education or higher, were employed or retired, engaged in regular physical activity, visited the hospital regularly, received pneumococcal and influenza vaccinations, and followed a diet had significantly higher AIS and DSMS scores ($p < 0.05$). In addition, AIS scores were significantly higher among those with no history of insulin use, no hospitalisation, and no diabetes-related complications, whereas DSMS scores were significantly higher among those without chronic disease, those who had received diabetes education, and those with a history of insulin use ($p < 0.05$) (Table 3).

Unmarried participants and those without a history of hospitalisation had higher scores on the healthy lifestyle behaviours subscale. Male participants, those who were employed or retired, and those without chronic disease had significantly higher scores on the healthy lifestyle behaviours and blood glucose management subscales ($p < 0.05$).

Table 1. Distribution of participants' sociodemographic and diabetes-related characteristics.

Sociodemographic and diabetes-related characteristics		Mean±SD	
Age (years)		61.4±11.7	
Height (cm)		165.0±9.5	
Weight (kg)		79.6±14.7	
BMI (kg/m ²)		29.4±5.5	
		n	%
Gender	Women	236	57.3
	Men	176	42.7
Marital status	Married	375	91.0
	Single	37	9.0
Educational background	Middle school and below	263	63.8
	High school and above	149	36.2
Working status	Housewife	183	44.4
	Retired	135	32.8
	Employed	94	22.8
Monthly income	My income is less than my expenses	186	45.1
	My income is equal to my expenses	187	45.4
	My income is more than my expenses	39	9.5
Physical activity	Yes	142	34.5
	No	270	65.5
Diabetes medicine	Diet only	18	4.4
	OAD (Oral Antidiabetic Drug)	264	64.1
	Insulin	40	9.7
	Insulin + OAD	90	21.8
Hospital visits in the last year	Yes	324	78.6
	No	88	21.4
Pneumococcal	Yes	59	14.3
	No	353	85.7
Flu vaccine	Yes	127	30.8
	No	285	69.2
Training type*	Medication use	215	84.6
	Nutrition	198	78.0
	High blood sugar	127	50.0
	Low blood sugar	126	49.6
	Exercise	39	15.4
	Foot care	12	4.7
Educator*	Physician	184	72.4
	Nurse	133	52.4
	Dietitian	184	72.4
Diet application features	Avoiding sugary foods	291	70.6
	Avoiding salty foods	149	36.2
	Avoiding fatty foods	146	35.4
Complications of diabetes	Cardiovascular disease	41	44.1
	Nephropathy	27	29.0
	Neuropathy	12	12.9

Some patients provided more than one response. BMI: Body mass index; Mean ± SD: Mean ± standard deviation.

Table 2. Average scores obtained by participants from the scales.

Scales	Score (Mean ± SD)
AIS	26.6±8.1
DSMS	61.6±12.4
Healthy lifestyle behaviors (F1)	38.4±7.3
Blood sugar management (F2)	12.7±3.8
Healthcare services utilization (F3)	10.5±4.0

AIS: Acceptance of Illness Scale, DSMS: Diabetes Self-Management Scale, Mean ± SD: Mean ± Standard Deviation

Patients with a history of insulin use had higher scores on the blood glucose management and healthcare utilisation subscales, while those with secondary education or higher, those engaging in regular physical activity, those who had received diabetes education, those who visited hospitals regularly, those who were vaccinated, and those who followed a diet scored significantly higher on all subscales of the DSMS ($p<0.05$) (Table 4).

Table 3. Comparison of total scores on the acceptance of illness scale and diabetes self-management scale according to participants' sociodemographic and diabetes-related characteristics.

Sociodemographic and diabetes-related characteristics		AIS total score		DSMS total score	
		Mean±SD	p*	Mean±SD	p*
Gender	Women	25.6±8.2	0.004	60.2±11.9	0.011
	Men	27.9±7.8		63.3±12.8	
Educational background	Middle school and below	25.7±8.6	0.002	59.4±12.0	< 0.001
	High school and above	28.3±6.7		65.4±12.0	
Working status	Housewife	25.0±8.5a	0.001**	59.2±11.6a	0.002**
	Retired	27.2±6.0a,b		63.4±11.5b	
	Employed	28.4±8.4b		63.5±13.5b	
Physical activity	Yes	29.0±7.8	< 0.001	67.3±12.0	< 0.001
	No	25.4±8.0		58.5±11.5	
Chronic illness	Yes	26.3±8.4	0.060	60.7±12.6	0.006
	No	27.9±6.5		64.7±10.8	
Diabetes education	Yes	26.7±8.2	0.797	63.6±12.3	< 0.001
	No	26.5±7.9		58.3±11.7	
Diabetes medication	Diet only	28.3±10.9a	0.010**	59.7±15.1	0.064**
	OAD	27.3±8.0a		60.5±12.2	
	Insulin	23.0±6.8b		63.8±13.6	
	Insulin + OAD	25.9±7.9a,b		64.0±11.4	
Insulin use history	Yes	25.4±7.8	0.021	64.1±11.9	0.001
	No	27.3±8.1		60.1±12.4	
Hospital admission	Yes	27.1±8.2	0.013	63.8±11.5	< 0.001
	No	24.7±7.4		53.3±12.1	
Hospitalization	Yes	21.6±8.5	0.002	58.4±13.5	0.194
	No	26.9±8.0		61.7±12.3	
Pneumococcal	Yes	30.4±6.4	< 0.001	68.6±12.8	< 0.001
	No	26.0±8.2		60.4±11.9	
Flu vaccine	Yes	28.0±8.0	0.017	65.7±12.1	< 0.001
	No	26.0±8.1		59.7±12.0	
Diet	Yes	27.8±7.8	< 0.001	67.3±12.0	< 0.001
	No	23.8±8.2		58.5±11.5	
Complications	Yes	24.0±7.7	< 0.001	60.7±12.6	0.617
	No	27.4±8.0		64.7±10.8	

*Student's t-test and one-way analysis of variance (ANOVA) were used. A p value of <0.05 was considered statistically significant. AIS: Acceptance of Illness Scale, DSMS: Diabetes Self-Management Scale, Mean±SD: Mean±Standard Deviation

Table 4. Comparison of participants' sociodemographic and diabetes-related characteristics with the type 2 diabetes self-management scale.

Characteristics		Healthy lifestyle behaviors	p*	Blood sugar management	p*	Healthcare use	p*
		Mean ± SD		Mean ± SD		Mean ± SD	
Gender	Women	37.7±7.2	0.033	12.2±3.7	0.005	10.2±3.8	0.187
	Men	39.3±7.3		13.3±3.7		10.8±4.2	
Marital status	Married	38.1±7.2	0.002	12.7±3.7	0.929	10.4±4.0	0.089
	Single	42.0±7.4		12.7±4.0		11.5±4.0	
Educational background	Middle school and below	37.0±7.1	<0.001	12.2±3.8	0.001	10.2±3.9	0.049
	High school and above	40.8±7.0		13.5±3.5		11.0±4.1	
Working status	Housewife	36.9±6.8a	<0.001**	12.2±3.8a	0.042**	10.2±3.8	0.366**
	Retired	39.5±6.1b		13.3±3.4b		10.7±4.1	
	Employed	39.8±8.2b		13.0±3.9b		10.7±4.2	
Physical activity	Yes	42.7±6.7	<0.001	13.5±3.7	0.001	11.1±4.3	0.016
	No	36.2±6.5		12.2±3.7		10.1±3.8	
Chronic illness	Yes	37.9±7.5	0.003	12.4±3.8	0.005	10.4±4.0	0.273
	No	40.2±5.9		13.7±3.4		10.9±3.9	
Diabetes education	Yes	39.4±7.4	<0.001	13.4±3.6	<0.001	10.9±4.0	0.013
	No	36.8±6.7		11.6±3.8		9.8±4.0	
Insulin use history	Yes	38.7±7.3	0.461	14.1±3.1	<0.001	11.2±4.0	0.003
	No	38.2±7.3		11.8±3.9		10.0±4.0	
Hospital admission	Yes	39.3±6.9	<0.001	13.2±3.6	<0.001	11.3±3.8	<0.001
	No	35.0±7.7		10.9±3.8		7.4±3.2	
Hospitalization	Yes	34.8±7.9	0.013	12.5±3.6	0.856	11.0±3.6	0.506
	No	38.6±7.2		12.7±3.8		10.4±4.0	
Pneumococcal	Yes	42.4±7.3	<0.001	14.0±3.7	0.003	12.2±4.0	<0.001
	No	37.7±7.0		12.5±3.7		10.2±3.9	
Flu vaccine	Yes	40.8±7.3	<0.001	13.4±3.8	0.011	11.6±3.9	<0.001
	No	37.3±7.0		12.4±3.7		10.0±4.0	
Diet	Yes	40.7±6.3	<0.001	13.4±3.6	<0.001	11.0±4.0	<0.001
	No	32.9±6.4		10.9±3.5		9.1±3.8	

*Student t-test, **One Way ANOVA analysis. p<0.05 is considered statistically significant. OAD: Oral Antidiabetic Drug

AIS scores showed a positive correlation with healthy lifestyle behaviours, blood glucose management, healthcare utilisation, height, and monthly income, and a negative correlation with BMI. Healthy lifestyle behaviours scores were positively correlated with blood glucose management, healthcare utilisation, height, and monthly income, and negatively correlated with

weight and BMI. Blood glucose management scores were positively correlated with healthcare utilisation, height, and monthly income, and negatively correlated with BMI. Total DSMS scores were positively correlated with height and monthly income and negatively correlated with BMI and smoking status (Table 5).

Table 5. Correlation of participants scale scores.

		AIS	F1	F2	F3	Total score
F1	r	.472				
	p	<0.001				
F2	r	.280	.522			
	p	<0.001	<0.001			
F3	r	.266	.431	.534		
	p	<0.001	<0.001	<0.001		
Total Score	r	.448	.886	.785	.740	
	p	<0.001	<0.001	<0.001	<0.001	
Age	r	-.044	-.072	-.068	.075	-.039
	p	.371	.144	.166	.131	.430
Height	r	.110	.190	.181	.093	.197
	p	.026	<0.001	<0.001	.060	<0.001
Weight	r	-.023	-.100	-.003	.045	-.045
	p	.642	.043	.954	.366	.362
BMI	r	-.099	-.222	-.110	-.018	-.170
	p	.045	<0.001	.025	.721	<0.001
Number of cigarettes smoked	r	-.035	-.301	-.103	-.125	-.239
	p	.773	.011	.396	.301	.046
Monthly income	r	.245	.236	.106	.091	.200
	p	<0.001	<0.001	.031	.065	<0.001

F1: Healthy lifestyle behaviors; F2: Blood glucose management; F3: Health care utilization; AIS: Acceptance of Illness Scale; BMI: Body mass index. Pearson correlation analysis was performed.

In linear regression analysis, variables significantly associated with the total AIS score were total DSMS score ($\beta=0.280$, $p<0.001$) and presence of diabetes-related complications ($\beta=-2.206$, $p=0.014$). The model explained 25.0% of the variance ($R^2=0.250$) and was statistically significant ($F=11.525$; $p<0.001$) (Table 6).

Variables significantly associated with total DSMS score included physical activity ($\beta=-4.641$, $p<0.001$), presence of chronic disease ($\beta=2.505$, $p=0.030$), diabetes education ($\beta=-2.342$, $p=0.018$), history of insulin use ($\beta=-4.302$, $p<0.001$), hospital admission ($\beta=-5.954$, $p<0.001$), pneumococcal vaccination ($\beta=-3.712$, $p=0.008$), influenza vaccination ($\beta=-2.150$, $p=0.041$), diet adherence ($\beta=-6.708$, $p<0.001$), and total AIS score ($\beta=0.460$, $p<0.001$). The model explained 47.1% of the variance ($R^2=0.471$) and was statistically significant

($F=29.105$; $p<0.001$). No significant associations were found for the remaining variables. After confirming that the assumptions of regression were met, multiple linear regression analysis was performed ($VIF < 5$; Durbin-Watson = 1.821 and 1.695). The 95% confidence intervals for the regression coefficients are presented (Table 6).

Discussion

The mean Acceptance of Illness Scale (AIS) score in our study was determined to be 26.6 ± 8.1 .^[18-20] In the literature, averages of 22.79 ± 6.72 in diabetic foot patients^[18], 30.66 ± 7.08 in pregnant diabetic patients^[19], and 27.56 ± 7.08 in cancer patients have been reported.^[20] These differences are thought to stem from the diversity in sociodemographic and clinical characteristics and disease types.

Table 6. Linear regression analysis of factors associated with AIS and DSMS total scores.

	B	95% CI for B	SE	Standardized β	t	p
AIS Total Score ($R^2=0.250$; $F=11.525$; $p<0.001$)						
Gender	.247	-1.942 to 2.435	1.113	.015	.221	0.825
Educational background	-.641	-2.231 to 0.949	.809	-.038	-.792	0.429
Working status	1.097	-0.190 to 2.384	.655	.119	1.676	0.094
Physical activity	-.411	-1.964 to 1.141	.790	-.024	-.521	0.603
Diabetes medication	-.246	-1.487 to 0.994	.631	-.027	-.390	0.697
History of insulin use	1.895	-0.392 to 4.182	1.163	.114	1.629	0.104
Hospital admission	.619	-1.169 to 2.407	.909	.031	.681	0.496
Hospitalization	1.650	-1.600 to 4.899	1.653	.048	.998	0.319
Pneumococcal	-1.750	-3.879 to 0.378	1.083	-.076	-1.617	0.107
Flu vaccine	.335	-1.275 to 1.946	.819	.019	.409	0.682
Diet	-.521	-2.217 to 1.174	.863	-.029	-.604	0.546
Complication	2.206	0.442 to 3.970	.897	.114	2.458	0.014
DSMS total score	.280	0.209 to 0.350	.036	.428	7.804	<0.001
DSMS total score ($R^2=0.471$; $F=29.105$; $p<0.001$)						
Gender	-.875	-3.712 to 1.961	1.443	-.035	-.607	0.544
Educational background	1.388	-0.708 to 3.483	1.066	.054	1.302	0.194
Working status	.141	-1.518 to 1.800	.844	.010	.167	0.867
Physical activity	-4.641	-6.600 to -2.683	.996	-.179	-4.658	<0.001
Chronic disease	2.505	0.241 to 4.770	1.152	.083	2.175	0.030
Status of receiving diabetes education	-2.342	-4.273 to -0.411	.982	-.092	-2.384	0.018
History of insulin use	-4.302	-6.327 to -2.277	1.030	-.169	-4.176	<0.001
Hospital admission	-5.954	-8.191 to -3.718	1.138	-.198	-5.234	<0.001
Hospitalization	2.549	-1.465 to 6.563	2.042	.048	1.248	0.213
Pneumococcal	-3.712	-6.447 to -0.977	1.391	-.105	-2.668	0.008
Flu vaccine	-2.150	-4.210 to -0.089	1.048	-.080	-2.051	0.041
Diet	-6.708	-8.788 to -4.628	1.058	-.246	-6.341	<0.001
AIS	.460	0.343 to 0.577	.060	.301	7.702	<0.001

Linear regression analysis was performed. A p value of <0.05 was considered statistically significant. For binary variables, "Yes" was coded as 0 and "No" as 1. Therefore, negative regression coefficients indicate higher scores among participants with the relevant characteristic.

AIS: Acceptance of Illness Scale; DSMS: Diabetes Self-Management Scale.

In our study, it was found that retired patients with a high school education or above had higher AIS scores. In Büyükkaya's study, illness acceptance was reported to be higher among patients with a high income level^[7]; while another study conducted on patients with type 2 diabetes showed that illness acceptance was higher among working patients and those with a university education or above.^[6] Furthermore, Taşkın Yılmaz et al. found that individuals with an educational level

of primary school and above had higher illness acceptance compared to those who were illiterate, whereas employment status had no significant effect on illness acceptance.^[9] The finding in our study that sociodemographic characteristics such as educational level and retirement status were associated with illness acceptance is generally consistent with the results reported in the literature. This suggests that educational level and economic security may positively influence

individuals' health literacy, thereby improving their ability to understand, accept, and cope with the disease process.

In our study, it was found that participants who followed a diet and exercised regularly had higher AIS scores. This finding is consistent with the results of a study conducted by Döner and colleagues on diabetic foot patients and suggests that adapting to lifestyle changes may positively influence patients' illness acceptance process.^[18] However, caution is required when generalising the results due to differences between patient groups and sample limitations. Our findings demonstrate that non-pharmacological approaches, such as diet and exercise, play an important role in increasing illness acceptance in type 2 diabetes management, alongside pharmacological treatment, and suggest that this approach could contribute to clinical practice and the literature.

In our study, it was observed that illness acceptance levels were lower in patients hospitalised due to diabetes and who developed diabetes-related complications. The literature also reports that illness acceptance is higher in patients who do not develop complications due to diabetes and who have good metabolic control.^[8] Similarly, it has been reported that diabetic patients who use insulin and have high illness acceptance develop fewer complications and have better metabolic control parameters.^[10] A limitation of our study is that patients' metabolic control parameters could not be assessed; nevertheless, our findings suggest that individuals with low illness acceptance may not adequately adhere to treatment modalities, potentially increasing the risk of hospitalisation and complications. This situation demonstrates that illness acceptance is a critical psychosocial factor in diabetes management and that increasing the level of acceptance may contribute to the literature in terms of its potential to reduce complications and hospital admissions.

In our study, the mean DSMS for patients was found to be 61.6 ± 12.4 ; in Koç's study, this value was found to be 65.4 ± 11.8 .^[17] In our study, it was observed that self-management scores were lower in patients with low educational levels and housewife status. The literature also reports positive relationships between self-management and educational level and employment status; for example, in Koç's study, self-care behaviours and self-efficacy were found to be higher in patients with a high school education or above, while in the study by Bohanny and colleagues, they were found to be higher in working patients.^[17-21] These findings indicate that self-management in individuals with diabetes is influenced by sociocultural, educational, and economic factors and that strengthening self-management skills by taking these factors into account may have the potential to improve diabetes control.

In our study, it was observed that patients with a low body mass index who exercised regularly, had received diabetes education, and followed a diet had higher DSMS scores. Similarly, the literature reports that an increase in body mass index reduces self-management, while physical activity increases it^[17]; a study conducted on Hispanic adults in the United States reported that the self-efficacy of individuals with diabetes increased as a result of the education provided and the support of home health personnel.^[22] Furthermore, a study conducted in Indonesia on uncontrolled type 2 diabetic patients showed that individuals who received diabetes education experienced improvements in diabetes management.^[23] Similarly, the literature reports that patients who adhere to a diabetic diet have higher levels of self-management. Although metabolic parameters were not evaluated in our study, the findings suggest that regular exercise, weight control, diabetes education, and diet implementation can strengthen diabetes self-management. These results emphasise that focusing solely on pharmacological treatment in

diabetes management is insufficient and that a comprehensive treatment approach supported by non-pharmacological factors such as lifestyle and education is important.

In our study, no significant difference was observed in DSMS scores between patients who developed diabetes-related complications and those who did not. The literature reports that education and self-management support programmes provided to diabetic patients may reduce the risk of complications.^[15] This difference may be due to the cross-sectional design of our study and the fact that self-management behaviours were measured only with questionnaire data, which may not have fully reflected the differences between the groups. Furthermore, the limited number of patients attending the family medicine clinic, as the majority of patients who developed complications were referred to departments such as internal medicine and nephrology, may be another reason for the lack of observed differences between the groups.

Regression analyses showed that the AIS score was affected by the DSMS score and the presence of complications, while the DSMS score was influenced by exercise, diabetes education, dietary adherence, history of insulin use, regular healthcare visits, and vaccinations (Table 6). These findings indicate that self-management is influenced not only by individual motivation but also by education, lifestyle, and healthcare services. The literature also supports that diabetes education and lifestyle interventions increase both self-management and illness acceptance.^[13,15,17,22,24,25] Therefore, in family medicine practice, individualized education, diet and exercise interventions, and regular follow-up may strengthen illness acceptance and self-management and reduce long-term complication risk. In primary care, continuity of care provides an opportunity to repeatedly assess patients' illness perceptions, health literacy, and

barriers to self-management. Brief motivational interviewing, patient empowerment strategies, and individualized counseling may help improve both illness acceptance and diabetes self-management during routine family medicine visits.

Limitations

This study has several limitations. First, it was conducted in a single center and included patients from a specific socio-cultural and socio-economic background, which limits the generalizability of the findings. Since the study was carried out among patients with type 2 diabetes attending the family medicine outpatient clinic of Ankara Training and Research Hospital, the results cannot be generalized to all individuals with diabetes in Türkiye. The number of eligible patients per day and the number of patients who declined participation were not systematically recorded; therefore, potential non-response bias could not be evaluated. Second, metabolic and biochemical parameters related to diabetes (such as HbA1c, fasting plasma glucose and lipid profile) were not included in the analyses, which may have limited the evaluation of the relationship between illness acceptance, self-management, and clinical outcomes. Third, data were collected using self-reported questionnaires, including the Acceptance of Illness Scale and the Diabetes Self-Management Scale. Although these validated scales provide valuable information, self-reporting may be subject to recall bias and social desirability bias. Finally, the cross-sectional design of the study does not allow causal inferences; therefore, the observed positive association between illness acceptance and diabetes self-management cannot establish a cause-effect relationship. Future multicenter, longitudinal studies including objective metabolic parameters and more diverse populations are recommended to confirm and expand these findings.

Conclusion

In our study, a positive association was found between illness acceptance and self-management levels in patients with type 2 diabetes. Regression analyses showed that illness acceptance was associated with self-management and the presence of complications, whereas self-management was associated with education, lifestyle, and treatment processes. The findings indicate that these processes are interconnected and should be addressed together. In primary care and family medicine practice, rather than focusing solely on pharmacological treatment, adopting a holistic approach that includes individualized interventions such as motivational interviewing, gradual exercise planning tailored to the individual's current physical capacity, and nutritional recommendations adapted to socioeconomic conditions may improve diabetes management by enhancing illness acceptance and self-management.

Ethical approval

This study has been approved by the Health Sciences University Ankara Training and Research Hospital Ethics Committee (approval date 06.03.2024, number 2451). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: ASÖ, MÇ; data collection: ASÖ, MFF, ŞÇ; analysis and interpretation of results: ASÖ, MÇ; draft manuscript preparation: ASÖ. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest to disclose.

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Evaluation of post-vaccination pneumonia incidence in patients receiving pneumococcal vaccine administered by home health care services

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This study was derived from the PhD thesis of Osman Barak, titled "Evaluation of post-vaccination pneumonia incidence in patients receiving pneumococcal vaccine administered by home health care services", conducted under the supervision of Prof. Dr. Seçil Günher Arıca; Dr. Aybüke Bacanlı at Health Sciences University, Department of Family Medicine, in 2025.

ABSTRACT

Objective: Individuals receiving home health care services often constitute a group with multiple chronic conditions, limited physical mobility, and restricted access to healthcare facilities. Immunization services are therefore critical for preventing infections in this population. Therefore, this study aimed to evaluate the frequency of pneumonia and related hospitalization rates after pneumococcal vaccination in patients receiving home healthcare services.

Methods: A retrospective study was conducted at the Home Health Care Unit of Prof. Dr. Cemil Taşcıoğlu City Hospital, by reviewing the records of 125 patients who had received pneumococcal vaccination at home between June and September 2023. For each patient, the number of pneumonia episodes and hospitalization status before and after vaccination were compared.

Results: A total of 125 patients were included in the study, consisting of 85 (68.0%) females and 40 (32.0%) males. Regarding age stratification, 9 (7.2%) patients were under 65 years of age, while 116 (92.8%) patients were 65 years of age and older. The mean number of pneumonia episodes decreased significantly from 1.68 ± 1.42 before vaccination to 0.44 ± 0.66 after vaccination, corresponding to an approximately 73.5% reduction ($p < 0.001$). After vaccination, patients had substantially lower odds of developing pneumonia (matched OR 12.40). A similar improvement was observed in hospitalization rates, which decreased from 17.6% before vaccination to 7.2% afterward ($p = 0.019$). Hospitalization odds were about threefold lower after vaccination.

Conclusion: Our study shows that pneumococcal vaccination among home health care patients was associated with a significant reduction in pneumonia episodes and pneumonia-related hospitalizations. Given the uncontrolled pre-post design, these associations should not be interpreted as direct causal effects. The improvement observed after vaccination suggests that pneumococcal immunization is clinically important for high-risk individuals and should be expanded among similar risk groups. To maximize protection, healthcare providers should routinely screen the immunization status of home healthcare patients and integrate pneumococcal vaccination into standard homecare protocols as a priority preventive measure.

Keywords: Home care services, pneumococcal vaccine, pneumonia, immunization

Introduction

Pneumonia is a serious infection of the lower respiratory tract characterized by inflammation, exudation, and consolidation within the alveoli.^[1] Community-acquired pneumonia (CAP) is the most common form and represents a major cause of morbidity and mortality, particularly among older adults and individuals with chronic illnesses or immunosuppressive conditions.^[2,3] Most CAP cases are caused by *Streptococcus pneumoniae*, whose virulence depends on its ability to evade host immune defenses through mechanisms involving capsular polysaccharides, pneumolysin, and surface adhesins.^[4] Additionally, increasing antibiotic resistance and the age-related decline in immune response make pneumococcal infections more difficult to control.^[5,6]

Globally, pneumonia remains one of the leading causes of death due to infectious diseases. According to data from the World Health Organization, approximately 2.5 million people die from pneumonia each year.^[7] A significant proportion of these deaths occur in individuals aged 65 years and older, as well as in those with chronic comorbidities such as diabetes mellitus, chronic obstructive pulmonary disease (COPD), and heart failure.^[8,9] Pneumonia is not limited to an acute infectious episode; in the long term, it can lead to complications that decrease quality of life and increase health care costs.^[10,11]

Individuals receiving home health care services represent a specific risk group for pneumonia. Factors such as advanced age, limited mobility, swallowing disorders, malnutrition, and frequent antibiotic use increase the likelihood of developing pneumonia in this population. Furthermore, low vaccination rates and challenges in regular follow-up among home health care patients make infection control more complex. Therefore, preventive strategies and continuous monitoring

programs are essential to reduce pneumonia risk in this vulnerable group.^[12]

Vaccination is one of the most effective preventive strategies against pneumococcal infections. In adults, conjugate (PCV13, PCV20) and polysaccharide (PPV23) vaccines have been shown to reduce the incidence of severe pneumococcal infections and hospitalization rates, particularly in older adults and those with chronic diseases. Immunization not only provides individual protection but also contributes to reducing the overall pneumonia burden at the community level.^[13-15]

This study aimed to evaluate the frequency of pneumonia and related hospitalization rates after pneumococcal vaccination in patients receiving home healthcare services.

Materials and Methods

This study was designed as a retrospective cohort and conducted at the Home Health Care Unit of Prof. Dr. Cemil Taşcıoğlu City Hospital. Records of patients who received pneumococcal vaccination at home and met the inclusion criteria were reviewed. To evaluate post-vaccination pneumonia development, the inclusion criterion required at least six months to have passed since the date of vaccination. The pre-vaccination observation window was defined as the 24-month period preceding the vaccination date. The post-vaccination follow-up ranged from 6 to 15 months (median, 6 months). Pneumonia episodes occurring during this follow-up period were recorded.

Inclusion criteria

Patients were included if they met all of the following: (i) received pneumococcal (PCV13) vaccination at home by the Home Health Care Unit between June and September 2023; (ii) at least six months had elapsed since vaccination at the time

of data collection; (iii) complete medical records were available in the unit database and the Hospital Information System; and (iv) at least one documented clinical follow-up after vaccination. Patients with incomplete records or without any post-vaccination follow-up were excluded. In total, 125 vaccinated individuals met these criteria and were included in the analysis.

Data were obtained from the Home Health Care Unit's standard patient record forms and the Hospital Information System. Recorded variables included patients' demographic characteristics (age, sex), comorbidities, type of pneumococcal vaccine administered (all patients were vaccinated with PCV13), as well as all pneumonia diagnoses and hospital admissions due to pneumonia before and after vaccination. The diagnosis of pneumonia was based on physicians' documented diagnoses in home healthcare or hospital records and, when available, was confirmed by clinical and radiological findings.

The study was approved by the Ethics Committee of Prof. Dr. Cemil Taşcıoğlu City Hospital (Date: 03.12.2024, Decision No: 271). As this was a retrospective record review, no direct contact with patients occurred, and informed consent was not required.

Data analysis was performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as mean $\pm$ standard deviation, median (minimum-maximum), and interquartile range (IQR) for continuous variables, and as number (n) and percentage (%) for categorical variables. The distribution of continuous variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Nonparametric tests were applied for variables not normally distributed.

For within-subject comparisons of continuous variables before and after vaccination, the Wilcoxon Signed-Rank test was used. The McNemar

test was applied for paired categorical variables (such as presence of pneumonia or hospitalization due to pneumonia). Comparisons between two independent groups were made using the Mann-Whitney U test, and comparisons among three or more groups were analyzed using the Kruskal-Wallis H test. Differences between categorical variables were evaluated using the Chi-square test or Fisher's Exact test when appropriate. Correlations between continuous variables were assessed using Spearman correlation analysis.

No a priori sample-size or power calculation was performed; all patients meeting the inclusion criteria during the study period were enrolled (total sampling). A p-value < 0.05 was accepted as statistically significant for all tests.

Results

The study included 125 patients with a mean age of 80.91 ± 11.12 years (range: 33–103), and a median age of 82 years. As presented in Table 1, 7.2% of the participants (<65 years) were in the young-middle-aged group, while 92.8% (≥ 65 years) belonged to the elderly group. Among them, 68.0% ($n = 85$) were female and 32.0% ($n = 40$) were male.

Table 1. Descriptive characteristics of the patients ($n = 125$).

Variables		
Age (years) Median (Min–Max)	82.0 (33.0-103.0)	
	n	%
Age group (years)		
<65 (Young-Middle aged)	9	7.2
≥ 65 (Elderly)	116	92.8
Gender		
Female	85	68.0
Male	40	32.0
Survival Status		
Alive	94	75.2
Deceased	31	24.8

n = Number, = Frequency, Median = Midpoint, Min = Minimum, Max = Maximum.

Regarding survival status, 75.2% (n = 94) of the patients were alive, whereas 24.8% (n = 31) had died during the follow-up period after vaccination.

According to Table 2, the number of chronic diseases per patient ranged from 1 to 6, with a mean of 3.52 ± 1.56 and a median of 4.0. Among the 125 patients included in the study, a total of 444 chronic disease diagnoses were recorded. Hypertension was the most common condition, affecting 80.0% (n = 100) of patients, followed by diabetes mellitus (46.4%; n = 58), hyperlipidemia (24.8%; n = 31), Alzheimer's disease/dementia (25.6%; n = 32), cerebrovascular disease (23.2%; n = 29), arrhythmia (16.0%; n = 20), and heart failure (16.8%; n = 21). Among respiratory diseases, COPD was present in 19.2% (n = 24) and asthma in 8.0% (n = 10). Overall, these findings indicate a high burden of chronic comorbidities, particularly cardiovascular and neurological disorders.

Table 3 presents the distribution of pneumonia episodes before vaccination. The mean number of pneumonia cases was 1.68 ± 1.42 (range: 0–8), with a median of 1.0. Overall, 18.4% (n = 23) of the patients had no history of pneumonia, whereas 64.0% (n = 80) had experienced pneumonia managed on an outpatient basis. Additionally, 10.4% (n = 13) had both outpatient and hospitalization-requiring pneumonia, and 7.2% (n = 9) had pneumonia requiring hospitalization only. Before vaccination, 17.6% (n = 22) of patients had been hospitalized due to pneumonia.

Table 4 summarizes the distribution of pneumonia episodes after vaccination. The mean number of pneumonia cases was 0.44 ± 0.66 (range: 0–3), with a median of 0.0. Following vaccination, 64.0% (n = 80) of patients did not develop pneumonia, 28.8% (n = 36) experienced outpatient-treated pneumonia, 3.2% (n = 4) had both outpatient and

Table 2. Distribution of chronic diseases observed in patients (n = 125).

Chronic diseases*	n	Responses (%)	Cases (%)
Hypertension	100	22.5	80
Diabetes Mellitus	58	13.1	46.4
Heart Failure	21	4.7	16.8
Coronary Artery Disease	10	2.3	8
Arrhythmia	20	4.5	16
Hyperlipidemia	31	7	24.8
COPD	24	5.4	19.2
Asthma	10	2.3	8
Chronic Kidney Disease	14	3.2	11.2
Cerebrovascular Disease	29	6.5	23.2
Alzheimer's Disease/Dementia	32	7.2	25.6
Parkinson's Disease	6	1.4	4.8
Epilepsy	9	2	7.2
Depression	4	0.9	3.2
Rheumatologic Diseases (RA, AS, SLE)	6	1.4	4.8
Osteoporosis	2	0.5	1.6
Urinary Incontinence	11	2.5	8.8
Cancers (colon, breast, lung, stomach)	9	2	7.2
Other Rare Diagnoses	20	4.5	16
Total	444	100	355.2

n = Number, = Frequency. *Since multiple responses were allowed, the total n exceeds the sample size.

hospitalization-requiring pneumonia, and 4.0% (n = 5) had pneumonia requiring hospitalization only. Regarding post-vaccination hospitalizations, 92.8% (n = 116) of patients were not admitted, while 7.2% (n = 9) required hospitalization.

Table 5 presents a significant reduction in pneumonia episodes after vaccination. The mean

number of pneumonia cases decreased from 1.68 ± 1.42 before vaccination to 0.44 ± 0.66 afterward, and this difference was statistically significant ($p < 0.001$). The median number declined from 1.0 (IQR = 1.0) to 0.0 (IQR = 1.0). Additionally, the number of patients who experienced pneumonia episodes significantly decreased from 102 (81.6%)

Table 3. Characteristics of patients regarding pneumonia and hospitalization before vaccination (n = 125).

Variables		
Numbers of pneumonias (pre-vaccine) Mean $\pm$ SD	1.68 $\pm$ 1.42	
	n	%
Pneumonia status (pre-vaccine)		
No Pneumonia	23	18.4
Outpatient	80	64.0
Outpatient + Hospitalization	13	10.4
Hospitalization	9	7.2
Hospitalization (pre-vaccine)		
No	103	82.4
Yes	22	17.6

n = Number, = Frequency, Mean = Average, SD = Standard Deviation.

Table 4. Post-vaccination pneumonia and hospitalization characteristics of patients (n = 125).

Variables		
Numbers of pneumonias (post-vaccine) Mean $\pm$ SD	0.44 $\pm$ 0.66	
	n	%
Pneumonia status (post-vaccine)		
No Pneumonia	80	64.0
Outpatient	36	28.8
Outpatient + Hospitalization	4	3.2
Hospitalization	5	4.0
Hospitalization (post-vaccine)		
No	116	92.8
Yes	9	7.2

n = Number, = Frequency, Mean = Average, SD = Standard Deviation.

Table 5. Comparison of the number of pneumonia episodes before and after vaccination (n = 125).

Variables	Pre-vaccine	Post-vaccine	p
Patients with Pneumonia episodes, n(%)	102(81.6)	45(36.0)	
Numbers of Pneumonia, Mean $\pm$ SD	1.68 $\pm$ 1.42	0.44 $\pm$ 0.66	<0.001
Numbers of Pneumonia, Median (IQR)	1.0 (1.0)	0.0 (1.0)	

Wilcoxon Signed Ranks Test, $p < 0.05$. According to the mean values, a 73.5% reduction in pneumonia frequency after vaccination was calculated (Reduction (%) = [(Pre-vaccination mean - Post-vaccination mean) / Pre-vaccination mean] $\times$ 100).

before vaccination to 45 (36%) afterward. Overall, the frequency of pneumonia decreased by approximately 73.5% following vaccination.

The comparison of pneumonia cases and hospitalizations before and after vaccination was performed using the McNemar test (Table 6). Among the 102 patients who had pneumonia prior to vaccination, 62 (60.8%) did not experience recurrence afterward, while pneumonia developed in 5 (21.7%) of the 23 patients without a previous history. This decrease was statistically significant ($p < 0.001$), with a matched odds ratio of 12.40 (95% CI: 4.99–30.84), corresponding to markedly lower odds of pneumonia in the post-vaccination period; because of the observational design, this should not be read as a causal risk reduction. Regarding hospitalizations, 20 of the 22 patients (90.9%) who had been hospitalized previously did not require readmission, whereas 7 of 103 patients (6.8%) without prior hospitalization were admitted later. This difference was also significant ($p = 0.019$). The matched odds ratio was 2.86 (95% CI: 1.21–6.76), suggesting that the

odds of hospitalization decreased nearly threefold post-vaccination. Overall, all variables showed OR values greater than 1, confirming a statistically significant decline in both pneumonia incidence and hospitalization frequency after vaccination.

In Table 7, patients who developed pneumonia after vaccination ($n = 45$) and those who did not ($n = 80$) were compared in terms of clinical characteristics. The mean number of comorbidities was 3.45 ± 1.52 in patients without pneumonia and 3.62 ± 1.62 in those with pneumonia, and this difference was not statistically significant ($p = 0.610$). Regarding COPD, in the non-pneumonia group, 70 (87.5%) patients did not have COPD, while 10 (12.5%) did; in the pneumonia group, 31 (68.9%) patients did not have COPD, whereas 14 (31.1%) did. The difference between the two groups was statistically significant ($p = 0.011$), indicating that despite the overall protective effect of vaccination, patients with COPD continued to have a higher risk of developing pneumonia compared to those without COPD.

Table 6. Comparison of patients' pneumonia and hospitalization status before and after vaccination ($n = 125$).

Post-Vaccination Pneumonia	Pre-Vacc. No ($n=23$)	Pre-Vacc. Yes ($n=102$)	p	Matched OR (95% CI)
No ($n=80$)	18 (78.3)	62 (60.8)	<0.001	12.40 (4.99–30.84)
Yes ($n=45$)	5 (21.7)	40 (39.2)		
Post-Vaccination Hospitalization	Pre-Vacc. No ($n=103$)	Pre-Vacc. Yes ($n=22$)		
No ($n=116$)	96 (93.2)	20 (90.9)	0.019	2.86 (1.21–6.76)
Yes ($n=9$)	7 (6.8)	2 (9.1)		

McNemar test, $p < 0.05$. Values are n (%).

Table 7. Comparison of clinical characteristics of patients according to post-vaccination pneumonia status ($n = 125$).

Variables	No pneumonia ($n=80$)	Pneumonia ($n=45$)	p
Numbers of Comorbidities, Mean $\pm$ SD	3.45 $\pm$ 1.52	3.62 $\pm$ 1.62	0.610a
Numbers of Comorbidities, Median (IQR)	3.5 (3.0)	4.0 (3.0)	
COPD, n (%)			
No	70 (87.5)	31 (68.9)	0.011b
Yes	10 (12.5)	14 (31.1)	

a = Mann-Whitney U test, b = Pearson Chi-Square test.

Discussion

A significant reduction in pneumonia frequency was observed following vaccination in the present study population. Among the 125 patients analyzed, only 23 (18.4%) had never experienced pneumonia before vaccination, whereas after vaccination, the number of patients without pneumonia increased to 80 (64%). The mean number of pneumonia episodes decreased from 1.68 to 0.44, corresponding to an approximately 73.5% reduction, which was statistically significant. When compared with the literature, the CAPiTA study conducted in the Netherlands reported that PCV13 reduced pneumococcal pneumonia caused by vaccine serotypes by 45.56% and provided 75% protection against invasive pneumococcal disease.^[16]

Another study found that PCV13 provided 61.5% protection against invasive pneumococcal diseases caused by all PCV13 serotypes, and although the effectiveness was lower against more resistant serotypes such as serotype 3 (46.3%), it still demonstrated a protective effect.^[17] The findings of the present study are consistent with these results.

Hospitalizations following pneumonia episodes significantly increase morbidity, particularly in older adults and those with multiple comorbidities, and impose a financial burden on healthcare systems.^[18] Before vaccination, 22 of the 125 patients (17.6%) in this study were hospitalized due to pneumonia, whereas after vaccination, this number decreased to 9 (7.2%), representing a statistically significant reduction, indicating a measurable protective effect of vaccination. Similar findings have been reported in the literature. In Taiwan, Tsai et al. reported a 60% reduction in pneumonia-related hospitalizations among older adults vaccinated with PPV23 under the national immunization program.^[19] In a large U.S. cohort study of individuals aged ≥ 65 years, Hsiao et al. found a significant 10% decrease in all-

cause pneumonia-related hospitalizations and a 9.4% reduction in lower respiratory tract infection hospitalizations following PCV13 vaccination.^[20] In Italy, Baldo et al. reported that one-year survival rates among individuals aged ≥ 65 years hospitalized for community-acquired pneumonia were 83.6% in the unvaccinated group, 85.9% in the PPV23 group, and 89.3% in the PCV13 group.^[21] Therefore, our findings are consistent with studies suggesting that pneumococcal vaccination in comparable populations is associated with lower pneumonia frequency and fewer hospitalizations.

Although the patients in our study had a mean of 3.5 chronic diseases, no significant correlation was found between the number of comorbidities and the frequency of pneumonia. However, the literature reports varying results on this issue. In a population-based cohort study conducted by Ochoa-Gondar et al. in Spain among individuals aged ≥ 50 years, the incidence of pneumococcal pneumonia increased progressively with the number of comorbidities: 42.1 per 100,000 person-years in those with no comorbidities, 89.9 in those with one, 201.1 in those with two, 350.9 in those with three, 594.3 in those with four, and 761.2 in those with five or more. These findings indicate that as the comorbidity burden increases, the risk of developing pneumococcal pneumonia rises proportionally, and that individuals with multiple diseases should be prioritized for vaccination.^[22] Similarly, in a retrospective cohort study conducted by Campling et al. in the United Kingdom, individuals with comorbid diseases were shown to have a significantly higher likelihood of developing community-acquired pneumonia requiring hospitalization compared to those without underlying conditions. The risk of pneumonia was markedly higher among individuals with chronic respiratory, cardiac, hepatic, and renal diseases as well as diabetes; the odds ratios ranged from 1.18 for diabetes up to 5.48 for chronic respiratory disease. These findings demonstrate that the presence of comorbid diseases has a strong impact

on pneumonia development.^[23] It is plausible that the vaccine reduced pneumonia incidence across all comorbidity groups, thereby diminishing any observable association. Additionally, since all patients had at least one chronic disease, the absence of a non-comorbid control group may have limited the ability to distinguish differences in pneumonia risk related to comorbidity status. Therefore, although our study did not identify a statistically significant relationship, existing evidence supporting comorbidity as an independent risk factor must be acknowledged, and these patient groups should remain a priority in vaccination programs.

Chronic obstructive pulmonary disease (COPD) was present in 24 of the 125 patients (19.2%) included in the study. The presence of COPD was found to be more common among those who developed pneumonia after vaccination (12.5% in patients without pneumonia vs. 31.1% in those with pneumonia), and this difference was statistically significant. However, the literature presents varying results on this issue. Ignatova et al. reported that the PCV13 vaccine significantly reduced the incidence of community-acquired pneumonia among COPD patients in a cohort of 483 males, with lower rates of pneumonia, exacerbations, and hospitalizations observed over a ten-year follow-up period compared to unvaccinated individuals. Moreover, higher survival rates were reported in the vaccinated group.^[24] Likewise, Walters et al., in a Cochrane systematic review, found that the likelihood of developing community-acquired pneumonia was significantly lower in vaccinated COPD patients compared to unvaccinated individuals, although no significant difference was observed for pneumococcal pneumonia specifically.^[25] In contrast, Granger et al. concluded that evidence from randomized controlled trials did not demonstrate a significant impact of pneumococcal vaccination on morbidity or mortality among

COPD patients.^[26] These differing results suggest that while COPD remains a strong risk factor for the development of pneumonia, vaccination can reduce, but not completely eliminate this risk. In our study and in some others, the persistence of higher pneumonia rates among COPD patients even after vaccination may reflect the advanced pulmonary impairment in this population; however, the protective effect of vaccination remains evident.

As a protein-conjugate vaccine, PCV13 elicits a T-cell-dependent immune response with immunological memory and higher, more durable opsonophagocytic antibody titers than plain polysaccharide vaccines.^[27] This advantage is particularly relevant in frail older adults, in whom vaccine responses are attenuated by immunosenescence.^[28] By reducing nasopharyngeal carriage of vaccine-type pneumococci, conjugate vaccination may also limit the reservoir for mucosal spread and subsequent lower-respiratory infection.^[27] In a home-care population marked by multimorbidity, impaired mucociliary clearance, swallowing dysfunction, and recurrent antibiotic exposure, these mechanisms plausibly contribute to the lower pneumonia burden observed after vaccination, although the observational design precludes attributing the effect solely to the vaccine.

All patients received PCV13, the conjugate vaccine available through the national program during the study period. Higher-valency conjugate vaccines—PCV15 and PCV20—have since been licensed, and current guidance now recommends these broader-coverage conjugate vaccines (PCV20 alone, or PCV15 followed by PPV23) for older and at-risk adults to expand serotype coverage, including serotypes linked to residual disease and antimicrobial resistance.^[29] As serotype distribution shifts under vaccine pressure, the protection observed here with PCV13 may be further improved by these broader-coverage

vaccines; confirming this in home-care populations is an important direction for future work.

A distinctive feature of this study is that vaccination was delivered in the patient's home. For individuals with limited mobility, cognitive impairment, or caregiver dependence, in-clinic immunization is a substantial barrier; home delivery removes transport needs, reduces caregiver burden and exposure to crowded healthcare settings, and can be integrated into routine home-care visits—potentially improving coverage and timeliness. Although we did not perform a formal economic evaluation, the averted pneumonia episodes and hospitalizations suggest that home-based pneumococcal vaccination may be cost-effective in this high-risk group. From a health-planning perspective, embedding immunization within home-health programs offers a practical, scalable model for reaching an otherwise under-vaccinated population.

Regarding the evaluation of our findings, several limitations of this study should be noted. First, it was a retrospective, single-center study with a relatively small sample, which limits generalizability. Second, the uncontrolled pre-post design without a concurrent control group precludes causal inference; the observed reduction cannot be attributed to vaccination alone. Third, because patients are often vaccinated after a recent infection, the elevated pre-vaccination episode counts may partly reflect regression to the mean and confounding by indication, both of which would exaggerate an apparent post-vaccination decline. Fourth, the pre- and post-vaccination observation windows were of unequal length, which may bias the comparison of raw episode counts. Fifth, pneumonia was defined from documented clinical (and, where available, radiological) diagnoses rather than uniform microbiological confirmation, introducing possible misclassification and dependence on record completeness. Sixth, all patients had at

least one chronic disease, so no non-comorbid comparator was available. Finally, no a priori power calculation was performed. Prospective, multicenter studies with defined, equal follow-up periods and control groups are needed to confirm these findings.

In conclusion, home health care services represent an essential component of preventive medicine for individuals with multiple chronic conditions and limited access to healthcare facilities. This study is among the few field-based investigations evaluating the clinical effectiveness of pneumococcal vaccination in this population. Our findings suggest an association between pneumococcal vaccination and lower pneumonia frequency and pneumonia-related hospitalizations among patients receiving home health care services. These results highlight the clinical importance of maintaining and expanding pneumococcal immunization among frail individuals within home health care programs. Moreover, the findings suggest that vaccination practices implemented through home health care units can serve as an effective, applicable model in similar settings, contributing to public health improvement. Future prospective, multicenter studies are warranted to further assess the long-term effectiveness of pneumococcal vaccination in patients receiving home health care services.

Ethical approval

This study has been approved by the İstanbul Prof. Dr. Cemil Taşcıoğlu City Hospital Ethics Committee (approval date: 02.12.2024, number: 271). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: OB, AB; data collection: OB; analysis and interpretation of

results: OB, AB, SA; draft manuscript preparation: OB, AB, SA. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest to disclose.

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Status of family planning methods usage and associated factors in Rize

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ABSTRACT

Objective: Family planning is the prevention of unintended pregnancies and the avoidance of excessive fertility. Arranging the interval between pregnancies is one of the basic requirements for a healthy pregnancy and postpartum period. The family medicine practice, implemented in Türkiye since the early 2000s, addresses this fundamental need. Our study was conducted to determine the prevalence of family planning methods, sociodemographic characteristics, and the relationship between pregnancy history and family planning method use among women aged 18-49 living in the central district of Rize.

Methods: Our descriptive cross-sectional study was conducted between 2022 and 2023 and included 413 women aged 18-49 who were registered at four Family Health Centers in the central district of Rize. Data were collected retrospectively from the Family Medicine Information System (FMIS) by the researchers involved in the study. In univariate analyses, Mann-Whitney U, Kruskal-Wallis, and Chi-square tests were used. To identify the primary factors associated with modern method use, age over 35, and the number of pregnancies were included in the analysis. Odds ratios (OR) with 95% confidence intervals (CI) were calculated.

Results: In our study, 86.9% of individuals (n = 359) used family planning methods. Among those who used a method, 57.7% (n=207) used only modern methods, 25.9% (n=93) used only traditional methods, and 16.4% (n=59) used both modern and traditional methods. When assessing the relationships among educational status, employment status, smoking, and method use, only modern method use was significantly higher than the others (p=0.001). When evaluating the relationship between gravidity and the number of pregnancies by method-use status, the mean gravidity among users of modern methods or both modern and traditional methods was significantly higher than among those using only traditional methods (p=0.049). The primary variables associated with method use were identified as being a non-smoker, not having a child younger than two years of age, having no history of abortion, and the number of pregnancies.

Conclusion: The study reveals a high rate of family planning method use in the central district of Rize province; however, adoption of modern methods remains an area requiring further development.

Keywords: Family planning services, contraception, primary health care, reproductive health service

Introduction

Family planning is a fundamental public health service that enables individuals to have children at the desired time and in the desired number.^[1] It plays a critical role in preventing unintended pregnancies and unsafe abortions, reducing maternal mortality, and promoting women's reproductive rights. Increased contraceptive use has been associated with lower maternal mortality, while adequate birth spacing contributes to reductions in infant and child mortality.^[2] However, approximately 40% of pregnancies worldwide remain unintended, indicating a substantial unmet need for family planning services.^[1-3]

The use of contraceptive methods is influenced by multiple factors, including age, education, marital status, reproductive history, cultural norms, religious beliefs, family pressure, access to healthcare, and healthcare providers' attitudes.^[4-8] In addition to health benefits, contraception supports women's education, employment, and long-term economic empowerment.^[9] For this reason, improving access to family planning services is included among the targets of the United Nations Sustainable Development Goals for 2030.^[10,11]

Globally, in 2019, 1.1 billion women aged 15–49 were estimated to need family planning; 842 million were using modern methods and 80 million traditional methods.^[10] According to 2018 Turkey Demographic and Health Survey (TDHS), 70% of married women aged 15–49 use a contraceptive method, including 49% modern and 21% traditional methods, while the unmet need for family planning is 12%.^[12] According to Turkish Statistical Institute (TÜİK) data, the overall fertility rate decreased from 82.7‰ in 2001 to 49.5‰ in 2024.^[13] In the study conducted by Kızmaz and colleagues, 74.5% of the participants were using some method, and the most frequently

used method was condoms at 38.2%.^[14] Although the global use of modern methods has increased, marked regional differences persist.^[10,15]

Family Health Centers (FHCs), which provide primary healthcare services in Türkiye, have an important role in family planning through counseling and method provision. Local studies are valuable for understanding contraceptive behaviors and associated factors; however, research from the Eastern Black Sea region remains limited.^[16] Therefore, this study aimed to evaluate family planning method use, the distribution of modern and traditional methods, and related sociodemographic and fertility characteristics among women aged 18–49 registered at FHCs in the central district of Rize province.

Materials and Methods

This descriptive cross-sectional study was conducted between 2022 and 2023 and included 413 women aged 18–49 who were registered at four FHCs in the central district of Rize. The sample size was calculated using G*Power 3.1 software. Assuming a chi-square test with an effect size (Cohen's *w*) of 0.29, an alpha level of 0.05, a power of 0.99, and 3 degrees of freedom, the minimum required sample size was calculated as 280 participants.^[17] The data were collected by the researchers involved in the study through retrospective file screening via the FMIS. Using FMIS, informations were obtained regarding the patient's age, gravidity, history of abortion or stillbirth, employment status (unemployed, employed, unknown), educational status (illiterate, primary–secondary school, high school, university, unknown), smoking status (non-smoker, smoker, former smoker, unknown), place of residence (rural, urban, unknown), and whether the patient had a child younger than two years of age. For individuals whose family planning status was assessed, it was determined whether they used

any family planning method, and if so, whether the method was traditional or modern. The calendar method, withdrawal, breastfeeding, and vaginal douching were classified as traditional methods. Contraceptive methods were categorized based on the World Health Organization (WHO) classification system. Within this framework, lactational amenorrhea method (LAM) is included under traditional (natural) methods unless all three eligibility criteria are strictly fulfilled (exclusive breastfeeding, amenorrhea, and infant age <6 months).^[18] Modern methods were defined as intrauterine devices, condoms, tubal ligation, vasectomy, subdermal implants, oral contraceptive pills, injections, spermicides, and diaphragm use. The contraceptive methods used by participants were categorized into three groups: traditional-only, modern-only, and combined (modern + traditional). Women aged 18–49 with known method-use status were included in the study. Data entry and analysis were performed using SPSS 23.0. Descriptive data were presented as numbers, percentages, and means. The normality of the variable distributions was assessed using the Kolmogorov–Smirnov test. In the univariate analyses, family planning method-use characteristics and fertility characteristics were compared with the study variables. It was found that the continuous and discrete numerical data did not follow a normal distribution. Mann–Whitney U, Kruskal–Wallis, and chi-square tests were used in the univariate analyses. Bonferroni correction was applied in multiple comparisons to identify the group responsible for the difference. The level of significance was set at 0.05. Data classified as “unknown” were presented descriptively but excluded from inferential analyses. Independent variables identified as associated with family planning and modern method use in the univariate analyses were evaluated using logistic regression. To identify the primary factors associated with family planning method use, the model included

age ≥ 35 years, non-smoking status, number of pregnancies, absence of abortion history, and not having a child younger than two years of age. The number of pregnancies was entered into the logistic regression model as a continuous count variable. Odds ratios (OR) with 95% confidence intervals were calculated. Ethical approval for the study was granted by the Clinical Research Ethics Committee of the Recep Tayyip Erdoğan University School of Medicine.

Results

A total of 86.9% of the participants ($n = 359$) were using a family planning method. Among those who used a method, 57.7% used only modern methods, 25.9% used only traditional methods, and 16.4% used both modern and traditional methods (Figure 1).

Among traditional methods, withdrawal was the most commonly used, preferred by 25.6% of participants ($n = 92$). The breastfeeding method was reported by 0.3% ($n = 1$), and the calendar method was not used by any participant ($n = 0$). Among modern methods, the most widely used was the condom, reported by 37.9% of participants ($n = 136$). This was followed by intrauterine devices (IUDs) at 7.8% ($n = 28$), tubal ligation at 5.0% ($n = 18$), oral contraceptives (OCPs) at 3.9% ($n = 14$), and injections at 2.2% ($n = 8$). Vasectomy, subdermal implants, and combined condom + OCP use were each reported by 0.3% of participants ($n = 1$). Spermicide and diaphragm methods were not used by any participant ($n = 0$). Among the combined use of modern and traditional methods, the most common combination was condom + withdrawal, reported by 16.1% of participants ($n = 58$). In addition, only one participant (0.3%, $n = 1$) reported using the combination of condom + injection + withdrawal. Participants' method-use rates were not associated with age group, educational level, place of residence, employment

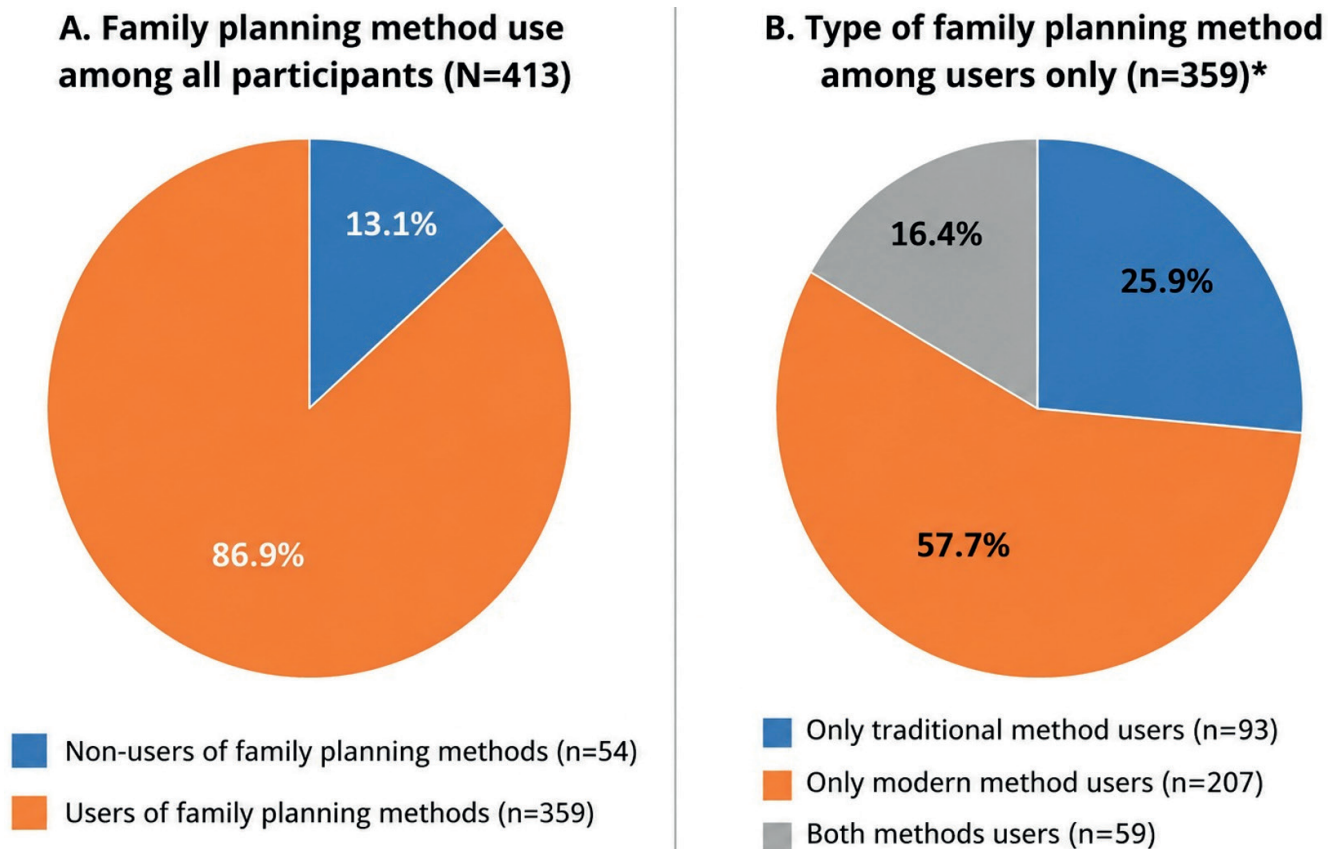


Figure 1. The use of family planning methods among the participants (A) and the distribution of family planning method users by method type (B).

*Percentages are calculated among family planning method users only (n=359).

status, or smoking status. No statistically significant association was observed between gravidity level and contraceptive method use ($p = 0.127$). When contraceptive use was assessed according to fertility characteristics, an increase in the frequency of method use was observed with the rising number of pregnancies. The prevalence of contraceptive use among women with zero pregnancies (66.7%) was significantly lower than among those with one or more pregnancies ($p = 0.001$). Among participants with a history of abortion, the contraceptive use rate was 77.4%, compared to 88.6% among those without; this difference was found to be statistically significant ($p = 0.016$). No significant association was identified

between a history of stillbirth and contraceptive use ($p = 0.793$). Contraceptive use was 81.6% among participants with a child under the age of two and 88.7% among those without; however, this difference was not statistically significant ($p = 0.062$) (Table 1).

When the relationship between the category of contraceptive method used and individuals' educational status, employment status, and smoking habits were examined, the combined use of modern and traditional methods was found to be significantly more common among smokers. ($p=0.001$). The relationship between mean gravidity, number of pregnancies, and the category of contraceptive method was found to

Table 1. Relationship between contraceptive use status and demographic characteristics.

		Method users n (%)	Non-users n (%)	Total n (%)	p value*
Age group (years)	15-24	24 (80.0)	6 (20.0)	30 (7.3)	p=0.078
	25-34	187 (84.6)	34 (15.4)	221 (53.5)	
	35 and above	148 (91.4)	14 (8.6)	162 (39.2)	
Educational status	Illiterate	4 (100.0)	0 (0.0)	4 (1.0)	p=0.933
	Primary-middle school	85 (87.6)	12 (12.4)	97 (23.5)	
	High school	104 (87.4)	15 (12.6)	119 (28.8)	
	University	52 (86.7)	8 (13.3)	60 (14.5)	
	Unknown	114 (85.7)	19 (14.3)	133 (32.2)	
Employment status	Employed	69 (88.5)	9 (11.5)	78 (18.9)	p=0.803
	Unemployed	137 (85.6)	23 (14.4)	160 (38.7)	
	Unknown	153 (87.4)	22 (12.6)	175 (42.4)	
Smoking status	Nonsmoker-Quit	292 (89.0)	36 (11.0)	328 (79.4)	p=0.051
	Smoker	43 (79.6)	11 (20.4)	54 (13.1)	
Residence	Rural	29 (85.3)	5 (14.7)	34 (8.2)	p=0.768
	Urban	330 (87.1)	49 (12.9)	379 (91.8)	
Gravidity	0	20 (76.9)	6 (23.1)	26 (6.3)	p=0.127
	1	110 (82.7)	23 (17.3)	133 (32.2)	
	2	130 (90.9)	13 (9.1)	143 (34.6)	
	3	57 (87.7)	8 (12.3)	65 (15.7)	
	4 and above	42 (91.3)	4 (8.7)	46 (11.1)	
Number of pregnancies	0 ^a	24 (66.7)	12 (33.3)	36 (8.7)	p=0.001
	1	121 (84.0)	23 (16.0)	144 (34.9)	
	2	133 (90.5)	14 (9.5)	147 (35.6)	
	3	56 (93.3)	4 (6.7)	60 (14.6)	
	4 and above	25 (96.2)	1 (3.8)	26 (6.3)	
History of abortion	Yes	48 (77.4)	14 (22.6)	62 (15.0)	p=0.016
	No	311 (88.6)	40 (11.4)	351 (85.0)	
History of stillbirth	Yes	5 (83.3)	1 (16.7)	6 (1.5)	p=0.793
	No	354 (87.0)	53 (13.0)	407 (98.5)	
Children under 2 years	Yes	84 (81.6)	19 (18.4)	103 (24.9)	p=0.062
	No	275 (88.7)	35 (11.3)	310 (75.1)	
Total		359 (86.9)	54 (13.1)	413 (100.0)	

^a Bonferroni correction: indicates the group contributing to the difference.

*Chi-square.

be statistically significant ($p = 0.033$ and $p = 0.043$, respectively). The observed differences were primarily attributable to the frequency of women with a gravidity of 3 and those with 3 pregnancies in the “both modern and traditional methods” category, which differed from the expected frequencies (Table 2).

When method use was evaluated according to modern and traditional subcategories, condom use was identified as the most frequently utilized method, with a prevalence of 37.9%. When mean gravidity of the participants and number of pregnancies were examined in relation to method use, participants who used a contraceptive

method had significantly higher mean gravidity and number of pregnancies ($p=0.026$ and $p=0.001$, respectively). As expected, increasing age was also associated with a significant rise in mean gravidity and number of pregnancies ($p=0.001$). Educational and employment statuses were also evaluated. Illiterate individuals had higher mean gravidity and parity, while employed individuals had lower mean gravidity and parity ($p=0.001$) (Table 3). Method use was 2.3 times higher among

non-smokers compared with smokers ($p=0.040$; 95% CI: 1.04–5.11), 2.0 times higher among those without a child under two years of age ($p=0.046$; 95% CI: 1.01–3.95), and 3.9 times higher among those without a history of abortion ($p=0.001$; 95% CI: 1.72–8.85). Additionally, each one-unit increase in the number of pregnancies was associated with a 2.2-fold increase in method use ($p=0.001$; 95% CI: 1.49–3.24) (Table 4).

Table 2. Relationship between method group and demographic characteristics.

Demographic characteristics		Modern methods only n (%)	Traditional methods only n (%)	Both modern and traditional methods n (%)	Total n (%)	p value*
Age group (years)	15-24	16 (66.7)	5 (20.8)	3 (12.5)	24 (6.7)	$p=0.457$
	25-34	108 (57.8)	53 (28.3)	26 (13.9)	187 (52.1)	
	35 and above	83 (56.1)	35 (23.6)	30 (20.3)	148 (41.2)	
Educational status	Illiterate	3 (75.0)	0 (0.0)	1 (25.0)	4 (1.1)	$p=0.327$
	Primary-Middle school	52 (61.2)	26 (30.6)	7 (8.2)	85 (23.7)	
	High school	63 (60.6)	29 (27.9)	12 (11.5)	104 (29.0)	
	University	33 (63.5)	18 (34.6)	1 (1.9)	52 (14.5)	
Employment status	Employed	48 (69.6)	18 (26.1)	3 (4.3)	69 (19.2)	$p=0.367$
	Unemployed	82 (59.9)	45 (32.8)	10 (7.3)	137 (38.2)	
Smoking	Non-smoker/Quit	175 (59.9)	83 (28.4)	34 (11.6)	292 (81.3)	$p=0.001$
	Smoker	18 (41.9)	8 (18.6)	17 ^a (39.5)	43 (12.0)	
Residence	Rural	13 (44.8)	9 (31.0)	7 (24.1)	29 (8.1)	$p=0.307$
	Urban	194 (58.8)	84 (25.5)	52 (15.8)	330 (91.9)	
Gravidity	0	11 (55.0)	9 (45.0)	0 ^a (0.0)	20 (5.6)	$p=0.033$
	1	61 (55.5)	31 (28.2)	18 (16.4)	110 (30.6)	
	2	72 (55.4)	37 (28.5)	21 (16.2)	130 (36.2)	
	3	36 (63.2)	6 (10.5)	15 ^b (26.3)	57 (15.9)	
	4 and above	27 (64.3)	10 (23.8)	5 (11.9)	42 (11.7)	
Number of pregnancies	0	14 (58.3)	10 (41.7)	0 ^a (0.0)	24 (6.7)	$p=0.043$
	1	69 (57.0)	33 (27.3)	19 (15.7)	121 (33.7)	
	2	72 (54.1)	36 (27.1)	25 (18.8)	133 (37.0)	
	3	34 (60.7)	8 (14.3)	14 ^b (25.0)	56 (15.6)	
	4 and above	18 (72.0)	6 (24.0)	1 (4.0)	25 (7.0)	
History of abortion	Yes	32 (66.7)	8 (16.7)	8 (16.7)	48 (13.4)	$p=0.272$
	No	175 (56.3)	85 (27.3)	51 (16.4)	311 (86.6)	
History of stillbirth	Yes	2 (40.0)	2 (40.0)	1 (20.0)	5 (1.4)	$p=0.704$
	No	205 (57.9)	91 (25.7)	58 (16.4)	354 (98.6)	
Children under 2 years	Yes	50 (59.5)	22 (26.2)	12 (14.3)	84 (23.4)	$p=0.828$
	No	157 (57.1)	71 (25.8)	47 (17.1)	275 (76.6)	
Total		207 (57.7)	93 (25.9)	59 (16.4)	359 (100.0)	

^{a,b} Bonferroni correction: indicates the group contributing to the difference.

*Chi-square.

Table 3. The relationship between participants' gravidity, contraceptive method use, and sociodemographic characteristics.

Characteristics		n	Gravidity mean±sd (median)	p value	Number of pregnancies mean±sd (median)	p value
Family planning use	Using	359	2.1±1.3 (2.0)	p=0.026*	1.8±1.1 (2.0)	p=0.001*
	Not using	54	1.6±1.1 (1.0)		1.2±1.0 (1.0)	
The methods Used	Modern	207	2.1±1.4 (2.0)	p=0.049**	1.9±1.1 (2.0)	p=0.094**
	Traditional	93	1.8±1.3 (2.0)		1.7±1.0 (2.0)	
	Modern+Traditional	59	2.2±1.1 (2.0)		1.9±0.8 (2.0)	
Age group	15-24	30	1.3±1.0 (1.0)	p=0.001**	1.1±0.8 (1.0)	p=0.001**
	25-34	221	1.6±1.0 (1.0)		1.5±0.8 (1.0)	
	35 and above	162	2.7±1.5 (2.0)		2.3±1.2 (2.0)	
Educational status	Illiterate	4	4.5±3.9 (3.5)	p=0.001**	3.3±2.6 (2.5)	p=0.001**
	Primary-middle school	97	2.6±1.4 (2.0)		2.3±1.2 (2.0)	
	High school	119	2.0±1.2 (2.0)		1.8±0.9 (2.0)	
	University	60	1.6±1.1 (1.0)		1.4±0.9 (1.0)	
Employment status	Employed	78	1.8±1.1 (2.0)	p=0.001**	1.7±1.1 (2.0)	p=0.013**
	Unemployed	160	2.3±1.4 (2.0)		2.0±1.1 (2.0)	
Smoking	Non-smoker/Quit	328	2.0±1.3 (2.0)	p=0.345**	1.8±1.1 (2.0)	p=0.510**
	Smoker	54	2.1±1.2 (2.0)		1.8±1.0 (2.0)	
Residence	Rural	34	2.2±1.3 (2.0)	p=0.396*	1.8±1.2 (2.0)	p=0.907*
	Urban	379	2.0±1.3 (2.0)		1.8±1.1 (2.0)	
History of abortion	Yes	62	3.6±1.5 (3.0)	p=0.001*	2.4±1.3 (2.0)	p=0.001*
	No	351	1.7±1.0 (2.0)		1.7±1.0 (2.0)	
History of stillbirth	Yes	6	3.5±2.2 (3.0)	p=0.043*	2.5±1.0 (2.5)	p=0.078*
	No	407	2.0±1.3 (2.0)		1.8±1.1 (2.0)	
Children under 2 years	Yes	103	1.8±1.0 (2.0)	p=0.089*	1.7±0.8 (1.0)	p=0.217*
	No	310	2.1±1.4 (2.0)		1.8±1.2 (2.0)	
Total		413	2.0 (1.0-3.0)		2.0 (1.0-2.0)	

* Mann Whitney U, **Kruskal-Wallis.

Table 4. Independent variables primarily associated with contraceptive method use (logistic regression).

	B	SE	Wald	p	OR	OR (95% CI)
Not smoking	0.83	0.41	4.20	0.040	2.30	1.04-5.11
Having no child under two years of age	0.69	0.33	3.97	0.046	2.00	1.01-3.95
No history of abortion	1.34	0.39	11.61	0.001	3.90	1.72-8.85
Number of pregnancies*	0.79	0.19	15.94	0.001	2.20	1.49-3.24
Age over 35 years	0.24	0.40	0.35	0.552	1.27	0.58-2.78

SE: Standard error; OR: Odds ratio; CI: Confidence interval.

*Continuous count variable.

Discussion

In this study, the prevalence of family planning method use among women aged 18–49 in the central district of Rize province was 86.9%, a rate higher than the national average in Türkiye (70%) and exceeding that reported in several previous regional studies.^[12,19-21] This finding indicates that primary healthcare services play an effective role in family planning and that Family Health Center (FHC)-based service delivery yields positive outcomes at the regional level.

When method types were examined, the prevalence of modern methods was 57.7%, indicating that modern methods were more widely used compared to traditional methods.

When interpreted in the context of national evidence, the contraceptive prevalence observed in this study is slightly higher than the national average reported in the 2018 Türkiye Demographic and Health Survey (TDHS), which indicated that 70% of currently married women use any contraceptive method, with modern method use at approximately 49% [TDHS 2018].^[12] In comparison, the modern method use in the present study (57.7%) suggests a relatively more advanced transition toward modern contraceptive uptake in this region. This may be attributable to the fact that the study population consisted of women receiving services in a centrally located healthcare facility. It may also reflect discrepancies between registry-based data and the participants' current contraceptive status.

Data from Türkiye and worldwide similarly demonstrate an increasing preference for modern methods.^[10,15] The most commonly used modern method was the condom (37.9%), while the most frequently used traditional method was withdrawal (25.6%). Previous national studies have reported a similar distribution, which may be explained by the condom's easy accessibility, low cost, and user-friendliness.^[19-21] The widespread

use of the withdrawal method may be attributed to cultural habits, its simplicity, and its free cost. However, considering the high failure rates associated with traditional methods, this pattern is known to pose risks to reproductive health.^[2,22]

In our study, method utilization rates did not show a significant association with age, education level, employment status, or place of residence. However, it is noteworthy that the use of modern methods was higher among non-smokers. In the literature, it has been reported that healthy lifestyle behaviors tend to cluster together and that contraceptive attitudes may be more favorable among individuals who do not smoke.^[23] This finding indicates that factors influencing the preference for modern methods are not only demographic but also behavioral. In the logistic regression analysis, the number of pregnancies was the strongest predictor of method use. Studies reporting that the need for family planning becomes more pronounced with increasing parity support this finding.^[20,24] It is expected that individuals approaching the completion of their childbearing, or who do not desire further childbearing, tend to prefer more effective and permanent methods. The finding that individuals with a history of abortion had significantly lower method use rates is an important result. In the literature, it has been reported that in the post-abortion period, factors such as lack of information, insufficient counseling, a desire for a new pregnancy within a short interval, or difficulties in accessing modern methods may contribute to this situation.^[5,22] This finding indicates the need to strengthen post-abortion family planning counseling. The lower rate of method use among individuals with a child under the age of two may be related to reliance on the contraceptive effect of breastfeeding during the postpartum period, perceptions of infertility, or delays in accessing healthcare facilities. Similar findings have also been reported in studies on postpartum family planning.^[22] Overall, our study shows that the use of modern

methods remains below the desired level, and that method preference is more closely associated with reproductive history and behavioral factors than with sociodemographic characteristics. In the literature, the multilevel factors influencing family planning preferences include levels of knowledge, cultural norms, partner influence, religious beliefs, healthcare providers' attitudes, and service delivery models.^[4-8,25-27] Therefore, family planning services need to be strengthened to focus not only on method provision but also on counseling, behavior change, and service access.

Limitations

Because our study was retrospective, it was not possible to assess participants' knowledge of the methods, the reasons for non-use, the determinants of their preferences, or the role of the spouse/partner in method choice. Women's satisfaction with the method and whether they switched methods could not be investigated. Some variables could not be evaluated for all participants due to missing data in the system. Furthermore, the data obtained using this method do not provide information about unmet family planning needs.

Conclusion

This study shows that the rate of family planning method use in the central district of Rize province is high; however, the use of modern methods remains an area that requires further improvement. Both overall contraceptive use and preference for modern methods increased markedly with increasing numbers of pregnancies. This finding indicates that reproductive history should be carefully considered in family planning counselling. The lower method use among women with a history of abortion suggests that this group may not be adequately benefiting from family planning services and highlights the need

to strengthen counseling services during the postpartum and post-abortion periods. To increase the use of modern methods, it is important to address knowledge gaps, improve access to these methods, and strengthen healthcare providers' counseling roles. Enhancing the accessibility and quality of family planning services is critically important for maintaining a healthy reproductive life cycle and strengthening women's health. The development of sustainable policies at national and regional levels, along with the expansion of knowledge, attitude, and behavior-based counseling services, will support progress in this field.

Ethical approval

This study has been approved by the Clinical Research Ethics Committee of the Recep Tayyip Erdoğan University School of Medicine (approval date 13.06.2024, number 2024/133). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: AYA, ÖG, ÖY, MÇ, AAMA; data collection: ÖG, ÖY, MÇ, AAMA; analysis and interpretation of results: AO, AYA; draft manuscript preparation: AYA, ÖG, ÖY, MÇ, AAMA, AO, CA. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest to disclose.

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Evaluation of folate insufficiency and associated factors: a retrospective cross-sectional study

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ABSTRACT

Objective: Although folate status has been widely studied, few studies have simultaneously evaluated multiple demographic, behavioral, and clinical factors in a single primary care population. This study aimed to determine the prevalence of folate insufficiency and evaluate the factors associated with this condition using routinely collected primary care data.

Methods: This retrospective cross-sectional study used electronic health records from adults registered at the Uludağ University Family Health Center who underwent serum folate measurement between January 1, 2020, and December 31, 2024. All eligible individuals with complete data were included in the final analysis (n = 995). Statistical analyses were performed using IBM SPSS Statistics version 28.00. A two-sided p-value of <0.05 was considered statistically significant.

Results: Of the 995 participants, 293 (29.4%) were male, and 702 (70.6%) were female; the mean age was 30.23 ± 12.92 years. Serum folate testing revealed insufficiency in 185 (18.6%) participants. In the multivariable model conducted among female participants, pregnancy complications (adjusted OR = 2.49, 95% CI: 1.34–3.60), allergic diseases (adjusted OR = 2.29, 95% CI: 1.19–3.31), genetic diseases (adjusted OR = 2.25, 95% CI: 1.29–3.54), cancer (adjusted OR = 1.81, 95% CI: 1.16–2.72), and non-pregnant status (adjusted OR = 1.70, 95% CI: 1.11–2.32) were independently associated with folate insufficiency.

Conclusion: Pregnancy complications, allergic diseases, genetic diseases, and cancer were associated with higher odds of folate insufficiency, whereas pregnant participants had lower odds than non-pregnant participants. The association with pregnancy status should be interpreted cautiously because data on folic acid supplementation and antenatal follow-up were unavailable. Family physicians should consider targeted folate assessment in patients with pregnancy complications and in individuals with relevant inflammatory, genetic, or oncological conditions.

Keywords: Folic acid, folate insufficiency, primary care

Introduction

Folic acid is a water-soluble B vitamin (vitamin B9) essential for DNA synthesis and cellular division. Folic acid, also known as folate or

vitamin B9, is a member of the B vitamin family and is a necessary cofactor for enzymes involved in DNA and RNA synthesis. More specifically, folic acid is required by the body for the synthesis of purines, pyrimidines, and methionine before

they are incorporated into DNA or protein. Folic acid is particularly important during phases of rapid cell division such as infancy, pregnancy, and erythropoiesis, and is a protective factor in cancer development. Because humans cannot synthesize folic acid endogenously, dietary supplementation is necessary to prevent deficiencies. Folic acid is found in green vegetables, beans, avocados, and some fruits. A supplementation of 1–5 mg of folic acid is recommended to prevent deficiency and a range of side effects associated with methotrexate (MTX) treatment, including mouth ulcers and gastrointestinal irritation. Folic acid is often prescribed as a supplement to individuals using these medications. Inadequate folate levels, particularly in women of childbearing age, can lead to a variety of health problems, including cardiovascular disease, megaloblastic anemia, cognitive impairments, and neural tube defects (NTDs). Folic acid is typically supplemented during pregnancy to prevent the development of NTDs and in people with alcoholism to prevent the development of neurological disorders.^[1] Folic acid is a functional food ingredient.^[2] Enriching the diet with folic acid is effective in reducing birth defects.^[3] It is neuroprotective, particularly in preventing neural tube defects and congenital anomalies. It has a positive effect on cancer cells.^[4-7]

In 2016, the World Health Organization published the “Comprehensive Antenatal Care (ANC) Guideline” as part of its recommendations to improve routine antenatal services and support a positive pregnancy experience.^[8]

Folic acid testing is performed in family medicine during general care and routine checkups. Diseases that cause folic acid insufficiency and other contributing factors should be identified, ensuring identified. Ensuring early diagnosis and treatment during the primary care process. A holistic approach that encompasses comprehensive and continuous care is crucial for preventing the consequences and complications

of folic acid insufficiency. Although the prevalence and clinical consequences of low folate status are well documented, few studies have simultaneously evaluated demographic, behavioral, pregnancy-related, and clinical factors in a single primary care population using routine electronic health records. Addressing this gap may help family physicians identify patient groups who could benefit from targeted assessment and preventive care.

We hypothesized, based on previous evidence, that folate insufficiency would be associated with demographic characteristics, lifestyle behaviors, pregnancy-related factors, and chronic clinical conditions among individuals attending a primary care family health center.

Materials and Methods

The primary objective of this study was to determine the prevalence of serum folate insufficiency and investigate its variation according to demographic, behavioral, pregnancy-related, and clinical characteristics among adults attending a family health center. The main research topic of this study can be described as determining the folic acid levels of individuals and investigating how folic acid levels differ according to individual characteristics. In this context, demographic characteristics, clinical conditions, biochemical measurements, and folic acid measurement data of patients who applied to the health center were obtained from records.

Descriptive analyses were performed to summarize the demographic, clinical, and laboratory characteristics of the study population. Continuous variables were presented as mean $\pm$ standard deviation, whereas categorical variables were summarized as frequencies and percentages.

Serum folate values were not evaluated as continuous variables in the primary analysis; participants were classified as having or not

having folate insufficiency according to the prespecified cutoff value. In summary, the study groups were examined with and without folic acid insufficiency. The study period included the COVID-19 pandemic, and the study population had a higher proportion of female participants. These sample characteristics were considered when interpreting the findings.

Of the 3,580 individuals initially screened, we excluded patients with missing folate measurements or incomplete key variables. The final complete-case analysis included all eligible patients with complete data ($n = 995$). Multiple imputation was not performed because the proportion of missing data was low and the dataset was retrospective.

Laboratory measurements

Obesity was defined as a body mass index ≥ 30 kg/m². Chronic disease was defined as at least one active chronic diagnosis documented in the electronic problem list or longitudinal clinical record. Allergic disease was defined as a documented allergic or atopic condition. Genetic disease was defined as a documented hereditary chromosomal or congenital genetic disorder. Pregnancy complications were defined as complications documented during the index pregnancy. Smoking and alcohol variables reflected current use documented at the index assessment. Because detailed diagnostic subcategories were not consistently available in the extracted electronic records, allergic diseases, genetic diseases, cancer, and pregnancy complications were evaluated as broad clinical categories.

Inclusion and exclusion criteria

Inclusion and exclusion criteria: Inclusion criteria comprised individuals aged ≥ 18 years who had at least one recorded serum folate measurement during the study period. Individuals receiving active treatments known to directly affect folate

metabolism (e.g., methotrexate, chemotherapy, or radiotherapy) were excluded. Chronic conditions such as hypertension, diabetes, allergic diseases, and cancer were not exclusion criteria, as these were evaluated as exposure variables within the analysis framework.

Study design and participants

This retrospective cross-sectional study used routinely collected electronic health record data from individuals registered at the Uludağ University Family Health Center. We evaluated adults who underwent serum folate measurement between January 1, 2020, and December 31, 2024. The minimum sample size was calculated as 385 participants using a 95% confidence level and a 5% margin of error. No random subsampling was performed. Instead, all eligible individuals with complete records during the study period were consecutively included in the final analysis. Therefore, the final sample of 995 participants exceeded the calculated minimum sample size because the complete eligible sample was retained.

Statistical analysis

Statistical analyses were performed using SPSS version 28.00 (IBM Corp., Armonk, NY, USA). Numerical data were coded and entered into the statistical software for analysis. Descriptive statistics were presented as mean $\pm$ standard deviation for continuous variables and frequency (percentage) for categorical variables.

The normality of continuous variables was assessed using the Shapiro–Wilk test. Although minor deviations from normality were observed for some variables, the large sample size ($n = 995$) supported the use of parametric tests, based on the central limit theorem. Independent-samples *t*-tests were used for continuous group comparisons. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate.

To control for multiple comparisons, we applied the Benjamini–Hochberg false discovery rate correction. Variables included in the multivariable logistic regression model were determined based on clinical relevance and prior evidence rather than solely on univariate statistical significance.

Candidate variables for the multivariable logistic regression analysis were age, education, smoking, alcohol use, obesity, chronic disease, allergic disease, genetic disease, cancer, pregnancy status, and pregnancy complications. Variables were considered based on prior biological plausibility and clinical relevance in addition to the findings of univariate analyses. Pregnancy-related variables were evaluated only among female participants. Results were reported as adjusted odds ratios with 95% confidence intervals. These included (i) modeling serum folate as a continuous outcome using linear regression, (ii) excluding rare conditions such as cancer and genetic diseases, and (iii) estimating E-values to assess the potential impact of unmeasured confounding. Results were expressed as odds ratios (OR) with 95% confidence intervals (CI). A forward likelihood-ratio procedure was used, with variables entered sequentially according to the predefined entry and removal criteria. A p-value <0.05 was considered statistically significant.

Results

The study population selection process is presented in Figure 1. Of the 995 participants, 293 (29.4%) were male, and 702 (70.6%) were female. Overall, 111 (11.2%) participants had a high school education or lower, 420 (42.2%) were university students, and 464 (46.6%) were university graduates. The smoking rate was 7.9%, and the alcohol consumption rate was 1.6%. The prevalence of obesity was 24.4%, cancer was 3.2%, chronic disease was 51.9%, and allergic disease was 19.5%. Among female participant, 266 (37.9%) were pregnant, and 35 (13.2%) of the

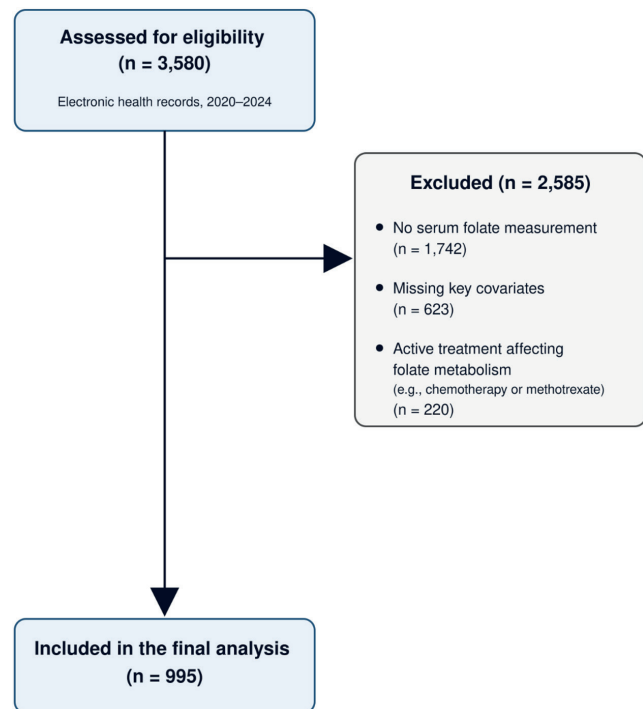


Figure 1. Flow diagram of participant selection.

pregnant participants experienced pregnancy complications. Serum folate testing revealed insufficiency in 185 (18.6%) participants. The mean age was 30.23 ± 12.92 years, and the mean number of chronic diseases among participants with at least one chronic disease was 1.11 ± 0.32 (Table 1).

Folate insufficiency differed significantly according to gender and education level. Insufficiency was more frequent among male than female participants ($p = 0.01$, and university students had higher insufficiency rates than the other education groups ($p = 0.04$). Smokers and alcohol users also had higher insufficiency rates than non-users ($p = 0.01$).

Folate insufficiency was more frequent among participants with obesity, cancer, chronic disease, and allergic disease than among those without these conditions (all $p = 0.01$). Pregnant participants had lower insufficiency rates than non-pregnant participants ($p = 0.01$), whereas

Table 1. General characteristics of the participants.

Variable	Category	n (%)
Gender	Male	293 (29.4)
	Female	702 (70.6)
Education	High school and below	111 (11.2)
	University student	420 (42.2)
	University graduate	464 (46.6)
Smoking	No	916 (92.1)
	Yes	79 (7.9)
Alcohol	No	979 (98.4)
	Yes	16 (1.6)
Obesity	No	752 (75.6)
	Yes	243 (24.4)
Genetic disease	No	933 (93.8)
	Yes	62 (6.2)
Cancer	No	963 (96.8)
	Yes	32 (3.2)
Chronic disease	No	479 (48.1)
	Yes	516 (51.9)
Allergic disease	No	801 (80.5)
	Yes	194 (19.5)
Pregnancy†	No	436 (62.1)
	Yes	266 (37.9)
Pregnancy complication‡	No	231 (86.8)
	Yes	35 (13.2)
Folic acid insufficiency	No	810 (81.4)
	Yes	185 (18.6)
Age (years)	Mean ± SD (range)	30.23 ± 12.92 (18–80)
Number of chronic diseases	Mean ± SD (range)	1.11 ± 0.32 (1–5)

† Pregnancy percentage was calculated among female participants only (n = 702). ‡ Pregnancy-complication percentage was calculated among pregnant participants only (n = 266).

participants with pregnancy complications had higher rates than those without complications ($p = 0.01$). The mean age of the insufficiency group was higher than that of the non-insufficiency group ($p = 0.01$). The number of chronic diseases was not significantly associated with folate insufficiency ($p = 0.64$) (Table 2).

To identify variables independently associated with folate insufficiency, we performed a

multivariable logistic regression analysis among female participants. Pregnancy complications (adjusted OR = 2.49, 95% CI: 1.34–3.60), allergic diseases (adjusted OR = 2.29, 95% CI: 1.19–3.31), genetic diseases (adjusted OR = 2.25, 95% CI: 1.29–3.54), cancer (adjusted OR = 1.81, 95% CI: 1.16–2.72), and non-pregnant status (adjusted OR = 1.70, 95% CI: 1.11–2.32) were retained in the final model. The model classification accuracy was 88%. and the Nagelkerke R^2 was 0.39 (Table 3).

Table 2. Examination of patient characteristics according to folic acid insufficiency status.

Variable	Category	No n (%)	Yes n (%)	p
Gender	Male	221 (75.4)	72 (24.6)	0.01*
	Female	589 (83.9)	113 (16.1)	
Education	High school and below	98 (88.3)	13 (11.7)	0.04*
	University student	329 (78.3)	91 (21.7)	
	University graduate	383 (82.5)	81 (17.5)	
Smoking	No	762 (83.2)	154 (16.8)	0.01*
	Yes	48 (60.8)	31 (39.2)	
Alcohol	No	803 (82.0)	176 (18.0)	0.01*
	Yes	7 (43.7)	9 (56.3)	
Obesity	No	629 (83.6)	123 (16.4)	0.01*
	Yes	181 (74.5)	62 (25.5)	
Genetic disease	No	779 (83.5)	154 (16.5)	0.01*
	Yes	31 (50.0)	31 (50.0)	
Cancer	No	798 (82.9)	165 (17.1)	0.01*
	Yes	12 (37.5)	20 (62.5)	
Chronic disease	No	443 (92.5)	36 (7.5)	0.01*
	Yes	367 (71.1)	149 (28.9)	
Allergic disease	No	691 (86.3)	110 (13.7)	0.01*
	Yes	119 (61.3)	75 (38.7)	
Pregnancy†	No	347 (79.6)	89 (20.4)	0.01*
	Yes	242 (91.0)	24 (9.0)	
Pregnancy complication‡	No	201 (87.0)	30 (13.0)	0.01*
	Yes	15 (42.9)	20 (57.1)	
Age (years)	Mean ± SD	29.96 ± 12.40	33.18 ± 14.74	0.01*
Number of chronic diseases	Mean ± SD	1.11 ± 0.41	1.09 ± 0.34	0.64

***Chi-square test. **Independent samples t-test. *Significant difference at 0.05

Table 3. Multivariable logistic regression analysis of factors associated with folic acid insufficiency among female participants.

Variable		OR	p	Lower 95% CI	Upper 95% CI
Folic acid insufficiency	Pregnancy complication	2.49	0.01*	1.34	3.60
	Allergic disease	2.29	0.01*	1.19	3.31
	Genetic disease	2.25	0.01*	1.29	3.54
	Cancer	1.81	0.01*	1.16	2.72
	Pregnancy status (non-pregnant)	1.7	0.01*	1.11	2.32

**Logistic Regression Analysis. *0.05 significant relationship. R²=0.39. OR= Odds Ratio

Discussion

The Nagelkerke R² of 0.39 indicates that the variables retained in the model accounted for a meaningful but incomplete proportion of the variation in folate insufficiency. Dietary

intake, supplementation, medication exposure, socioeconomic factors, and other unmeasured characteristics may explain additional variation.

Folate status may be affected by dietary quality, altered metabolism, chronic inflammation,

medication exposure, and increased physiological demand. Chronic disease as a broad category was associated with folate insufficiency in the univariate analysis but was not retained in the final multivariable model. In contrast, allergic disease, genetic disease, and cancer remained independently associated with insufficiency. These findings may reflect inflammatory, metabolic, nutritional, or treatment-related mechanisms; however, the broad and heterogeneous definitions of these disease groups preclude disease-specific conclusions.

Folate insufficiency was more frequent among men, smokers, alcohol users, university students, older participants, and participants with obesity in the univariate analyses. However, these variables were not retained in the final multivariable model and should not be interpreted as independently associated factors. Their univariate associations may reflect differences in dietary patterns, health behaviors, healthcare use, or comorbidities. Furthermore, the cross-sectional design does not permit conclusions regarding temporality or causality.

Although obesity was associated with folate insufficiency in the univariate analysis, it was not retained in the adjusted model. Therefore, its relationship with folate status may overlap with other demographic, behavioral, or clinical characteristics in this population.

Family physicians may consider a lower threshold for serum folate testing in patients with pregnancy complications and in individuals with chronic inflammatory, genetic, or oncological conditions when nutritional deficiency, anemia, malabsorption, or medication-related risk is suspected. Folate assessment should be accompanied by evaluation of dietary intake, supplementation, medication use, and other hematinic deficiencies. Prospective multicenter studies using standardized disease definitions and

collecting detailed supplementation and dietary data are needed to confirm these associations and determine whether targeted screening improves clinical outcomes.

A systematic review conducted in Brazil found that folic acid insufficiency is generally uncommon among women of childbearing age, pregnant women, and lactating women, with only one study reporting a prevalence as high as 37%.^[9] One study also demonstrated a stronger association between the weight-waist adjustment index and serum folate than with conventional obesity indicators.^[10] Similarly, our findings demonstrated a higher prevalence of folic acid insufficiency among obese individuals. This association may be explained by altered folate metabolism, dietary quality, and increased metabolic demand observed in obesity. These findings support previous evidence suggesting that obesity should be considered when evaluating folate status in primary care settings.

A cohort study emphasized the importance of initiating folic acid supplementation before pregnancy to support placental development and prevent neural tube defects.^[11] Other studies similarly reported protective effects of folic acid supplementation against congenital anomalies and adverse pregnancy outcomes.^[12-14] In our study, folic acid insufficiency was less frequent among pregnant women but was more common among women experiencing pregnancy complications. Similar findings in our study may be explained by the routine implementation of folic acid supplementation during uncomplicated pregnancies, whereas women with pregnancy complications may have increased physiological folate requirements or underlying clinical conditions that adversely influence folate metabolism. Nevertheless, these findings should be interpreted cautiously because information on folic acid supplementation was not available.

Randomized controlled trials have reported that folic acid supplementation contributes to improved glycemic control.^[15] Consistent with these reports, folic acid insufficiency was more frequent among individuals with chronic diseases in our study. This observation may indicate that chronic illnesses are accompanied by increased nutritional requirements, altered metabolism, or dietary inadequacies that contribute to reduced folate status. These findings further emphasize the importance of nutritional assessment as part of chronic disease management in primary care.

Methotrexate is a well-known folate antagonist and has been associated with folate depletion in several chronic inflammatory and malignant diseases.^[16,17] In addition, folic acid supplementation has been shown to reduce gastric precancerous lesions.^[18] Our study demonstrated that cancer was independently associated with folic acid insufficiency. This association is biologically plausible because malignant diseases may increase metabolic demand, impair nutritional status, or require treatments that interfere with folate metabolism. However, because cancer was evaluated as a broad clinical category, this finding should be interpreted with caution and warrants further investigation in disease-specific studies.

Previous studies have also reported associations between folate metabolism and neurological disorders, psychiatric diseases, and autism spectrum disorder.^[19-22] In our study, folic acid insufficiency was more common among men, smokers, alcohol users, and individuals with allergic diseases. These findings suggest that lifestyle-related factors and chronic inflammatory conditions may contribute to lower folate status. Similar observations have been reported in previous epidemiological studies and reinforce the importance of comprehensive lifestyle assessment during routine family medicine practice.

Genetic susceptibility has also been implicated in folate metabolism.^[23,24] Similarly, patients with genetic diseases in our study had significantly higher odds of folic acid insufficiency. Although the underlying genetic disorders were heterogeneous, the observed association may reflect disturbances in folate metabolism or increased nutritional requirements in these individuals. Because detailed genetic diagnoses were not available, these findings should be interpreted as hypothesis-generating rather than disease-specific associations.

Limitations

This study has several limitations. First, data on dietary folate intake and folic acid supplementation were unavailable, which may have resulted in residual confounding. Second, genetic factors such as MTHFR polymorphisms were not assessed. Third, red blood cell folate, which better reflects long-term folate status, was not measured. Fourth, the retrospective cross-sectional design may introduce indication bias and does not establish temporality or causality. Only individuals with available serum folate measurements and complete clinical records were included. Because detailed demographic and clinical information for excluded individuals was not systematically available, included and excluded individuals could not be compared, and a formal assessment of selection bias could not be performed. Fifth, the study was conducted at a single center and included patients selected for serum folate testing; therefore, its findings may not be generalizable to the general population or to populations with mandatory folic acid fortification. Finally, allergic diseases, cancer, genetic diseases, and pregnancy complications were analyzed as broad, heterogeneous clinical categories because detailed subclassification was not consistently available. Consequently, residual confounding and selection bias cannot be completely excluded.

Conclusion

This study identified an 18.6% prevalence of folate insufficiency among primary care patients who underwent serum folate testing. Pregnancy complications, allergic diseases, genetic diseases, and cancer were associated with higher adjusted odds of insufficiency, whereas pregnant participants had lower odds than non-pregnant participants. The pregnancy-status finding may reflect routine supplementation or closer antenatal follow-up and should not be interpreted as a direct protective effect of pregnancy. Family physicians should maintain a low threshold for serum folate testing in patients with pregnancy complications and in those with inflammatory, genetic, or oncological conditions when clinical or nutritional risk is present. A comprehensive approach that includes assessment of dietary intake, supplementation, medication use, and comorbidities, with specialist collaboration when necessary, may support early diagnosis, treatment, and prevention.

Ethical approval

This study has been approved by the Clinical Research Ethics Committee of Bursa Uludağ University Faculty of Medicine (approval date 19.09.2023, number 2023-17/48).

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: OG; data collection: OG; analysis and interpretation of results: OG; draft manuscript preparation: OG. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest to disclose.

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Influenza and pneumococcal vaccination status and related factors in obese adults: a single-center cross-sectional study

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ABSTRACT

Objective: This study aimed to evaluate influenza and pneumococcal vaccination status and related factors among adults with obesity attending a single-center obesity outpatient clinic.

Methods: This cross-sectional analytical study included 251 obese adults (BMI ≥ 30 kg/m²) who attended an obesity outpatient clinic. Data were collected using a structured face-to-face questionnaire including sociodemographic characteristics, body mass index, presence of chronic disease other than obesity, vaccination status, obesity-related risk perception, and sources of vaccine recommendation. Statistical analyses included Mann–Whitney U test, chi-square test, and multivariable logistic regression.

Results: The study included 251 adults with obesity. The median age was 51 years, the median BMI was 35.7 kg/m², 72.1% of participants were female, and 64.1% had chronic disease other than obesity. Influenza vaccination coverage was 45.8%, while pneumococcal vaccination coverage was 27.1%. Obesity-related risk perception was significantly associated with both influenza and pneumococcal vaccination uptake ($p < 0.001$ for both). In multivariable analysis, absence of obesity-related risk perception was associated with lower odds of influenza vaccination (OR=0.03; 95% CI: 0.02–0.07; $p < 0.001$), whereas the presence of chronic disease other than obesity increased the likelihood of influenza vaccination (OR=3.31; 95% CI: 1.58–6.95; $p = 0.002$). For pneumococcal vaccination, older age increased the likelihood of vaccination (OR=1.06; 95% CI: 1.02–1.09; $p < 0.001$), while absence of obesity-related risk perception was associated with lower vaccination uptake (OR=0.10; 95% CI: 0.04–0.23; $p < 0.001$). Family physicians were the most frequently reported source of vaccine recommendation among vaccinated participants.

Conclusion: These findings suggest that vaccination uptake among adults with obesity, particularly pneumococcal vaccination, may be improved by vaccine-specific counseling that emphasizes obesity-related infection risk, addresses safety concerns and information gaps, and supports clear vaccine recommendations during clinical encounters.

Keywords: Adults, obesity, influenza, pneumococcus, vaccination, risk perception

Introduction

According to the World Health Organization (WHO), obesity is characterized as a chronic, relapsing condition that impacts multiple physiological systems. This condition is associated with an increased risk and severity of cardiovascular diseases, diabetes, specific forms of cancer, and infectious diseases.^[1,2] A mounting body of evidence indicates that structural and functional alterations manifest in both the innate and adaptive components of the immune system in obese individuals, potentially leading to heightened vulnerability to infections.^[3]

Recent epidemiological studies have demonstrated a correlation between obesity and a more severe clinical course, particularly in cases of respiratory tract infections. A substantial body of research, including systematic reviews and meta-analyses published during the course of the COVID pandemic, has demonstrated a positive correlation between obesity and an increased risk of hospitalization, intensive care unit admission, and mortality.^[4,5] Research has also indicated that obesity is associated with elevated rates of complications and hospitalizations in patients infected with influenza.^[6,7]

The increased risk of infection in obese individuals is attributable to a complex interplay of physiological mechanisms, including chronic low-grade inflammation, adipokine imbalance, impaired immune cell function, and metabolic dysfunction.^[3,8] These immunometabolic changes have the potential to influence not only the response to natural infections but also the effectiveness and duration of immunity conferred by vaccines.^[8,9] For this reason, obesity is regarded as a risk factor requiring special consideration with respect to vaccine-preventable diseases.^[2,4]

Research on influenza vaccines has demonstrated that while antibody responses after vaccination are initially sufficient in obese individuals, clinical

protection may be lower compared to healthy individuals of normal weight.^[9,10] It has been documented that obese adults who have received the influenza vaccine have a considerably elevated risk of laboratory-confirmed influenza or influenza-like illness.^[10] Reports have indicated a correlation between obesity and a potential impairment in cellular immune response following vaccination.^[9,11]

In the context of pneumococcal vaccines, obesity is also considered a condition associated with increased risk of pneumonia and invasive pneumococcal disease. The presence of chronic inflammation, diminished respiratory function, and concomitant comorbidities in obese individuals may result in more severe pneumococcal infections. Clinical and epidemiological data demonstrate a correlation between pneumococcal vaccination in high-risk groups and a reduction in the incidence of serious pneumonia and invasive disease. Therefore, it is recommended that obese individuals be prioritized for pneumococcal vaccination.^[6,12]

However, reports indicate that vaccination rates among obese individuals remain below target levels in most countries. A multitude of factors have been demonstrated to influence vaccination behavior, including perceived risk, health literacy, socioeconomic status, and recommendations made by healthcare professionals.^[6,7] Research has demonstrated that recommendations from family physicians, particularly at the primary care level, play a pivotal role in determining adult vaccination behavior.^[7,11]

Although previous studies have described low adult vaccination rates in several high-risk groups, fewer studies have examined vaccination behavior in adults with obesity by simultaneously evaluating obesity-related risk perception and the source of vaccine recommendation. In this context, assessing whether individuals recognize obesity as a condition that may increase the

need for vaccination may help clarify behavioral determinants of vaccine uptake in this population.

This study aimed to evaluate influenza and pneumococcal vaccination status and related factors among adults with obesity attending a single-center obesity outpatient clinic.

Materials and Methods

Study design

This single-center cross-sectional analytical study was conducted between June 2025 and January 2026 in the obesity outpatient clinic of a tertiary teaching and research hospital. The study was designed to evaluate influenza and pneumococcal vaccination status and factors associated with vaccination behavior among adults with obesity.

Study population and sample

The study population consisted of all adults with obesity who attended the obesity outpatient clinic of a tertiary teaching and research hospital during the study period. A total of 258 eligible adults with obesity constituted the study population. Individuals aged 18 years or older with a body mass index (BMI) ≥ 30 kg/m², as defined by the World Health Organization, and who agreed to participate were included. Seven participants were excluded because of incomplete data or failure to complete the questionnaire. Therefore, the final study sample consisted of 251 participants, corresponding to a valid analysis rate of 97.3%.

Since the study aimed to include the entire accessible population of eligible adults with obesity attending the clinic during the study period, no separate sampling procedure was applied. An a priori sample size calculation was not performed. However, the final sample size of 251 participants was considered adequate for the planned descriptive analyses and multivariable

logistic regression models, which included five independent variables.

Data collection

Data were collected from the accessible study population using a structured face-to-face questionnaire administered to eligible adults with obesity who attended the obesity outpatient clinic during the study period. The questionnaire was developed by the researchers based on the relevant literature on adult vaccination, obesity-related infection risk, and determinants of vaccine uptake. No pilot study was conducted, and the questionnaire was not a psychometrically validated scale.

The questionnaire consisted of three sections: sociodemographic characteristics, including age and gender; clinical characteristics, including BMI and the presence of chronic disease other than obesity; and vaccination-related variables, including influenza and pneumococcal vaccination status, obesity-related risk perception, source of vaccine recommendation, and reasons for non-vaccination.

Obesity-related risk perception was assessed using a single researcher-developed yes/no question: "Do you think obesity increases the risk of severe respiratory infections and therefore creates a need for influenza and pneumococcal vaccination?" This question was intended to evaluate whether participants perceived obesity as a condition increasing the need for vaccination, not whether they perceived vaccination itself as risky. Since this item was not part of a validated multidimensional scale, it was interpreted as a simple indicator of perceived risk.

BMI was calculated by dividing body weight in kilograms by the square of height in meters (kg/m²). Vaccination status and the presence of chronic disease other than obesity were recorded based on participant self-report and were not verified

through vaccination cards, electronic health records, or national immunization registry data.

The dependent variables were influenza vaccination status and pneumococcal vaccination status. The independent variables were age, BMI, gender, presence of chronic disease other than obesity, and obesity-related risk perception.

Statistical analysis

Statistical analyses were performed using the Jamovi software (version 2.6.22.0). The distribution of continuous variables was assessed using the Shapiro–Wilk test. Given the non-normal distribution of the variables age ($W=0.989$; $p=0.046$) and body mass index (BMI) ($W=0.880$; $p<0.001$), descriptive statistics were presented as median and interquartile range (IQR). Categorical variables were expressed as number and percentage. Non-parametric tests were utilized for the purpose of conducting intergroup comparisons.

The Mann–Whitney U test was employed for the analysis of continuous variables in comparisons between pairs of groups, while the chi-square test was utilized for categorical variables. Initially, univariate analyses were conducted to ascertain the factors associated with influenza and pneumococcal vaccination status.

To identify the independent predictors of influenza and pneumococcal vaccination status, multivariable logistic regression analyses were performed. In both models, the dependent variable was defined as vaccination status (Yes/No). The following variables were included in the multivariable models: age, BMI, obesity-related risk perception, presence of chronic disease other than obesity, and gender. The results of the study were reported as odds ratio (OR) and 95% confidence interval (CI). The model's fit was evaluated by measuring deviance, Akaike information criterion (AIC), and pseudo R^2 values.

Ethical considerations

Ethics committee approval was obtained from the relevant institutional ethics committee (09.10.2024; No: 2024/18/11). The research was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from all participants included in the study.

Results

The final study sample comprised 251 adults with obesity, and all analyses were performed on this sample. The median age of the participants was 51 years (IQR: 17.0), and the median BMI was 35.7 kg/m² (IQR: 5.68). The demographic characteristics of the sample are displayed in Table 1.

Findings related to the influenza vaccine

The median age of individuals who received the influenza vaccine was 52 years (IQR: 18.5), while it was 48 years (IQR: 15.0) for those who did not receive the vaccine. A subsequent analysis revealed no statistically significant difference in age between the groups (Mann–Whitney $U=6663$, $p=0.054$). The median BMI was 36.8 (interquartile range [IQR]: 6.08) kg/m² in the influenza-vaccinated group and 35.2 (IQR: 4.35) kg/m² in the unvaccinated group, and no significant difference was found between the groups in terms of BMI (Mann–Whitney $U=6770$, $p=0.082$).

A statistically significant relationship was identified between obesity-related risk perception and influenza vaccination status ($\chi^2=108$, $p<0.001$). Positive obesity-related risk perception was reported by 90.4% (104/115) of influenza-vaccinated participants and by 25.0% (34/136) of unvaccinated participants. No statistically significant association was found between gender and influenza vaccination status ($\chi^2=1.94$, $p=0.164$).

A statistically significant relationship was also identified between the presence of chronic disease

other than obesity and influenza vaccination status ($\chi^2=18.4$, $p<0.001$). Chronic disease other than obesity was present in 78.3% (90/115) of influenza-vaccinated participants and in 52.2% (71/136) of unvaccinated participants (Table 2).

Findings related to the pneumococcal vaccine

The median age of individuals who received the pneumococcal vaccine was 57 (IQR: 16) years, while it was 48 (IQR: 15) years in individuals who did not receive the vaccine. A statistically significant difference was found between the groups in terms of age (Mann–Whitney $U=3911$, $p<0.001$). The median BMI was 36.5 (IQR: 6.20) kg/m^2 in the pneumococcal-vaccinated group and 35.5 (IQR:

5.13) kg/m^2 in the non-vaccinated group. A Mann–Whitney U-test was performed, and the result indicated that there was no significant difference in BMI between the two groups ($U=5509$, $p=0.203$).

A statistically significant association was found between obesity-related risk perception and pneumococcal vaccination status ($\chi^2=41.7$, $p<0.001$). Positive obesity-related risk perception was reported by 88.2% (60/68) of pneumococcal-vaccinated participants and by 42.6% (78/183) of unvaccinated participants.

The presence of chronic disease other than obesity was significantly associated with pneumococcal vaccination status ($\chi^2=6.16$, $p=0.013$). Chronic disease other than obesity was present in 76.5%

Table 1. Demographic characteristics of adults with obesity and their vaccination status with influenza and pneumococcal vaccines.

Variable	n (%) or Median (IQR)
Age (years)	51 (17)
BMI (kg/m^2)	35.7 (5.7)
Gender	
Female	181 (72.1)
Male	70 (27.9)
Presence of chronic disease other than obesity	
Yes	161 (64.1)
No	90 (35.9)
Positive obesity-related risk perception	
Yes	138 (55.0)
No	113 (45.0)
Those who have received the influenza vaccine	115 (45.8)
Those who have received the pneumococcal vaccine	68 (27.1)

Table 2. Comparison of demographic and clinical characteristics according to influenza vaccination status among obese adults.

Variable	Influenza vaccine*		Test	p
	Yes	No		
Age, median (IQR)	52 (18.5)	48 (15.0)	Mann–Whitney $U=6663$	0.054
BMI, median (IQR)	36.8 (6.1)	35.2 (4.4)	Mann–Whitney $U=6770$	0.082
Positive obesity-related risk perception, n (%)	104 (90.4)	34 (25.0)	$\chi^2=108$	<0.001
Presence of chronic disease other than obesity, n (%)	90 (78.3)	71 (52.2)	$\chi^2=18.4$	<0.001
Female gender, n (%)	78 (67.8)	103 (75.7)	$\chi^2=1.94$	0.164

* Group sizes: vaccinated n=115; non-vaccinated n=136.

(52/68) of pneumococcal-vaccinated participants and in 59.6% (109/183) of unvaccinated participants. However, no statistically significant relationship was found between gender and pneumococcal vaccination status ($\chi^2=0.0001$, $p=0.991$) (Table 3).

Among vaccinated participants, family physicians were the most frequently reported source of recommendation for both influenza and pneumococcal vaccines (influenza: 56.5%; pneumococcal: 47.1%). Other specialist physicians and pharmacists were also reported as recommendation sources, but at lower frequencies. These findings describe the distribution of recommendation sources among vaccinated participants and should not be interpreted as directly measuring physicians' vaccination practices or attitudes (Table 4).

The most frequent reason for not receiving the influenza vaccine was concern about vaccine-related adverse effects (33.1%), followed by the perception that vaccination was not needed (25.0%). For pneumococcal vaccination, the most

frequent reason was insufficient information about the vaccine (47.5%), followed by fear of adverse effects (15.8%) and the perception that vaccination was not needed (15.3%). Cost-related barriers, difficulty accessing healthcare facilities, previous negative vaccine experience, lack of physician recommendation, and religious or cultural concerns were reported less frequently (Table 5).

Multivariable logistic regression analyses

Multivariable logistic regression analyses were performed to evaluate the independent effects of age, BMI, obesity-related risk perception, presence of chronic disease other than obesity, and gender on vaccination status.

Multivariable logistic regression analysis for influenza vaccination (Model 1)

To assess the independent determinants of influenza vaccination status, a multivariable logistic regression analysis was performed. The model included age, BMI, obesity-related risk perception, presence of chronic disease other

Table 3. Comparison of demographic and clinical characteristics according to pneumococcal vaccination status among adults with obesity.

Variable	Pneumococcal vaccine*		Test	p
	Yes	No		
Age, median (IQR)	57.0 (16.0)	48.0 (15.0)	Mann-Whitney U=3911	<0.001
BMI, median (IQR)	36.5 (6.2)	35.5 (5.1)	Mann-Whitney U=5509	0.203
Positive obesity-related risk perception, n (%)	60 (88.2)	78 (42.6)	$\chi^2=41.7$	<0.001
Presence of chronic disease other than obesity, n (%)	52 (76.5)	109 (59.6)	$\chi^2=6.16$	0.013
Female gender, n (%)	49 (72.1)	132 (72.1)	$\chi^2=0.0001$	0.991

* Group sizes: vaccinated n=68; non-vaccinated n=183.

Table 4. Sources of vaccination recommendation for influenza and pneumococcal vaccines among vaccinated obese individuals

Recommendation source	Influenza vaccine (n=115) n (%)	Pneumococcal vaccine (n=68) n (%)
Family physician	65 (56.5)	32 (47.1)
Other specialist physicians	27 (23.5)	19 (27.9)
Pharmacist	21 (18.3)	15 (22.1)
Other	2 (1.7)	2 (2.9)

than obesity, and gender. Model fit indices were as follows: deviance=214, Akaike information criterion (AIC)=226, McFadden $R^2=0.382$, and Nagelkerke $R^2=0.547$.

In multivariable analysis, the likelihood of receiving the influenza vaccine was significantly lower among participants without obesity-related risk perception compared with those with positive obesity-related risk perception (OR=0.03; 95% CI: 0.02–0.07; $p<0.001$). The presence of chronic disease other than obesity independently increased the likelihood of receiving the influenza vaccine (OR=3.31; 95% CI: 1.58–6.95; $p=0.002$). Subsequent analyses revealed that age, BMI, and gender did not demonstrate independent effects on influenza vaccination status ($p > 0.05$) (Table 6).

Multivariable logistic regression analysis for pneumococcal vaccination (Model 2)

A multivariable vaccination logistic regression model was established to evaluate the independent determinants of pneumococcal vaccination status. The model included age, BMI, obesity-related risk perception, presence of chronic disease other than obesity, and gender. Model fit indices were as follows: deviance=230, AIC=242, McFadden $R^2=0.217$, and Nagelkerke $R^2=0.325$.

The analysis results indicated that age independently increased the likelihood of receiving the pneumococcal vaccine (OR=1.06; 95% CI: 1.02–1.09; $p<0.001$). The likelihood of receiving the pneumococcal vaccine was significantly lower among participants without obesity-related risk

Table 5. Reasons for non-vaccination against influenza and pneumococcal vaccines among unvaccinated obese individuals.

Reason for not getting vaccinated	Influenza (n=136) n (%)	Pneumococcal (n=183) n (%)
I don't think I need to be vaccinated	34 (25.0)	28 (15.3)
I don't think vaccines are necessary	19 (14.0)	16 (8.7)
I believe vaccines are ineffective	19 (14.0)	9 (4.9)
I don't have enough information about the vaccine	11 (8.1)	87 (47.5)
I'm afraid of the side effects of vaccines	45 (33.1)	29 (15.8)
Social security does not cover it / the fee is too high	2 (1.5)	6 (3.3)
Access to healthcare facilities is difficult	–	1 (0.5)
I had a bad experience with a vaccine before	3 (2.2)	3 (1.6)
My doctor did not recommend vaccination	2 (1.5)	4 (2.2)
Negative religious/cultural thoughts	1 (0.7)	–

Table 6. Multivariable logistic regression analysis of factors associated with influenza and pneumococcal vaccination among adults with obesity.

Variable	Influenza vaccination			Pneumococcal vaccination		
	OR*	95% CI	p	OR*	95% CI	p
Age (years)	1.00	0.97 – 1.03	0.929	1.06	1.02–1.09	<0.001
BMI (kg/m ²)	0.97	0.90 – 1.04	0.327	0.99	0.93–1.06	0.844
Obesity-related risk perception (negative vs positive)	0.03	0.02 – 0.07	<0.001	0.10	0.04–0.23	<0.001
Presence of chronic disease other than obesity (Yes vs No)	3.31	1.58 – 6.95	0.002	1.38	0.67–2.87	0.382
Female (vs male)	1.07	0.50 – 2.29	0.869	1.32	0.64–2.70	0.452

* ORs were reported as “vaccinated (Yes)”. For obesity-related risk perception, “negative” refers to participants who did not perceive obesity as increasing the need for vaccination, whereas “positive” refers to participants who perceived obesity as increasing the need for vaccination.

perception compared with those with positive obesity-related risk perception (OR=0.10; 95% CI: 0.04–0.23; $p<0.001$). BMI, the presence of chronic disease other than obesity, and gender did not show statistically significant independent associations with pneumococcal vaccination status ($p>0.05$) (Table 6).

Discussion

The most striking finding of this study was that a considerable proportion of adults with obesity had not received influenza and especially pneumococcal vaccination despite being followed in an obesity outpatient clinic. Vaccination uptake appeared to be closely related to whether participants recognized obesity as a condition increasing the need for vaccination. Pneumococcal vaccination was particularly limited and was more common among older participants, whereas influenza vaccination was more common among participants with chronic disease other than obesity. These findings suggest that awareness of obesity-related infection risk and vaccine-specific information needs are central issues in this clinical population.

The finding that obesity-related risk perception was associated with both vaccines suggests that recognition of obesity as a condition increasing the need for vaccination may be an important behavioral determinant of vaccine uptake. Participants who perceived obesity as increasing the need for influenza and pneumococcal vaccination were more likely to report being vaccinated. Previous studies have also shown that perceived disease risk, perceived severity, and perceived benefits of vaccination are important determinants of adult vaccination behavior.^[13,14] However, in the present study, risk perception was measured using a single yes/no question rather than a validated multidimensional scale. Therefore, this finding should be interpreted as

reflecting a simple perceived-risk indicator rather than a comprehensive psychological construct.

Among vaccinated participants, family physicians were the most frequently reported source of recommendation for both influenza and pneumococcal vaccines. This finding indicates that family physicians may be an important source of vaccine information for adults with obesity. Published evidence indicates that physician recommendation is one of the important predictors of adult vaccine acceptance, and clear vaccine recommendations from primary care physicians have been associated with increased vaccination uptake.^[14,15] However, the present study did not directly evaluate family physicians' knowledge, attitudes, or clinical practices regarding obesity-related vaccination. Therefore, this result should be interpreted as a patient-reported distribution of recommendation sources rather than evidence of physician behavior.

The low proportion of participants reporting lack of physician recommendation as the main reason for non-vaccination should also be interpreted cautiously. In the present study, the most common barriers were concern about vaccine-related adverse effects for influenza vaccination and insufficient information for pneumococcal vaccination. Previous studies have described missed opportunities for adult immunization in healthcare settings, particularly when vaccination is not discussed during encounters with high-risk individuals.^[16] In our study, however, the data do not allow direct conclusions about whether such missed opportunities occurred, because vaccination counseling practices were not observed directly.

The influenza and pneumococcal vaccination rates observed in this study were 45.8% and 27.1%, respectively. These rates may be considered suboptimal in light of previous adult vaccination coverage reports and national studies showing insufficient vaccination uptake among high-

risk groups. Previous reports have also shown that influenza vaccination rates in high-risk groups often remain below desired levels, while pneumococcal vaccination rates are generally lower than influenza vaccination rates.^[17,18] It is noteworthy that the reasons for non-vaccination differed by vaccine type. Concern about adverse effects was the most common reason for not receiving the influenza vaccine, whereas insufficient information was the leading reason for not receiving the pneumococcal vaccine. This suggests that influenza vaccine hesitancy may be driven mainly by safety concerns, while pneumococcal under-vaccination may be more closely related to limited awareness and insufficient knowledge.

National studies from Türkiye also support the finding that adult vaccination uptake remains insufficient among high-risk groups. In the TEMD Vaccination Study, influenza and pneumococcal vaccination rates among adults with diabetes were reported to be low, particularly for pneumococcal vaccination. Similarly, the diaVAX study showed that physician awareness and structured recommendations may improve influenza and pneumococcal vaccine uptake among patients with diabetes. The TURCAP study also reported low influenza and pneumococcal vaccination rates among adults hospitalized with community-acquired pneumonia. In this context, the present findings are consistent with national evidence showing that adult vaccination coverage remains limited among high-risk groups in Türkiye.^[19-21]

Multivariable logistic regression analyses have identified independent determinants for influenza and pneumococcal vaccination. Obesity-related risk perception was independently associated with both vaccines, whereas chronic disease other than obesity was associated with influenza vaccination and older age was associated with pneumococcal vaccination. These findings suggest that clinical risk and perceived risk may

influence vaccination behavior in different ways. Individuals with additional chronic diseases may have more frequent contact with healthcare services or may receive more vaccine-related counseling, which may partly explain their higher influenza vaccination uptake. For pneumococcal vaccination, the association with age may reflect greater awareness of pneumonia risk or more frequent medical follow-up among older adults.

Strengths of the Study

The primary strength of this study is its focus on adults with obesity, a group that is biologically vulnerable to severe respiratory infections but relatively underrepresented in adult vaccination behavior studies. The simultaneous evaluation of influenza and pneumococcal vaccination allowed comparison of vaccine-specific patterns of uptake and barriers. In addition, the assessment of obesity-related risk perception, recommendation source, and reasons for non-vaccination provided a broader understanding of behavioral and informational factors associated with adult vaccination in this clinical population. The use of multivariable logistic regression analyses also enabled the evaluation of independent factors associated with vaccination uptake.

Weaknesses and limitations of the study

This study has several limitations. First, its cross-sectional design precludes causal interpretation of the associations observed. Second, the study was conducted in a single tertiary obesity outpatient clinic, which may limit the generalizability of the findings to community-based or primary care populations. Third, although the study aimed to include the entire accessible population during the study period, participants were recruited from clinic attendees, and this may have introduced selection bias. Fourth, vaccination status, chronic disease status other than obesity, and reasons for non-vaccination were based on participant self-report and were not verified using vaccination

cards, electronic health records, or national immunization registry data. Therefore, recall bias and social desirability bias may have affected the results, particularly because the questionnaire was administered face to face. Fifth, obesity-related risk perception was measured using a single researcher-developed yes/no item rather than a validated multidimensional scale, limiting the depth and measurement validity of this construct. Sixth, socioeconomic variables such as education level, income, employment status, and health insurance status were not collected and therefore could not be included in the regression models. Finally, the study did not directly evaluate physicians' knowledge, attitudes, or recommendation behaviors; recommendation source was assessed only from the participants' perspective.

Conclusion

Influenza and pneumococcal vaccination status among adults with obesity was associated with obesity-related risk perception and selected clinical factors. The findings indicate that adults with obesity may benefit from clearer information about their risk of severe respiratory infections and the potential role of influenza and pneumococcal vaccination. Vaccine-specific counseling should address safety concerns related to influenza vaccination and information gaps related to pneumococcal vaccination. Strengthening clear and individualized vaccine recommendations during clinical encounters may support preventive health practices in this population.

Ethical approval

This study has been approved by the Samsun University Non-Interventional Research Ethics Committee (approval date: 09.10.2024, number: 2024/18/11). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: ET, BY; data collection: ET; analysis and interpretation of results: BY; draft manuscript preparation: BY. All authors reviewed the results and approved the final version of the article.

Source of funding

The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest to disclose.

Generative AI Statement

Generative AI tools were used solely for language editing and improvement of readability. The authors critically reviewed and revised the resulting text and take full responsibility for the final content.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Development of the scale for the assessment of mothers' readiness for the transition to complementary feeding, its validity and reliability study

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ABSTRACT

Objective: The aim of this study was to develop the “Scale for the Assessment of Mothers’ Readiness for the Transition to Complementary Feeding” and to examine its psychometric properties.

Methods: This methodological and cross-sectional study was conducted with 200 mothers of infants aged 4–6 months between March 2023 and October 2023. Content validity was assessed through expert evaluation. Construct validity was examined using exploratory and confirmatory factor analyses. Reliability was evaluated using Cronbach’s alpha, McDonald’s omega, composite reliability, and intraclass correlation coefficient.

Results: The final scale consisted of 10 items with a unidimensional structure. Internal consistency was good ($\alpha=0.827$; $\omega=0.828$; $CR=0.85$). The average variance extracted was below the recommended threshold ($AVE=0.38$). Test–retest reliability indicated good temporal stability ($ICC=0.87$, 95% CI [0.77–0.93]).

Conclusion: The scale demonstrated satisfactory reliability and construct validity and may serve as a useful tool for assessing mothers’ readiness for the transition to complementary feeding. However, further studies are needed to evaluate convergent and discriminant validity and to confirm its applicability across different populations.

Keywords: Breast feeding, weaning, mothers, infant, infant health

Introduction

Adequate nutrition in the first two years of life is essential for the complete development of human potential. Complementary feeding plays a key role in the physical, intellectual, and emotional development of infants during this period.^[1,2]

Complementary feeding is defined as the process that starts when breast milk alone becomes inadequate to meet infants’ nutritional needs and, therefore, there is a need for other foods and liquids along with breast milk.^[3,4] It typically covers a period of 6-24 months.^[5]

World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) recommend that infants be exclusively breastfed for the first six months, complementary foods be introduced after the sixth month, and breastfeeding be continued until 24 months and beyond.^[5,6] According to the 2020 Global Nutrition Report data, the rate of exclusive breastfeeding for the first six months in 2018 was 42%, while the rate of introducing complementary foods in infants aged 6-8 months was 69.5%. According to the above-mentioned report, it is aimed to increase the rate of exclusive breastfeeding in the first six months to a minimum of 50% or more in 2025.^[7] Additionally, WHO and UNICEF report that they aim to increase this rate to at least 70% by 2030.^[8] In line with these goals, it is essential to switch to complementary feeding in a timely manner.

The time for introducing complementary feeding is among the most discussed issues. Inadequate, early, or late transition to complementary feeding may have negative consequences in the short and long terms.^[1,2,5,9] Upon reviewing studies in the literature, the rate of early introduction of complementary foods is found to be high.^[6,10] There is evidence indicating that introducing complementary foods before the sixth month (early period) is associated with the risk of childhood overweight.^[9-11] Micronutrient deficiencies that may occur due to the late introduction of complementary feeding is another important issue.^[12] It is known that such nutrition-related problems in the first year of life also cause chronic diseases such as stunting, obesity, cardiovascular diseases, diabetes, and hypertension.^[11,13]

Complementary feeding has numerous dimensions, such as its timely initiation, as well as providing sensitive nutrition and safe delivery of appropriate foods in the amount, frequency, and consistency to meet the nutritional needs of a growing child while maintaining breastfeeding by taking precautions to minimize the risk of

contamination with pathogens.^[5,14] In this process, the knowledge and attitudes of mothers, who are the primary caregivers, represent a determining factor in the feeding practices of their children.^[1,6,15] Hence, it is important for mothers to be ready for the transition periods concerning their infants' nutrition.^[15]

In the literature review, a measurement tool in Spanish developed to measure mothers' knowledge about complementary feeding was found, whereas no similar scale developed to assess their readiness was encountered.^[2] A scale for the assessment of mothers' readiness for the transition to complementary feeding will be useful to midwives, nurses, and other healthcare professionals to determine the educational needs of mothers on the issue. Furthermore, it will be useful for educating mothers in line with individual needs, in individualized care practices, and in providing individualized educational needs.

The aim of this study was to develop the 'Scale for the Assessment of Mothers' Readiness for the Transition to Complementary Feeding' and to examine its psychometric properties.

Conceptual definition and theoretical underpinnings

The concept of "readiness" in health behavior is widely recognized as a multidimensional construct encompassing cognitive, affective, motivational, and behavioral components^[16,17] In the context of maternal and child health, readiness for the transition to complementary feeding reflects not only a mother's knowledge about appropriate feeding practices but also her attitudes, perceived competence, confidence, and intention to initiate and sustain appropriate feeding behaviors.

Several theoretical frameworks support the conceptualization of readiness as a complex and dynamic construct. The Health Belief Model (HBM)

posits that health-related behaviors are influenced by individuals' perceptions of susceptibility, severity, benefits, and barriers, as well as cues to action and self-efficacy.^[18] Within this framework, a mother's readiness to initiate complementary feeding may depend on her beliefs about the benefits of timely feeding, perceived risks of inappropriate practices, and her confidence in her ability to implement feeding recommendations.

Similarly, Self-Efficacy Theory emphasizes the role of perceived capability in performing specific behaviors. Maternal self-efficacy has been identified as a key determinant of infant feeding practices, influencing both the initiation and maintenance of appropriate complementary feeding behaviors.^[17,19] Mothers who perceive themselves as competent are more likely to demonstrate readiness and engage in recommended practices.

The Transtheoretical Model (Stages of Change) further conceptualizes readiness as a process that evolves over time, progressing from precontemplation to maintenance.^[20] In this model, readiness is not a static state but reflects an individual's position within a behavioral change continuum. Applied to complementary feeding, mothers may vary in their preparedness depending on their stage of awareness, intention, and prior experience.

Based on these frameworks, readiness for complementary feeding can be conceptualized as comprising multiple interrelated dimensions, including: (I) cognitive readiness (knowledge and awareness), (II) affective readiness (attitudes and beliefs), (III) motivational readiness (intention and willingness), (IV) behavioral readiness (practical preparedness), (V) self-efficacy (perceived competence), and (VI) contextual readiness (environmental and social support).^[16,17]

This conceptualization provides the theoretical basis for the development and validation of the present scale and supports its use as a practical tool in maternal and child health settings, particularly in primary care and nursing practice.

Methods

Study design

This study was designed as a methodological and cross-sectional research. The study was conducted in accordance with COSMIN and APA guidelines for scale development and reporting.

Participants recruitment

The study was carried out in the pediatric outpatient clinics of two hospitals in Türkiye between March 2023 and October 2023. The population of the study comprised mothers of 4-6-month-old infants who presented to the pediatric outpatient clinics of a district state hospital and a provincial training and research hospital in the Black Sea Region of Türkiye.

Inclusion criteria were: Having a 4-6-month-old typically developing infant, being literate, volunteering to take part in the research, being open to communication and collaboration, not having a diagnosed psychiatric disease, the absence of a disease or special needs in their infants that may affect infants' nutrition was included. Who filling out the data collection forms incompletely were excluded and nobody filled out the forms incompletely. Participants were recruited using a consecutive sampling method, whereby all individuals who met the inclusion criteria and presented to the study setting during the data collection period were invited to participate, the study achieved a 100% response rate. A flow diagram of the scale development process was presented in Figure 1 to ensure methodological transparency.

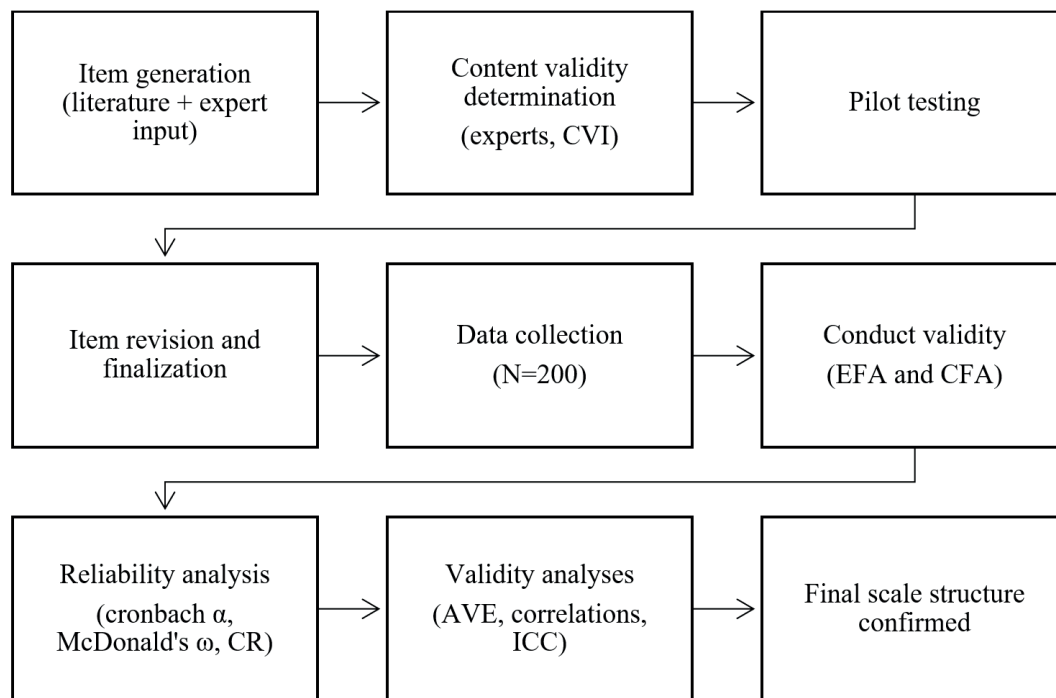


Figure 1. Flow diagram of the scale development process.

Sample size was determined based on the participant-to-item ratio, which is widely recommended in scale development studies. A minimum of 5–10 participants per item is suggested to ensure stable factor solutions.^[21,22] Accordingly, the present study included 200 participants for a 20-item scale (10:1 ratio), which is considered adequate for reliable factor analysis and consistent with methodological recommendations.^[23-28]

In line with this information, 200 mothers who met the inclusion criteria and agreed to take part in the research constituted the sample for the draft form of the 20-item scale.

Prior to the data collection stage, a pilot study was conducted with 15 mothers who had the same characteristics as the sample group. The comprehensibility of the items in the scale draft

was tested. It was evaluated that there was no incomprehensible statement after the pilot study. Mothers who took part in the pilot study were not included in the sample.

Data collection tools

The data were collected with the "Descriptive Information Form" prepared by the researchers and the draft form of the "Scale for the Assessment of Mothers' Readiness for the Transition to Complementary Feeding" developed by the researchers to assess mothers' readiness for the transition to complementary feeding. The survey and interview methods were employed when collecting data. It was ensured that all mothers who agreed to take part in the research and met the inclusion criteria filled out the descriptive information form and the scale draft.

Descriptive information form

This form includes 13 questions about parents' sociodemographic characteristics (age, educational status, employment status, etc.) and the child's age and gender.

Draft form of the scale

A seven-point Likert scale draft consisting of 21 items was prepared in line with the researchers' knowledge/experience and literature research concerning the transition to complementary feeding, readiness, and Likert scale development. The draft scale was presented to expert opinion to evaluate whether it was suitable for the measurement purpose and whether it covered the subject to be measured. First, a list was created of experts who had conducted research on the subject, possessed relevant expertise, and had parenting/motherhood experience. Expert opinion forms were sent via email to a total of 20 experts. Of the 20 experts [eight academicians in the field of pediatric nursing (7) and midwifery (1), two specialist doctor in the field of child health and a dietitian], 11 responded to the email. Afterward, an educator specialized in Turkish language and literature evaluated the draft scale reviewed by the researchers in terms of language and expression. In line with the recommendations from experts, the final version of the scale draft was revised before implementation. As a result of the evaluations, one inappropriate item (I can ensure my baby is fed at the family dinner table) was removed and the draft scale consisted of 20 items.

Statistical analysis

Data were analyzed using SPSS (IBM SPSS Statistics for Windows, Version 25.0), AMOS (Version 21), JASP, and Jamovi software. Descriptive statistics were presented as frequencies and percentages for categorical variables, and means, standard deviations, minimum, and maximum values

for continuous variables. Exploratory and confirmatory factor analyses were performed to assess construct validity. A significance level of $p < 0.05$ was considered statistically significant.

Validity and reliability

Content validity

Content validity was assessed using the Content Validity Index (CVI). Experts rated each item on a 4-point scale according to the Davis technique (1= Not appropriate at all, 2= Needs major revision, 3= Needs minor revision, 4= Very appropriate) in terms of relevance. The item-level CVI (I-CVI) was calculated as the proportion of experts rating the item as 3 or 4. Items with an I-CVI of 0.80 or higher were considered acceptable.^[28,29] The scale-level CVI (S-CVI) was calculated as the average of the I-CVI values (S-CVI/Ave). The S-CVI/UA was calculated as the proportion of items that achieved universal agreement among experts. Items falling below the acceptable threshold were revised or removed (an item) based on expert feedback.

Construct validity

Construct validity was assessed through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) and further supported by composite reliability (CR) and average variance extracted (AVE).

Exploratory factor analysis (EFA)

Prior to exploratory factor analysis, the Kaiser-Meyer-Olkin (KMO) measure was used to assess sampling adequacy, and Bartlett's test of sphericity was conducted to examine the suitability of the correlation matrix for factor analysis.^[27] Exploratory factor analysis (EFA) was conducted on the 20-item draft scale using Principal Axis Factoring. Items were evaluated based on factor loadings (≥ 0.40) and cross-loadings. Items not meeting these criteria were removed to improve construct validity. After item refinement, a 10-

item final form was obtained. Parallel analysis and scree plot inspection supported a single-factor solution. Since a unidimensional structure was retained, no rotation was applied.

Confirmatory factor analysis (CFA)

The compatibility between the factor structure identified in the exploratory factor analysis (EFA) and the hypothesized measurement model was examined using confirmatory factor analysis (CFA). A first-order one-factor model was specified. Model fit was evaluated using χ^2/df , RMSEA, SRMR, CFI, and TLI. Model fit was assessed according to commonly accepted criteria (CFI and TLI ≥ 0.90 , RMSEA ≤ 0.08 , SRMR ≤ 0.08).^[24,30,31] Modification indices were inspected, and correlated error terms were added between conceptually or methodologically related items (I1–I3 and I4–I7) to improve model fit. All analyses were conducted using standardized estimates.

Reliability

Cronbach's alpha coefficient was used to determine the internal consistency of the scale. The reliability coefficient for Cronbach's alpha internal consistency is expected to be higher than 0.70, which is a generally acceptable value.^[27] If the total score correlation coefficient of the scale is lower than 0.30, it can be concluded that there is a problem in the relevant items, and these items can be removed if they pose a serious problem.^[32-34] The impact of the removed items on Cronbach's alpha coefficient should be checked when deciding on removing items.^[32,35] For reliability to be interpreted as good, the correlation coefficient should be 0.30 and above.^{[32/[xRef],34]} Therefore, during item removal, the effect on the item total score coefficient and Cronbach alpha coefficient was examined. In addition to Cronbach's alpha, McDonald's omega and composite reliability (CR) coefficients were calculated to provide more robust estimates of internal consistency.

To investigate whether the scale scores changed overtime, the scale was re-applied to 35 participants two weeks later. The sample size for the test-retest analysis was determined in accordance with the recommendation in the literature to have at least 30 participants.^[36-38] Participants who agreed to participate in the test-retest were included in the study. Test-retest reliability was assessed using ICC and supported by Pearson's correlation analysis.

Ethical consideration

The research was approved by the Sakarya University Faculty of Medicine Non-Invasive Research Ethics Committee on [31 Jan 2023]. At every stage of the research, ethical principles in the Declaration of Helsinki were followed. Verbal and written informed consent was obtained from all participants.

Results

The mean age of the participating mothers was 30.6 ± 5.4 [min 20.0-max 41.0]. Of the mothers, 41.5% were university graduates, and 67.5% were unemployed. The gender of 53.5% of the infants included in the research was male. Considering the age distribution of the infants, 36% were 4 months old, 44% were 5 months old, and 20% were 6 months old. Descriptive characteristics of the participants were presented in Table 1.

Descriptive statistics indicated that total scores ranged from 50 to 70 (66.35 ± 4.35).

Content validity

The item content validity index (I-CVI) calculated as a result of evaluations from 11 experts was found to be between 0.91 and 1.00 for all items. The S-CVI/Ave for the overall scale was 0.98. The S-CVI/UA was found to be 0.81.

Table 1. Descriptive characteristics of the participants (N=200).

	Mean±SD	Min-max	n (%)
Mean of mothers age (years)	30.6±5.4	20.0-41.0	
Education level	Primary school		13 (6.5)
	Middle school		25 (12.5)
	High school		79 (39.5)
	University		83 (41.5)
Working status	Unemployed (housewife)		135 (67.5)
	Full time		60 (30.0)
	Part time		5 (2.5)
Place of residence	Village/Town		12 (6.0)
	District		159 (79.5)
	City center		29 (14.5)
Income status	Income exceeds expenses		46 (23.0)
	Income equals expenses		143 (71.5)
	Income less than expenses		11 (5.5)
Family type	Nuclear family		181 (90.5)
	Extended family		19 (9.5)
Number of children	Single child		83 (41.5)
	Two child		79 (39.5)
	Three child		30 (15.0)
	Four child and above		8 (4.0)
Infant's gender	Female		93 (46.5)
	Male		107 (53.5)
Infant's age (years)	4 months		72 (36.0)
	5 months		88 (44.0)
	6 months		40 (20.0)

Construct validity

The result of the KMO test applied to the structure consisting of 20 items prior to EFA was found to be 0.828. The result of Bartlett's test of sphericity was statistically significant (χ^2 (190) =1176.860 $p<0.001$). Conceptual domains of the draft items and results of the analysis before items extraction were presented in Supplementary Table S1.

Exploratory factor analysis was initially conducted on the full item pool, together with parallel analysis, which suggested a multi-factor structure. However, several items showed low factor loadings and cross-loadings and were therefore excluded based on predefined criteria. Following

item reduction, the analyses were repeated with the remaining items.

The final exploratory factor analysis and parallel analysis results supported a unidimensional structure. The results of the exploratory factor analysis for the last 10 items of the scale were presented in Table 2. Accordingly, a single-factor solution was retained for the scale. The factor loadings of the remaining items ranged from 0.478 to 0.740.

Inspection of the scree plot based on eigenvalues further confirmed the one-factor structure. Scree plot for the final version of the model was presented in Figure 2. The final model had

Table 2. Exploratory factor analysis results for the final 10-item scale (PAF).

Factor loadings		
Items	Factor 1	Uniqueness
I19	0.740	0.452
I18	0.632	0.600
I14	0.622	0.613
I17	0.620	0.615
I20	0.600	0.640
I5	0.573	0.671
I16	0.546	0.701
I12	0.542	0.706
I10	0.529	0.720
I3	0.478	0.771
Cronbach's alpha	0.827	
Eigenvalues	4.159	
Explained variance	41.588	
KMO= 0.850 X ² (45)= 591.342; Bartlett Test (p)<0.001		

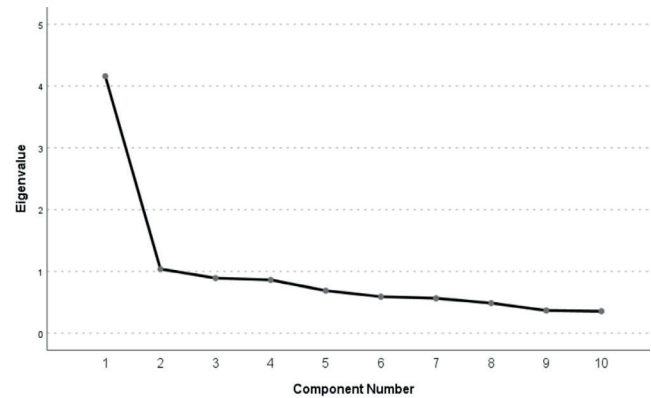
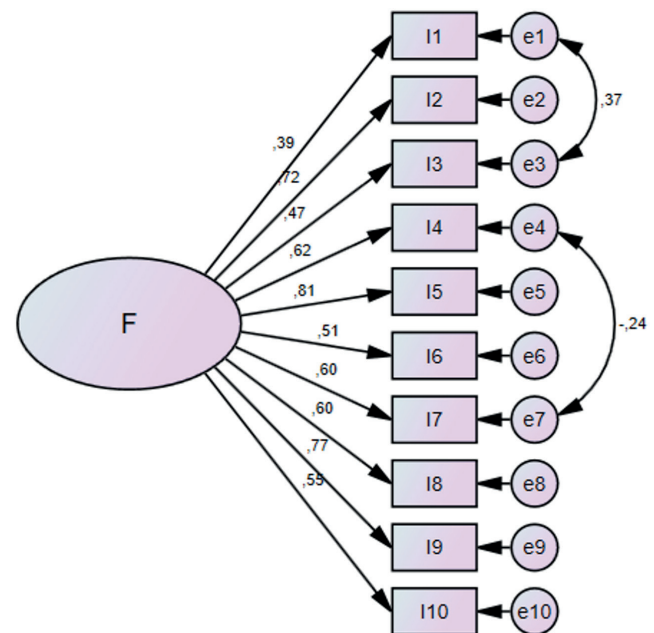
'Principal axis factoring' extraction method was used in combination with a 'none' rotation

an eigenvalue greater than 1.00 and explained 41.6% of the total variance (Table 2). A first-order confirmatory factor analysis (CFA) was conducted to test the unidimensional structure of the scale, with the single latent factor representing the Scale for the Assessment of Mothers' Readiness for the Transition to Complementary Feeding and the items specified as observed indicators. Confirmatory factor analysis of model was presented in Figure 3.

The CFA model demonstrated acceptable fit ($\chi^2/df= 1.091$, CFI= 0.963, TLI= 0.950, RMSEA= 0.021, SRMR= 0.077). Standardized factor loadings ranged from 0.39 to 0.81 and were statistically significant ($p<0.001$). Standardized factor loadings from confirmatory factor analysis (First-order model) were presented in Table 3.

Reliability

The scale demonstrated good internal consistency ($\alpha=0.827$; $\omega=0.828$). Composite reliability was satisfactory (CR=0.85), whereas AVE was below

**Figure 2.** Scree plot for the final version of the model.**Figure 3.** Confirmatory factor analysis of model.

the recommended level (0.38). Item-total correlations exceeded 0.30 for all items, and no item deletion was required. Split-half reliability also supported the stability of the scale. The test-retest reliability assessed in 35 participants with a two-week interval demonstrated a high level of stability (ICC=0.87, 95% CI [0.77–0.93]). Pearson's correlation analysis further supported this finding, indicating a strong positive relationship between the two measurements ($r=0.88$, $p<0.001$).

Table 3. Standardized factor loadings from confirmatory factor analysis (first-order model).

Items	Standardized loading	Unstandardized loading	SE	CR	p
I3	0.390	1.000	–	–	<0.001
I5	0.722	1.527	0.266	5.745	< 0.001
I10	0.468	1.212	0.188	6.439	< 0.001
I12	0.625	0.959	0.174	5.508	< 0.001
I14	0.806	1.615	0.313	5.152	< 0.001
I16	0.515	1.217	0.189	6.425	< 0.001
I17	0.600	0.860	0.176	4.881	< 0.001
I18	0.597	0.768	0.131	5.867	< 0.001
I19	0.766	0.931	0.161	5.799	< 0.001
I20	0.552	1.086	0.204	5.330	< 0.001

CR: Critical ratio; SE: Standard error

Discussion

The literature review showed that there was no similar measurement tool developed to assess mothers' readiness for the transition to complementary feeding. It is thought that this scale developed will evaluate mothers' readiness for the transition to complementary feeding and guide healthcare professionals in terms of eliminating the deficiencies in this regard in a timely manner. The current study revealed that the scale has a high level of reliability and adequately measures the construct it aims to measure.

Determining the validity and reliability of the tested measurement tool represent two important stages in the scale development process.^[35,39] Validity refers to the ability of a measure to measure the trait of interest.^[32,40] This study examined content and construct validity to test the scale's validity. Expert opinion was sought to test the scale's content validity.^[32,40,41] The Davis technique was employed for expert opinion, and the CVI was calculated.^[28,29] The content validity of the scale was evaluated using both item-level and scale-level indices. Item-content validity indices (I-CVI) vary between 0.91 and 1.00. The fit index of all items is above the criterion value of 0.80.^[29] Also, S-CVI/Ave for the overall scale was 0.98, indicating excellent content

validity.^[42] The high S-CVI/Ave value indicates that the scale has strong content validity, supporting its adequacy in representing the construct of mothers' readiness for complementary feeding. The Scale-Level Content Validity Index based on Universal Agreement (S-CVI/UA) was calculated as 0.81, indicating that 81% of the items achieved universal agreement among the experts. This finding suggests a high level of consensus regarding the relevance and representativeness of the items.^[42]

In addition, the majority of items met the recommended content validity criteria, and only a limited number of items required minor revisions based on expert feedback. Overall, the content validity analysis demonstrated that the items adequately represent the theoretical construct, and the scale has strong content validity to support further psychometric evaluation.

At the construct validity stage, factor analysis was conducted to examine the relationships among the scale items. The suitability of the data for factor analysis was assessed using the Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity. The KMO value was 0.828, indicating a good level of sampling adequacy, and Bartlett's test of sphericity was statistically significant ($p < 0.001$), confirming sufficient correlations among items

for factor analysis. These results indicate that the data were appropriate for factor extraction.^[26,39]

EFA and CFA were conducted to examine the construct validity of the scale.^[27]

The results of the exploratory factor analysis, conducted using Principal Axis Factoring, consistently supported a unidimensional structure for the scale. The initial EFA of the full item pool suggested a multi-factor structure; however, several items demonstrated low factor loadings and cross-loadings and were subsequently removed based on predefined criteria. Following item reduction, the factor structure was re-evaluated, and both the scree plot and eigenvalue criteria indicated a dominant single factor. In addition, parallel analysis supported a one-factor solution. All retained items loaded at acceptable levels, indicating strong construct coherence. Taken together, these findings suggest that the scale measures a single underlying construct.^[21,24,31]

Consequently, the exploratory factor analysis indicated a unidimensional structure explaining approximately 41.6% of the total variance, with an eigenvalue greater than 1. In the confirmatory factor analysis, the model fit indices were $\chi^2/df=1.091$, RMSEA=0.021, GFI=0.900, CFI=0.963, SRMR=0.077, and TLI=0.950. These values indicate a good model fit and support the adequacy of the proposed unidimensional structure.^[27,32,39,43] Standardized factor loadings ranged between 0.390 and 0.806. Item 3 was retained due to its theoretical relevance to the construct despite its relatively lower factor loading.

Correlated error covariance between I1–I3 were included due to similar item wording and overlapping content related to sequencing of infant feeding practices, which may introduce shared measurement error. The correlated error covariance between I4 and I7 was included based on modification indices and may reflect

shared method variance associated with self-report measurement. Modifications have applied cautiously and kept to a minimum to preserve the theoretical integrity of the model.

Reliability is the degree of consistency that a measurement displays when repeated under the same conditions.^[28,32,35,40] Cronbach's alpha coefficient, McDonald's omega and item-total score correlation coefficient are the most frequently utilized criteria to evaluate a scale's internal consistency.^[27,32,44] These reliability analyses are conducted to test whether the statements in the scale are consistent among themselves and whether all of the statements measure the same conceptual construct.^[27,28,41] The value of 0.70 for Cronbach's alpha coefficient is within acceptable limits. Furthermore, for high reliability, this value is expected to be 0.80 and above.^[28,32,35] For reliability to be interpreted as good, the item-total score correlation coefficient must be 0.30 and above. If the item-total score correlation coefficient of the scale is lower than 0.30; it is decided to delete problematic items by examining the impact of these items on Cronbach's alpha coefficient.^[32,34] In the present work, when two items with the item-total score correlation coefficient below 0.30 were deleted, these items have removed since Cronbach's alpha value changed significantly. McDonald's omega ($\omega = 0.828$) and Cronbach's alpha ($\alpha = 0.827$) have indicated good internal consistency of the scale.

The average variance extracted (AVE) values were below the recommended threshold of 0.50. However, composite reliability (CR) values exceeded 0.70, indicating adequate internal consistency. According to Fornell and Larcker (1981), convergent validity may still be considered acceptable when CR is above 0.60 despite low AVE values.^[45] The relatively low AVE values may be attributed to the multifaceted nature of readiness, which encompasses diverse dimensions.

In this study, test-retest reliability was assessed two weeks later in a subsample of 35 participants to evaluate the temporal stability of the scale.^[28,32,34,41] Although the period between these two measurements varies depending on the behavior measured and the target audience, it is generally stated that 2-4 weeks is an adequate period.^[28,34] Additionally, the use of a subsample of approximately 30 or more participants is considered acceptable for estimating test-retest reliability in scale development studies, particularly in early psychometric evaluation phases where feasibility and participant retention are important considerations. Methodological guidance suggests that sample sizes above 30 are generally sufficient to provide stable estimates of correlation-based reliability coefficients, including intraclass correlation coefficients (ICCs), when the instrument is newly developed and administered within a short retest interval.^[37,38] Accordingly, the selection of 35 participants in the present study is consistent with recommended practice in psychometric research and provides an adequate basis for evaluating temporal stability.

The intraclass correlation coefficient found as a result of the test-retest analysis showed a high level of temporal stability (ICC=0.87, 95% CI [0.77–0.93]). This finding was further supported by Pearson's correlation analysis.^[24,28,29,32,46] which demonstrated a strong positive relationship between the two measurements ($r=0.88$, $p<0.001$). Although readiness may be considered a potentially dynamic construct, the high ICC suggests that the scale demonstrates strong temporal stability over the assessed time interval. Therefore, the scale can be considered a reliable tool for repeated measurements in similar populations.

This scale, developed as a result of the analyses, was evaluated to be a valid and reliable measurement tool for assessing mothers' readiness for the transition to complementary feeding.

The concept of "readiness" in health behavior is widely recognized as a multidimensional construct encompassing cognitive, affective, motivational, and behavioral components.^[16,17] Although readiness is theoretically multidimensional, empirical findings in scale development studies may reveal a unidimensional structure, particularly when these components are highly interrelated and perceived holistically by respondents.^[47,48] In the context of maternal decision-making regarding infant feeding, these dimensions may converge into a single overarching perception of readiness. Therefore, the emergence of a unidimensional factor structure in the present study may reflect the integrated and practical nature of readiness as experienced by mothers. This structure enhances its practical utility in clinical and primary care settings, where brief, integrative assessments are often preferred for screening and decision-support purposes. Nevertheless, future research should examine whether multidimensional models may emerge in different populations or cultural contexts, and whether more granular subdimensions could improve predictive validity in intervention studies.

The descriptive results indicated that total readiness scores ranged from 50 to 70, with a relatively high mean score (66.35 ± 4.35). This suggests that participants generally reported high levels of readiness for the transition to complementary feeding. The relatively narrow standard deviation and the clustering of scores toward the upper end of the scale may indicate a potential ceiling effect within the current sample. This pattern may be attributed to the characteristics of the study sample, which consisted of mothers of infants aged 4–6 months who may already have been exposed to information or support regarding infant feeding practices. Alternatively, it may reflect generally high levels of perceived readiness in this population. Future studies with more diverse samples are recommended to further examine the scale's ability to discriminate

across different levels of readiness, particularly in populations with lower baseline knowledge or support.

To the best of our knowledge, this is one of the first scales developed in Türkiye addressing mothers' readiness for the transition to complementary feeding. However, the study has some limitations. The sample consisted of Turkish mothers with normally developing infants aged 4-6 months. Although the instrument demonstrated acceptable psychometric properties within a Turkish sample, its validity across different cultural and healthcare contexts has not yet been established. Health-related constructs such as readiness for complementary feeding are known to be influenced by cultural norms, feeding practices, and maternal beliefs, which may vary substantially across populations.^[49,50] Therefore, measurement equivalence cannot be assumed without formal cross-cultural validation procedures, such as measurement invariance testing. Future research should examine the factorial structure of the scale in diverse cultural settings and assess whether the construct of readiness is interpreted similarly across populations. Such studies are essential to ensure the generalizability and broader applicability of the instrument in international maternal and child health research.

Although the present study included an acceptable sample size for factor analytic procedures, methodological literature suggests that larger samples may provide more stable and generalizable parameter estimates in scale development studies. While sample sizes of 200 or more are generally considered adequate for exploratory and confirmatory factor analyses, recent psychometric research emphasizes that larger samples contribute to improved stability and replicability of factor structures, particularly in models with higher complexity or weaker factor loadings.^[23,24] In addition, cross-validation procedures, which are recommended to further

strengthen construct validity, typically require sufficiently large samples that can be split into independent subsamples for exploratory and confirmatory analyses. Therefore, the sample size of the current study may be considered sufficient but relatively limited in terms of fully supporting cross-validation procedures and maximizing the robustness and generalizability of the findings. Future studies with larger and more diverse samples are recommended to further validate the factor structure, enable cross-validation analyses, and strengthen the psychometric evidence of the scale.^[21,24]

Although the present study provides strong evidence for the factorial validity and internal consistency of the scale, certain limitations should be acknowledged. First, the study primarily focused on factorial validity, and evidence based on external validity was not fully examined. In particular, convergent and discriminant validity could not be assessed due to the absence of additional theoretically related and unrelated constructs in the dataset. Therefore, future research is recommended to evaluate the relationships of the scale with constructs such as maternal self-efficacy and parenting stress to further establish its construct validity.

In addition, predictive validity was not examined within the scope of this cross-sectional design. Longitudinal studies are therefore needed to determine whether readiness scores can predict subsequent infant feeding practices over time. The scale was designed as a continuous measure of readiness for research purposes rather than a diagnostic or screening tool. Therefore, no cut-off score was established. Future studies may explore the potential for defining clinically meaningful thresholds using ROC analysis when external criterion variables become available.

According to the recommendations of health authorities such as WHO and UNICEF, it is important that healthcare professionals monitor

exclusive breastfeeding for the first six months of typically developing infants who do not have any nutrition-related health problems and evaluate mothers' readiness for the transition to complementary feeding when their infants are 4-6 months old to ensure timely transition to complementary feeding.

In this regard, healthcare professionals can use the measurement tool developed as a checklist. Using it in this way will be beneficial both in supporting and monitoring infants' exclusive breastfeeding for the first six months and in planning the necessary early education and consultancy services in line with the needs of mothers who need to be supported in the transition to complementary feeding.

The scale is designed as a unidimensional continuous measure of mothers' readiness for the transition to complementary feeding and is intended primarily for research purposes and for informing clinical awareness rather than for diagnostic classification. Each item of the 10-item, seven-point Likert-type scale is scored from 1 ("I am not ready at all") to 7 ("I am completely ready"). The total score is obtained by summing all item scores, yielding a range between 10 and 70, with higher scores indicating greater readiness. There are no reverse-coded items. Although item-level responses may be examined descriptively, the primary interpretation of the scale is based on the total score. The scale was validated in a sample of mothers of typically developing infants aged 4-6 months.

Ethical approval

This study has been approved by the Sakarya University Faculty of Medicine Non-Invasive Researchs Ethics Committee (approval date 31.01.2023, number E-71522473-050.01.04-216162-01). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: NÇ, GH; data collection: GH; analysis and interpretation of results: NÇ, GH; draft manuscript preparation: GH. All authors reviewed the results and approved the final version of the article.

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The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest to disclose.

Generative AI statement

During the preparation and revision of this manuscript, we used ChatGPT (OpenAI) for language and stylistic editing and for technical guidance regarding the installation and use of statistical softwares (jamovi and jasp) for the additional analyses requested during the revision process. The statistical analyses were performed by the authors using the statistical softwares, and the resulting analyses and outputs were reviewed and verified by the authors. After using this tool, we reviewed and evaluated the information provided as appropriate and take full responsibility for the content, analyses, and conclusions of the publication."

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Association of anemia with comorbidity and polypharmacy in adults aged ≥ 80 years: an outpatient-based cross-sectional study

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ABSTRACT

Background: Anemia, multiple chronic conditions, and polypharmacy are common in older adults and are associated with adverse clinical outcomes. This study aimed to examine the relationship between anemia, chronic disease burden, and polypharmacy in individuals aged 80 years and older.

Methods: This single-center cross-sectional study included individuals aged ≥ 80 years who were followed in a Healthy Aging outpatient clinic. Anemia was defined using World Health Organization criteria. Comorbidity burden (≥ 4 chronic conditions) and polypharmacy (≥ 6 medications) were recorded. Multivariable logistic regression was used to identify factors independently associated with anemia.

Results: The study included 134 individuals. The mean age of the participants was 85.5 ± 3.9 years, and 61.2% were women. The overall prevalence of anemia was 51.5%. Compared to non-anemic individuals, those with anemia were older and had significantly higher comorbidity burden and a greater prevalence of polypharmacy. Hemoglobin levels were negatively correlated with both the number of medications and the number of comorbidities. In multivariable logistic regression analyses, age and polypharmacy were independently associated with anemia in one model. In an alternative model accounting for collinearity, age and comorbidity burden remained independently associated with anemia.

Conclusions: Anemia is highly prevalent among individuals aged ≥ 80 years and is associated with comorbidity burden and polypharmacy. The findings suggest that a more holistic clinical approach that also considers these factors may be useful in the evaluation of anemia in this age group. Prospective studies are needed to clarify the direction of these associations.

Keywords: Anemia, aged, 80 and over, comorbidity, multimorbidity, polypharmacy

Introduction

Anemia is a health problem that is frequently observed in the older age group and is important in terms of clinical outcomes. The World Health

Organization (WHO) defines anemia as a hemoglobin level of <13 g/dL in men and <12 g/dL in women.^[1] While the prevalence of anemia in community-dwelling older adults ranges from 8.1% to 24.7%, this rate increases to 31–60% in

nursing homes and up to 40–72% in hospitalized older adults.^[2]

In older individuals, anemia is evaluated not only as a hematological disorder, but as a multidimensional clinical condition associated with falls, reduced functional capacity, cognitive impairment, and increased mortality. Therefore, the early recognition and appropriate management of anemia in the older age group is of importance in terms of preserving functionality and maintaining quality of life.^[2] However, anemia in advanced age often appears not as a condition attributable to a single cause, but rather as a complex picture in which multiple clinical factors coexist. With aging, a decrease in physiological reserve, an increase in chronic disease burden, inflammatory processes, nutritional deficiencies, and malignancies may contribute to the development of anemia.^[3]

In this context, individuals aged eighty years and older represent a distinct population characterized by increased comorbidity burden, polypharmacy, and heterogeneous clinical features. The prevalence of comorbidities and multiple medication use both makes clinical decision-making processes more difficult and complicates the interpretation of laboratory abnormalities such as anemia.^[4]

On the other hand, polypharmacy is evaluated not only as multiple medication use, but also as an indicator reflecting an individual's overall health status and disease burden.^[5] In the literature, there are findings indicating that multiple medication use may be related to anemia through mechanisms such as gastrointestinal bleeding, disorders of nutrient absorption, and chronic inflammation.^[2] However, it is thought that approaches aimed at reducing polypharmacy (deprescribing) in older adults may contribute to the reduction of medication-related adverse effects.^[6]

However, studies evaluating the relationships between anemia, comorbidity burden, and polypharmacy in older adults are limited in our country. Although the general definition of the elderly population typically includes those aged 65 and over, this study focused specifically on individuals aged 80 years and older. This selection was primarily determined by the specific setting of our study, the 'Healthy Aging Outpatient Clinic,' which exclusively provides care for this age group. Furthermore, individuals aged 80 years and older represent a distinct population characterized by increased comorbidity burden and polypharmacy compared to younger older adults. This study aims to evaluate the relationship between anemia and factors such as comorbidity burden and polypharmacy in adults aged 80 and over. By using real-world clinical data, this study aims to provide findings that are relevant and practical for primary care settings. We hypothesized that anemia would be associated with a higher comorbidity burden and polypharmacy in this age group.

Material and Methods

Study design and ethical approval

This single-center, cross-sectional study was conducted in Amasya University Sabuncuoğlu Şerefeddin Training and Research Hospital between May and November 2025. In this province, follow-up of adults aged ≥80 years within the Ministry of Health 'Healthy Aging' program is centralized in this unit; therefore, the sampling frame was inherently single-center. The source population consisted of individuals aged 80 years and older who were registered and followed in the Healthy Aging Outpatient Clinic/Program. Participants were assessed either during outpatient visits or home visits. Data for each participant were collected only once at the time of assessment by a Family Medicine Specialist with over five years of experience in geriatric care and a registered nurse with at least ten years of

experience in home care services. Both researchers had received training on the administration of the assessment forms within the scope of the Healthy Aging Program to ensure standardization. This standardized protocol comprised a systematic three-step workflow: First, a face-to-face interview was conducted to administer the geriatric assessment scales. Second, the patient's self-reported chronic diseases and medication list were cross-referenced with the national electronic health record system and hospital database to ensure accuracy and minimize recall bias. Finally, venous blood sampling was performed. Regardless of the assessment setting, the same data collection method was applied to all participants.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by the local ethics committee (Date: 28.04.2025; Approval No: E-76988455-050.04-258208). Written informed consent was obtained from all participants or their legal representatives prior to data collection. Because all clinical and laboratory assessments were performed as part of this routine medical care, the study incurred no additional costs and received no specific funding.

Participants and inclusion criteria

Consecutive enrollment was employed to help reduce investigator-driven selection bias.

This approach was aligned with the structure of the Ministry of Health's 2024 "Healthy Aging Program," in which individuals aged 80 years and older are followed at this center.

All eligible individuals registered in the program were consecutively included in the study, irrespective of the assessment setting. Individuals with the following characteristics were excluded:

- Evidence of acute infection (fever, clinical/objective signs of infection, a documented diagnosis in the medical record, or antibiotic treatment),

- Malignancy cases receiving active chemotherapy,
- Individuals with active clinical bleeding.

For participants who could not be directly assessed due to cognitive impairment, sensory disability, or communication difficulties, data were obtained from primary caregivers.

Sample size

Sample size was determined based on the principle that logistic regression analysis requires at least 10 events per variable ($EPV \geq 10$) for each independent variable.^[7] Among the 134 participants included, anemia was identified in 69 individuals, meeting the minimum number of events required for analysis in a five-variable model. Thus, the sample size was considered adequate for multivariable logistic regression analysis.

Variables and measurement methods

Demographic data

Demographic characteristics such as age, sex, and living alone status were recorded.

Comorbidity assessment

Common chronic diseases were queried and recorded according to International Classification of Diseases (ICD-10) codes. These included hypertension, diabetes, heart failure, dementia, chronic obstructive pulmonary disease (COPD), cerebrovascular disease, malignant neoplasms (cancer), and Parkinson's disease. The total number of chronic diseases for each participant was calculated and used in analyses both as a continuous variable and as a categorical variable (≥ 4 comorbidities: high comorbidity burden). Because the presence of four or more comorbidities is considered a threshold reflecting clinical frailty in older adults in the literature, this classification was also adopted in the present study.^[4,8,9]

Medication use and polypharmacy assessment

Medications used by participants were grouped according to the Anatomical Therapeutic Chemical (ATC) classification system. The most frequently used medication groups included analgesics (paracetamol, non-steroidal anti-inflammatory drugs, opioids), central nervous system-related drugs (antidepressants, antipsychotics), gastric acid suppressants, and laxatives.

In addition, the total number of medications for each participant was recorded. While polypharmacy is commonly defined as the use of ≥ 5 medications, definitions in the literature vary significantly depending on the population studied.^[10] In our cohort of 'oldest-old' adults, the median number of prescribed medications was found to be 5.5. Therefore, to avoid a ceiling effect and to better stratify the high medication burden in this specific age group, a higher threshold of ≥ 6 medications was adopted for this study.

Functional status

Functional status was assessed using the Katz Index of Activities of Daily Living (ADL). This index consists of six domains—bathing, dressing, toileting, transfer (bed–chair), continence, and feeding—and is scored from 0 to 6. A score of 0 indicates total dependence, while a score of 6 indicates full independence. Participants who were unable to perform at least one of these activities were classified as dependent.^[11]

Nutritional status

Nutritional status was assessed using the Mini Nutritional Assessment–Short Form (MNA-SF). Scores of ≤ 7 indicated malnutrition, 8–11 indicated risk of malnutrition, and ≥ 12 indicated normal nutritional status. In analyses, malnutrition and risk of malnutrition groups were combined and classified as “presence of malnutrition.” Participants receiving oral nutritional supplements were also included in this group.^[12]

Assessment of depressive symptoms

Depressive symptoms were assessed using the Geriatric Depression Scale (GDS-30). A score of ≥ 11 was accepted as indicating the presence of a depressive state.^[13]

Definition and grouping of anemia

To ensure international comparability, WHO-recommended hemoglobin thresholds were used. Accordingly, individuals with hemoglobin (Hb) levels < 13.0 g/dL in men and < 12.0 g/dL in women were considered anemic. Participants were divided into two groups (anemia present vs. absent) according to these criteria.^[1]

Laboratory measurements

Venous blood samples were obtained either in the hospital setting or during home visits. Samples were collected in accordance with biosafety rules, with precautions taken to minimize hemolysis risk, and were transported to the laboratory on the same day under 2–8°C conditions.

Complete blood count, hemoglobin (g/dL), and mean corpuscular volume (MCV, fL) measurements were performed using a fully automated hematology analyzer (Sysmex XN-1000, Japan). Serum iron ($\mu\text{g/dL}$), ferritin (ng/mL), vitamin B12 (pg/mL), folate (ng/mL), TSH ($\mu\text{IU/mL}$), and 25-OH vitamin D (ng/mL) levels were measured using chemiluminescent immunoassay (CLIA) (Siemens Advia Centaur XP, USA). Glucose (mg/dL), urea (mg/dL), creatinine (mg/dL), uric acid (mg/dL), albumin (g/L), and CRP (mg/L) were analyzed using appropriate enzymatic and colorimetric methods (Beckman AU 5800, USA).

Statistical analysis

Analyses were performed using IBM SPSS Statistics (version 27.0; IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Kolmogorov–Smirnov test. Normally distributed data were presented

as mean $\pm$ standard deviation, and non-normally distributed data as median (minimum–maximum). Categorical variables were presented as number and percentage (%). To compare differences between groups according to anemia status, the chi-square test was used for categorical variables, and the independent samples t-test or Mann–Whitney U test was applied for continuous variables depending on distribution.

Multivariable logistic regression analysis was performed to identify independent factors associated with anemia. Candidate covariates were selected based on both statistical and clinical considerations. First, variables showing an association with anemia in univariable analyses at a significance level of $p < 0.05$ were considered eligible. Second, variables known from previous literature to be clinically relevant to anemia in older adults (age, sex, nutritional status, renal function, polypharmacy, and comorbidity burden) were also included, regardless of their univariable significance. Accordingly, the following variables were evaluated in the multivariable models: age, sex, malnutrition, urea level, polypharmacy, and comorbidity burden. Because a strong correlation was observed between the number of medications and the number of comorbidities ($r = 0.765$), indicating potential multicollinearity, these variables were not entered simultaneously into the same model. Instead, two separate multivariable models were constructed: model 1 included polypharmacy, and model 2 included comorbidity count. Variable selection was performed using the Forward Likelihood Ratio (Forward LR) method. Model fit was assessed using the Hosmer–Lemeshow goodness-of-fit test. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to estimate the strength of associations. Logistic regression assumptions and

interpretation of ORs were based on established methodological approaches.^[14] As there were no missing data, no imputation method was applied. Statistical significance was defined as $p < 0.05$ for all analyses.

Results

Descriptive characteristics

A total of 134 participants were included in the study. The mean age of the participants was 85.5 ± 3.9 years, and 61.2% were women. Of the individuals, 23.9% were living alone, and 48.5% were dependent in activities of daily living. The overall prevalence of anemia was found to be 51.5%. When the distribution by sex was examined, the prevalence of anemia was determined to be 52.4% in women and 50.0% in men. Hypertension (82.8%) was the most frequently reported chronic disease. High comorbidity burden (≥ 4 comorbidities) was present in 56.7% of participants, and polypharmacy (≥ 6 medications) was observed in 50.0%. The most commonly used medication groups were analgesics (67.1%) and proton pump inhibitors (47.0%) (Table 1).

Clinical and laboratory characteristics according to anemia status

In comparisons by anemia status, participants in the anemia group had a significantly higher mean age ($p = 0.048$). High comorbidity burden (69.6% vs. 43.1%; $p = 0.002$), comorbidity count (median: 4 vs. 3; $p = 0.008$), and use of ≥ 6 medications (63.8% vs. 35.4%; $p = 0.001$) were also significantly more frequent in the anemia group. When laboratory findings were examined, hemoglobin and iron levels were significantly lower in the anemia group, whereas urea levels were higher ($p < 0.01$; $p = 0.008$; $p = 0.019$, respectively) (Table 2).

Table 1. Descriptive characteristics of the study population.

Sample size (n=134)	Mean±SD	Median (min-max)
Age (years)	85,54±3,877	-
Gender n(%)		
Female	82 (61.2)	-
Male	52 (38.8)	-
n (%)		
Alone (Living Status)	32 (23.9)	-
Dependency (ADL)	65 (48.5)	-
Malnutrition (MNA-SF)	27 (20.1)	-
Depressive Symptoms (GDS)	59 (44.0)	-
Comorbid disease n (%)		
Hypertension	111 (82.8)	-
Dementia	42 (31.3)	-
Diabetes Mellitus	35 (26.1)	-
Congestive Heart Failure	25 (18.7)	-
Chronic Obstructive Pulmonary Disease	18 (13.4)	-
Parkinson's Disease	12 (9.0)	-
Cerebrovascular Disease	9 (6.7)	-
Cancer	5 (3.7)	-
Comorbidity Burden n (%)		
≤ 3 Comorbidities (Low–Moderate)	58 (43.3)	-
≥ 4 Comorbidities (High)	76 (56.7)	-
Number of Comorbidities	-	4 (0–8)
Medications n (%)		
Analgesics	90 (67.1)	-
Proton pump inhibitors	63 (47.0)	-
Laxatives	19 (14.2)	-
CNS-acting medications	16 (11.9)	-
Polypharmacy n (%)		
≤ 5 Medications	67 (50)	-
≥ 6 Medications	67 (50)	-
Number of Medications		5.50 (0–10)
Laboratory Parameters	Mean±SD	Median (min-max)
Hemoglobin (g/dL)	-	12.35 (8.6–16.0)
MCV (fL)	-	91 (64–106)
Iron (µg/dL)	-	61 (20–185)
Ferritin (ng/mL)	-	46.0 (5.6–372.1)
Vitamin B12 (pg/mL)	-	306.5 (82–2000)
Folate (ng/mL)	-	7.34 (1.5–24.0)
Glucose (mg/dL)	-	5.95 (4.6–9.6)

ADL, dependency in daily activities ; CRP, C-Reactive Protein; GDS, Geriatric Depression Scale; MCV,Mean Corpuscular Volume; MNA-SF, Mini Nutritional Assessment ; TSH,Thyroid Stimulating Hormone; SD , standard deviation; Antidepressants and antipsychotics were grouped as CNS-acting medications.

Analgesics included paracetamol, NSAIDs, and opioid analgesics.

Anemia was defined as hemoglobin <12 g/dL for females and <13 g/dL for males.

Table 1. Continued.

Laboratory Parameters	Mean±SD	Median (min-max)
Urea (mg/dL)	45.98±16.80	-
Creatinine (mg/dL)	1.02±0.299	-
Uric acid (mg/dL)	-	5.8 (2.0–11.8)
Albumin (g/L)	-	38.6 (26.2–88.0)
TSH (µIU/mL)	-	1.35 (0.0–18.2)
Vitamin D (ng/mL)	-	11.62 (4.2–54.7)
CRP (mg/L)	-	3.55 (0.1 –141.4)
Anemia status n (%)		
Female	43 (52.4)	-
Male	26 (50.0)	-
Total	69 (51.5)	-

ADL, dependency in daily activities ; CRP, C-Reactive Protein; GDS, Geriatric Depression Scale; MCV,Mean Corpuscular Volume; MNA-SF, Mini Nutritional Assessment ; TSH,Thyroid Stimulating Hormone; SD , standard deviation; Antidepressants and antipsychotics were grouped as CNS-acting medications.

Analgesics included paracetamol, NSAIDs, and opioid analgesics.

Anemia was defined as hemoglobin <12 g/dL for females and <13 g/dL for males.

Table 2. Comparison of patient characteristics based on anemia status.

(n=134)	No anemia (n=65)	Anemia (n=69)	p
Age (years) ^a	84.68 ± 3.14	86.36 ± 4.32	0.048 ^t
Gender n (%)			0.783
Female	39 (60.0)	43 (62.3)	
Male	26 (40.0)	26 (37.7)	
n (%)			
Alone (Living Status)	14 (21.5)	17 (24.6)	0.637
Dependency (ADL)	27 (41.5)	38 (55.1)	0.117
Malnutrition(MNA-SF)	13 (20.0)	14 (20.3)	0.967
Depressive Symptoms (GDS)	26 (40.0)	33 (47.8)	0.362
Comorbid disease n (%)			
Hypertension	52 (80.0)	59 (85.5)	0.398
Dementia	20 (30.8)	22 (31.9)	0.889
Diabetes Mellitus	15 (23.1)	20 (29.0)	0.486
Congestive Heart Failure	12 (18.5)	13 (18.8)	0.955
Chronic Obstructive Pulmonary Disease	9 (13.8)	9 (13.0)	0.892
Parkinson's Disease	5 (7.7)	7 (10.1)	0.619
Cerebrovascular Disease	4 (6.2)	5 (7.2)	0.412
Cancer	1 (1.5)	4 (5.8)	0.196

ADL, dependency in daily activities ; CRP, C-Reactive Protein; GDS, Geriatric Depression Scale; MCV,Mean Corpuscular Volume; MNA-SF, Mini Nutritional Assessment ; TSH,Thyroid Stimulating Hormone;

SD, standard deviation; ^a, mean ± standard deviation; ^b, median (minimum–maximum).

^t, Student's t-test; m, Mann–Whitney U; χ^2 , Chi-square test

Antidepressants and antipsychotics were grouped as CNS-acting medications.

Analgesics included paracetamol, NSAIDs, and opioid analgesics.

Anemia was defined as hemoglobin <12 g/dL for females and <13 g/dL for males.

Table 2. Continued.

(n=134)	No anemia (n=65)	Anemia (n=69)	p
Comorbidity Burden n (%)			
≤ 3 Comorbidities	37(56.9)	21(30.4)	0.002 χ^2
≥ 4 Comorbidities	28(43.1)	48(69.6)	
Total Number of Comorbidities ^b	3 (0-8)	4 (0-7)	0.008 m
Medications n (%)			
Analgesics	40 (61.5)	50 (72.5)	0.178
Proton pump inhibitors	29 (44.6)	34 (49.3)	0.589
Laxatives	9 (13.8)	10 (14.5)	0.944
CNS-acting medications	6 (9.2)	10 (14.5)	0.348
Polypharmacy n (%)			
≤ 5 Medications	42 (64.6)	25 (36.2)	0.001 χ^2
≥ 6 Medications	23 (35.4)	44 (63.8)	
Total Number of Medications ^b	5 (0-8)	6 (0-10)	0.001m
Laboratory Parameters			
Hemoglobin ^b	13.5 (12.1 –16.0)	11.4 (8.6 –13.0)	<0.01m
MCV ^b	91.0 (64.7 –103.0)	91.0 (64.0 –106.0)	0.839
Iron ^b	69 (23 –185)	56 (20 –155)	0.008m
Ferritin ^b	45.7 (5.6 –249.8)	46.3 (8.2 –372.1)	0.732
Vitamin B12 ^b	312 (133 –2000)	304 (82 –1289)	0.650
Folate ^b	7.71 (3.2 –24)	6.61 (1.5 –24)	0.064
Glucose ^b	126(85-229)	123 (97 –212)	0.223
Urea ^a	43.4±17.15	48.4±16.21	0.019t
Creatinine ^a	0.98±0.25	1.05±0.33	0.268
Uric acid ^b	5.9 (2 –11.8)	5.6 (2.4 –10.3)	0.322
Albumin ^b	39.0 (31 –45.9)	36.7 (26.2 –88)	0.092
TSH ^b	1.34 (0 –18.2)	1.37 (0 –10.0)	0.904
Vitamin D ^b	10.4 (4.2 –54.7)	15.7 (4.2 –54.5)	0.097
CRP ^b	4.01 (0.1 –36.2)	2.67 (0.1 – 141.4)	0.268

ADL, dependency in daily activities ; CRP, C-Reactive Protein; GDS, Geriatric Depression Scale; MCV,Mean Corpuscular Volume; MNA-SF, Mini Nutritional Assessment ; TSH,Thyroid Stimulating Hormone;

SD, standard deviation; ^a, mean ± standard deviation; ^b, median (minimum–maximum).

t ,Student's t-test; m, Mann–Whitney U; χ^2 , Chi-square test

Antidepressants and antipsychotics were grouped as CNS-acting medications.

Analgesics included paracetamol, NSAIDs, and opioid analgesics.

Anemia was defined as hemoglobin <12 g/dL for females and <13 g/dL for males.

Logistic regression analysis

A statistically significant negative correlation was observed between hemoglobin level and the number of medications (Spearman's rho = -0.230, p = 0.008) as well as the number of comorbidities (Spearman's rho = -0.227, p = 0.008) (Table 3).

Logistic regression analyses were performed to identify factors associated with anemia. In univariable analyses, age, polypharmacy, and comorbidity burden were significantly associated with anemia (p < 0.05). Sex, malnutrition, and urea level were not statistically significant but

were retained in multivariable modeling due to their established clinical relevance. Given the high correlation between medication count and comorbidity count ($r = 0.765$), these variables were analyzed in separate multivariable models to avoid multicollinearity.

In Model 1 (including polypharmacy), age (OR = 1.166; 95% CI: 1.053–1.291; $p = 0.003$) and polypharmacy (OR = 4.051; 95% CI: 1.892–8.676; $p < 0.001$) were independently associated with anemia. In Model 2 (including comorbidity count), age (OR = 1.126; 95% CI: 1.022–1.240; $p = 0.017$) and comorbidity burden (OR = 2.950; 95% CI: 1.430–6.088; $p = 0.003$) remained independently associated with anemia. The Hosmer–Lemeshow test indicated adequate model fit for both models (Model 1: $p = 0.125$; Model 2: $p = 0.516$) (Table 4).

Table 3. Correlation of hemoglobin with number of medications and comorbidities.

	Spearman's rho (r)	p
Number of medications	-0.230	0.008
Number of comorbidities	-0.227	0.008

A p value < 0.05 was considered statistically significant.

Discussion

This study demonstrated that anemia is common among individuals aged 80 years and older and is associated with both comorbidity burden and polypharmacy. The findings suggest that considering these factors in the evaluation of anemia in very old adults may be meaningful.

With aging, decreases in physiological reserves, chronic low-grade inflammation, vascular stiffness, and metabolic changes are among the key mechanisms that increase the frequency of cardiovascular diseases. These processes are known to be closely related to the rise in hypertension and multimorbidity prevalence in advanced age.^[15] Indeed, the literature reports that the prevalence of hypertension in older adults exceeds 70%^[16] and that multiple chronic disease burden is common. Similarly, in older populations with cardiovascular disease, the proportion of individuals with four or more comorbidities has been reported to be approximately 50%.^[4] Consistent with these findings, hypertension was the most frequently observed chronic condition in our study (82.8%). In addition, the presence of four

Table 4. Logistic regression analysis of factors associated with anemia.

		Univariate						Multivariable				
Model 1	β	OR	95% CI			p	β	OR	95% CI			p
Age	0.118	1.126	1.025		1.237	0.013	0.154	1.166	1.053	-	1.291	0.003
Gender	0.098	0.907	0.453	-	1.818	0.783						
Polypharmacy	1.167	3.214	1.585	-	6.516	<0.001	1.399	4.051	1.892	-	8.676	<0.001
Malnutrition	0.018	1.018	0.437	-	2.370	0.967						
Urea	0.019	1.019	0.997	-	1.041	0.090						
Model 2												
Age	0.118	1.126	1.025		1.237	0.013	0.126	1.126	1.022	-	1.240	0.017
Gender	0.098	0.907	0.453	-	1.818	0.783						
High comorbidity burden	1.070	2.916	1.439	-	5.911	0.003	1.082	2.950	1.430	-	6.088	0.003
Malnutrition	0.018	1.018	0.437	-	2.370	0.967						
Urea	0.019	1.019	0.997	-	1.041	0.090						

OR, odds ratio; CI, confidence interval. The dependent variable was anemia status.

Model 1: Included age, sex, polypharmacy (≥ 6 medications), malnutrition, and urea (Hosmer–Lemeshow $p = 0.125$).

Model 2: Included age, sex, comorbidity burden (≥ 4 comorbidities), malnutrition, and urea (Hosmer–Lemeshow $p = 0.516$).

Variable selection in both models was performed using the forward likelihood ratio method

or more comorbidities in 56.7% of the participants reflects a high multimorbidity burden and is in line with the existing literature.

It is well recognized that medication use increases substantially in parallel with an increasing number of comorbidities. In the literature, approximately 56% of individuals aged 85 years and older are reported to use five or more medications; among individuals with two comorbid diseases, 20.8% reportedly use 4–9 medications and 1.1% use ten or more.^[5] These data suggest a relationship between multimorbidity and polypharmacy in advanced age. In line with these findings, polypharmacy (use of six or more medications) was identified in 50% of participants in our study. Additionally, the high prevalence of analgesic use may be related to musculoskeletal problems and chronic pain, which are common in advanced age.^[17]

In this study, anemia prevalence among individuals aged 80 years and older was 51.5%. This rate suggests that anemia is a common clinical problem in very old adults and is generally consistent with the high prevalence rates reported in the literature. Similarly, studies conducted among older adults receiving home healthcare services have reported high anemia prevalence. Aslaner et al. reported an anemia prevalence of 58.7% in this group^[18], while in a prospective cohort study by Yurt and Yavuz, the prevalence was 65.4% among older adults receiving home care.^[19] Although lower prevalence rates have been reported in community-dwelling older adults, rates exceeding 50% appear consistent with the literature in groups with higher healthcare needs.^[2]

It has been reported that the high prevalence of anemia in older adults may be associated with multiple factors, including age-related physiological changes, chronic inflammation, physical inactivity, polypharmacy, nutritional deficiencies, and an increased comorbidity

burden.^[2] In this respect, the advanced age of the study population, high comorbidity burden, and prevalent polypharmacy may be considered among the factors contributing to the observed frequency of anemia.

The presence of multimorbidity has been explained by various biological mechanisms that may be associated with the development of anemia in advanced age. It has been reported that low-grade chronic inflammation accompanying an increased chronic disease burden may contribute to the development of inflammation-related anemia by suppressing erythropoiesis and disrupting iron metabolism.^[3] In this context, the finding in our study that anemia was independently associated with comorbidity burden may be considered consistent with these mechanisms. Indeed, some studies have reported that the likelihood of developing anemia increases progressively in individuals with two or more comorbidities, and that this increasing trend becomes more pronounced particularly in the presence of three or more comorbidities.^[9,18] Similarly, in our study, the presence of four or more comorbidities was found to be significantly associated with anemia. This threshold is consistent with previous studies as a marker reflecting clinical vulnerability.^[8]

In our study, the finding that urea levels were higher and iron levels were lower in anemic individuals suggests that impaired renal function and alterations in iron metabolism may contribute to the development of anemia. Indeed, the literature has shown that blood urea nitrogen is inversely associated with hemoglobin levels, independent of glomerular filtration rate.^[20] On the other hand, previous studies have reported that iron deficiency and other nutritional deficiencies play a role in the etiology in approximately one third of older adults with anemia, while chronic inflammation or chronic kidney disease contributes to the etiology in another one third.^[21]

However, in our study, no statistically significant association was found between malnutrition and anemia. This finding may be related to the fact that the screening tool used (MNA-SF) does not directly include hematological parameters, the multifactorial nature of anemia, and the relatively low prevalence of malnutrition in the study population. On the other hand, the positive association observed between iron levels and hemoglobin suggests that the role of nutritional deficiency in the development of anemia cannot be completely excluded.^[22] This observation implies that, when evaluating anemia in older adults, incorporating biochemical parameters alongside general nutritional screening tools may be helpful.

Polypharmacy is considered one of the important clinical factors that may be associated with the development of anemia in advanced age. In the literature, it has been reported that multiple medication use may be associated with anemia through mechanisms such as gastrointestinal adverse effects, impaired nutrient absorption, and chronic inflammation. In particular, nonsteroidal anti-inflammatory drugs, anticoagulants, and certain cardiovascular medications have been reported to increase the risk of gastrointestinal mucosal damage and occult bleeding, while medications such as proton pump inhibitors and metformin may affect iron and vitamin B12 absorption.^[2] Within this framework, the identification of analgesics as the most frequently used medication group in our study may be compatible with potential gastrointestinal mechanisms described in the literature. In parallel, the independent association between polypharmacy and anemia suggests that medication burden should be considered during anemia assessments in very old adults. Nonetheless, further detailed and prospective studies are needed to clarify the specific effects of medication types, duration of use, and combinations on this relationship.

This study has several limitations. First, its single-center design and relatively limited sample size may affect generalizability. In addition, the study population consisted of individuals registered in the Healthy Aging Program and followed in a dedicated outpatient/home-care setting. Therefore, the participants may represent a selected group of adults aged 80 years and older with relatively higher healthcare needs than the general community-dwelling older population. This should be considered when extrapolating the findings to broader older adult populations or to different primary care settings. Consecutive sampling helps reduce selection bias by the researchers, but it may limit how well the results apply to other populations because only program-registered individuals were included. Due to the cross-sectional design, observed associations cannot be interpreted causally. No sub-classification of anemia etiology was performed. Furthermore, while the sample size was adequate to evaluate the cumulative burden of comorbidity, it was insufficient to analyze the specific associations between anemia and individual disease subtypes (e.g., different types of neoplasms) or specific drug classes. Additionally, the fact that some clinical data were obtained from primary caregivers may have modestly affected data accuracy.

Despite these limitations, the study's focus on individuals aged 80 years and older and the combined evaluation of comorbidity and polypharmacy, based on real-world data, may contribute to a better understanding of the clinical characteristics of this patient group in our country.

Conclusion

This study indicates that anemia is commonly observed among individuals aged 80 years and above and appears to be associated with a higher burden of comorbidities and increased medication use. These observations highlight the potential value of assessing anemia within a broader

clinical context, which includes consideration of existing comorbidities and polypharmacy, to inform a more comprehensive and individualized care approach in very old adults. From a primary care perspective, these findings suggest that anemia in adults aged 80 years and older should not be evaluated solely as an isolated laboratory abnormality. When anemia is detected in this age group, clinicians should also consider reviewing the patient's comorbidity burden, medication list, renal function, nutritional indicators, and potential drug-related contributors. In particular, the presence of polypharmacy may serve as a practical warning sign prompting medication review and assessment of potentially reversible causes of anemia.

Ethical approval

This study has been approved by the Amasya University Non-Interventional Clinical Research Ethics Committee (approval date 28.04.2025 number E-76988455-050.04-258208). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: AD, SBŞ; data collection: AD, SBŞ; analysis and interpretation of results: AD, SBŞ; draft manuscript preparation: AD, SBŞ. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest to disclose.

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Evaluation of family medicine identity levels and personality types among family medicine residents and specialists

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ABSTRACT

Objective: This study aimed to examine the association between family physicians' professional identity and Enneagram-based dominant personality types, and to explore whether professional identity scores vary across personality patterns.

Methods: This descriptive cross-sectional study was conducted between June 5-September 1, 2025, among family medicine residents and specialists who had completed residency training at the same tertiary training institution in Türkiye. Of 230 invited physicians, 218 participated (response rate: 94.8%); after excluding three outliers, analyses were performed on 215 physicians (122 residents, 93 specialists). Data were collected using a sociodemographic form, the Family Medicine Identity Scale (FMIS; 46 items; subdimensions: physician-patient communication, professional satisfaction, scope of work/comprehensive approach, biopsychosocial approach) and the Taştan Personality Type Inventory (44 items; nine Enneagram types). Due to the cross-sectional design, causal inferences cannot be drawn.

Results: No significant differences were found in total or subscale FMIS scores across any dominant Enneagram personality type (all $p > 0.05$). Effect sizes for all non-significant comparisons were small (η^2 range=0.008–0.045). The mean total FMIS score was 71.28 ± 9.35 . The most frequent dominant personality types were Type 1 (27.9%) and Type 2 (25.1%).

Conclusion: These findings suggest that professional identity strength in family medicine may be shaped more by shared specialty norms and training than by dominant personality type. We recommend future longitudinal and qualitative studies to further explore how different personality types enact family medicine identity in practice.

Keywords: Social identification, family practice, personality, personality inventory

Introduction

Primary care plays a decisive role in health outcomes as the first point of contact within the health system, ensuring continuity of

preventive services, chronic disease follow-up, care coordination and accessibility.^[1] Although it is defined in this way in the Alma-Ata Declaration, family medicine—being a relatively new specialty with a broad scope of practice—

requires further clarification of its professional definition.^[2] Although the importance of family medicine is emphasized in the literature, it has been shown to be perceived as less attractive in career choices, with persistently low interest in the field. Therefore, clarifying this role within training and fostering a strong professional identity in primary care are of critical importance.^[3,4] Because one of the essential prerequisites for delivering high-quality care in medical practice is the development of a robust professional identity.^[5,6]

The positive development of professional identity may enhance job satisfaction and reduce the risk of burnout.^[6] The literature emphasizes that physicians who strongly internalize the roles and values of family medicine communicate more effectively with their patients and advocate more convincingly for family medicine's distinctive role within the healthcare system.^[7] Family medicine identity is a dynamic construct grounded in physicians' perceived professional roles, values, adopted attitudes, and everyday clinical practices.^[8] Studies conducted among medical students and early-career physicians have shown that, despite family medicine being perceived as an important specialty for society, general practice may be considered less attractive compared to other specialties when it comes to career choice, and career intentions toward family medicine tend to remain relatively low.^[3,4] This situation underscores the critical importance of more clearly defining family medicine roles and responsibilities during training. Building a strong, supported professional identity in primary care is essential both to improve the quality of care and to enhance the attractiveness of the field as a career.^[3,4,7] Researchers across different countries have worked to define this construct. In Türkiye, Ustunol et al. contributed to the field by developing a new scale tailored to the Turkish context.^[9]

Family medicine serves as the gateway to the health system and this role places long-term patient relationships, effective communication and advocacy at the center of practice.^[10] Therefore, although communication and continuity in family medicine are guided by shared professional standards, how these processes are experienced and sustained may be influenced by physicians' personality traits and relational styles.

Personality can be viewed as a holistic reflection of innate temperament traits and character shaped across the life course through social environments and experiences.^[11,12] Although there are publications discussing the Enneagram model in medical education, particularly in relation to self-awareness and team functioning, studies evaluating it together with professional identity remain limited.^[13]

The Enneagram is a personality model that classifies individuals into nine core types based on motivations, dominant fears, internal orientations, and ways of perceiving the world.^[14] Greater self-awareness may help individuals recognize their preferences, stressors, strengths and limitations, supporting more effective coping and more balanced interpersonal relationships.^[15,16]

Although the Enneagram provides a rich theoretical framework for understanding personality, it faces notable empirical limitations. The literature reports mixed evidence for reliability and validity, and normative data for physician populations remain absent.^[17] Acknowledging these constraints, the present study utilizes the Enneagram not as a definitive diagnostic tool, but as an exploratory and complementary framework for examining physician personality dynamics. Nevertheless, specific Enneagram type characteristics may theoretically align with distinct dimensions of family medicine professional identity. Type 1's perfectionism and rule-orientation may relate to the scope of work and comprehensive approach;

Type 2's helping orientation may connect with physician–patient communication; and Type 9's conflict avoidance and harmony-seeking may reflect the biopsychosocial approach. Based on this framework, we posited the alternative hypothesis (H1) that different dominant Enneagram personality types would show different FMIS scores, against the null hypothesis (H0) that no such differences would exist.

Contemporary frameworks suggest that professional identity may converge despite personality differences. Cruess et al. (2019) and Sternszus et al. (2024) emphasize that professional identity formation is shaped through socialization within educational environments and shared role expectations — processes that may overshadow individual personality-driven differences in identity scale scores.^[8,18]

The balance between inherent personality patterns and educational influences in professional identity formation (PIF) offers a valuable perspective for medical training.^[17,19] If identity were viewed as a largely stable construct, residency programs might prioritize selection based on specific profiles.^[17] Conversely, treating character structure as a dynamic growth process—as suggested in Enneagram literature—allows curriculum design to focus on self-reflective interventions.^[17,19] Preliminary evidence suggests that such developmental approaches may enhance communication skills and interpersonal growth within healthcare contexts.^[17] Furthermore, identifying underlying motivations could enable faculty to provide more balanced mentorship tailored to the individual developmental needs of residents.^[19]

This study aimed to examine the association between family physicians' professional identity and Enneagram-based personality patterns, and to explore the extent to which professional identity is shared and under which conditions individual differences become more pronounced.

To the best of our knowledge, no previous study has examined the relationship between family medicine professional identity and Enneagram-based personality typologies. Understanding whether professional identity dimensions covary with personality patterns may offer valuable insights for residency training. If identity were primarily shaped by stable personality traits, training programs might benefit from tailored approaches for different personality profiles. Conversely, if identity develops largely through shared training experiences and socialization, this would support the design of uniform educational interventions aimed at strengthening professional identity regardless of incoming personality characteristics. The present study thus addresses a gap in the literature and provides a framework for interpreting how convergence or divergence in identity scores relates to both personality and contextual factors in primary care training.

Materials and Methods

This descriptive cross-sectional study was conducted between June 5, 2025 and September 1, 2025. Participants were family medicine residents at a tertiary care training hospital in Türkiye and family medicine specialists who had completed residency training at the same institution.

A sample size calculation using G-Power 3.1.9.7 (effect size=0.50; α =0.05; power=95%) indicated a minimum required sample of 210 participants; assuming 10% data loss, the target sample size was set at 230. Of 230 invited physicians, 218 participated (response rate: 94.8%); three participants were identified as outliers based on examination of skewness and kurtosis values and Q-Q plots of scale scores, and were excluded; analyses were conducted on the remaining 215 participants. Of these, 122 were residents and 93 were specialists. Informed consent was obtained from all participants (Figure 1). No missing data were identified.

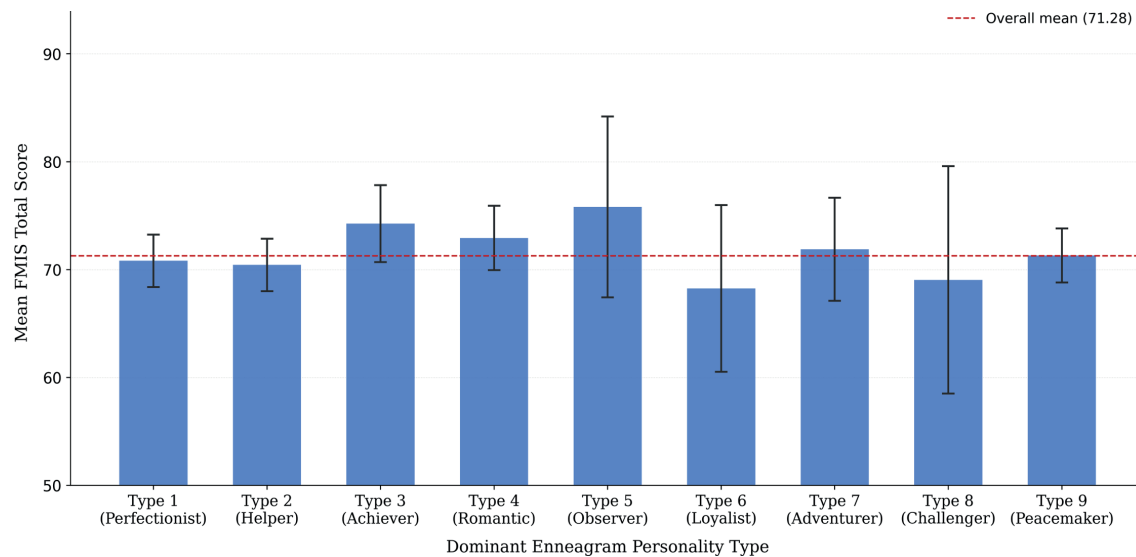


Figure 1. Mean FMIS total scores by dominant enneagram personality type.

Error bars represent 95% confidence intervals. The dashed line indicates the overall mean score (71.28). No significant differences were observed across personality types (all $p > 0.05$). FMIS: Family Medicine Identity Scale.

The study was conducted using a digital survey technique and a supervised questionnaire administration method. Data were collected via Google Forms. Participant anonymity and data confidentiality were maintained by ensuring that no identifying information was recorded. Informed consent was obtained electronically prior to participation; participants were informed of the voluntary nature of the study, their right to withdraw at any time without consequence, and that no incentives were offered. Participants completed a researcher-developed sociodemographic information form (age, sex, marital status, years in medical practice [defined as total years elapsed since graduation from medical school], years in residency/specialist practice, academic status and specialists' workplace), the Family Medicine Identity Scale (FMIS) and the Taştan Personality Type Inventory (TPTI).

FMIS is a 46-item instrument that quantitatively assesses the level of professional identity development based on family physicians' responses. The scale comprises the following subdimensions: physician-patient communication, professional satisfaction, breadth of practice and comprehensive approach, and biopsychosocial approach. Developed by Dr. Ustunol in 2019, the FMIS uses a five-point Likert format. Response options are "Strongly Agree", "Agree", "Partly Agree", "Disagree" and "Strongly Disagree".^[9]

TPTI is a 44-item, 7-point Likert instrument based on the Enneagram approach, scored from 0 ("Strongly disagree") to 6 ("Strongly agree"), that assesses nine personality types. The scale was developed by Taştan et al. in 2013. Items are grouped into nine types: the perfectionist, the helper, the achiever, the romantic, the observer, the loyalist, the adventurer, the challenger and the peacemaker.^[15]

The necessary permissions were obtained from the scale owners. For the TPTI, the dominant personality type was determined as the type with the highest raw score; no ties were observed in the current sample. Homogeneity of variances was assessed using Levene's test prior to all ANOVA comparisons; when homogeneity was met, the Scheffé post-hoc test was applied, and when it was not, Tamhane's T2 was used.

Analyses were performed using IBM SPSS Statistics 22. Categorical variables were summarized as numbers and percentages, and continuous variables as mean $\pm$ standard deviation and minimum–maximum values.

For comparisons between two groups, the independent-samples t-test was used and for comparisons among more than two groups, one-way ANOVA was applied. When the assumption of homogeneity of variances was met, the Scheffé post-hoc test was used; otherwise, Tamhane's T2 was applied. Associations between continuous variables were assessed using Pearson correlation and associations between categorical variables were evaluated using the chi-square/Fisher's exact test, as appropriate. A p value < 0.05 was considered statistically significant. Internal consistency of the instruments in the current sample was evaluated using Cronbach's alpha. The FMIS demonstrated high reliability overall ($\alpha=0.944$) and across its subscales: physician–patient communication ($\alpha=0.886$), professional satisfaction ($\alpha=0.817$), scope of work and comprehensive approach ($\alpha=0.763$), and biopsychosocial approach ($\alpha=0.816$). The TPTI also showed adequate internal consistency ($\alpha=0.827$).

The sample size was calculated to detect a moderate effect (Cohen's $f = 0.50$); accordingly, the study was not powered to detect small effects (e.g., Cohen's $f = 0.20$ – 0.30), which may have gone undetected. Given the exploratory nature of the analysis, we

did not adjust for multiple comparisons; however, all reported p -values remain non-significant even under conservative correction (e.g., Bonferroni $\alpha = 0.05/36 = 0.0014$). This study was reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) checklist for cross-sectional studies. In our study, the null hypothesis (H_0) stated that there is no statistically significant association between dominant Enneagram personality type and the level of family medicine identity, whereas the alternative hypothesis (H_1) stated that such an association exists.

The study was approved by the local ethics committee on 04 June 2025 (approval no: 1-25-1385).

Results

A total of 215 physicians were included. Overall, 68.8% were female, 31.2% male; 37.7% were single, 60.9% married, and 1.4% divorced/widowed. In terms of academic status, 56.7% were residents and 43.3% specialists. Among specialists, 24.7% worked in a Family Health Center (FHC), 35.5% in a hospital, 36.6% in a District Health Directorate (DHD)/Community Health Center (CHC) and 3.2% in other settings. The mean age was 30.61 ± 3.27 years; mean years in practice 5.35 ± 2.91 ; mean years in residency 2.05 ± 1.04 and mean years as a specialist 2.39 ± 1.24 (Table 1).

Descriptive statistics for physicians' total and subscale scores on the FMIS (n, mean, standard deviation, minimum, and maximum) are presented in Table 2. The mean FMIS subscale scores were 72.86 ± 9.47 for physician–patient communication, 63.08 ± 11.74 for professional satisfaction, 73.67 ± 9.79 for scope of work and comprehensive approach and 78.29 ± 13.82 for the biopsychosocial approach. The mean total FMIS score was 71.28 ± 9.35 .

Table 1. Descriptive statistics on the sociodemographic characteristics of physicians.

Sociodemographic Characteristics		n (%)	Mean ± SD (min-max)
Gender	Female	148 (68.8)	
	Male	67 (31.2)	
Marital Status	Single	81 (37.7)	
	Married	131 (60.9)	
	Divorced/Widowed	3 (1.4)	
Academic Status	Family Medicine Resident	122 (56.7)	
	Family Medicine Specialist	93 (43.3)	
Specialists' Workplace	FHC	23 (24.7)	
	Hospital	33 (35.5)	
	DHD/CHC	34 (36.6)	
	Other	3 (3.2)	
Age (years)			30.61 ± 3.27 (25-42)
Years in Medical Practice			5.35 ± 2.91 (1-17)
Years in Residency			2.05 ± 1.04 (1-5)
Years as Specialist			2.39 ± 1.24 (1-5)

FHC: Family Health Center, DHD: District Health Directorate, CHC: Community Health Center

Table 2. Examination of descriptive statistics for the family medicine identity scale.

Subdimensions	n	Mean ± SD	Min-max	95% CI of mean
Physician-Patient Communication (Factor 1)	215	72.86 ± 9.47	40-95.45	[71.59, 74.13]
Professional Satisfaction (Factor 2)	215	63.08 ± 11.74	32-90	[61.51, 64.65]
The Scope of Work and Comprehensive Approach (Factor 3)	215	73.67 ± 9.79	41.82-94.55	[71.59, 74.13]
Biopsychosocial Approach (Factor 4)	215	78.29 ± 13.82	26.67-100	[76.44, 80.14]
Total Scale	215	71.28 ± 9.35	41.74-93.91	[70.03, 72.53]

The lowest and highest mean scores were observed for Item 23 ("Being easily accessible for my patients positively affects the patient-physician relationship", mean=2.60) and Item 38 ("I think specialist training is necessary for the formation of a family medicine identity", mean=4.33), respectively. Clinically, the low score for Item 23 suggests that physicians do not view accessibility as the primary driver of the patient-physician relationship, while the high score for Item 38 reflects a strong sense of family medicine as a distinct specialty grounded in specialized training. Mean scores were also below 3.0 for Item 32, "Family medicine is a way of life for me" (mean=2.93), and Item 4, "I think I get enough respect in the eyes of patients" (mean=2.76) (Table 3).

According to the Tastan Personality Types Inventory (TPTI), 27.9% of the physicians were classified as "the perfectionist" (type 1), 25.1% as "the helper" (type 2), 9.8% as "the achiever" (type 3), 1.9% as "the romantic" (type 4), 3.7% as "the observer" (type 5), 4.7% as "the loyalist" (type 6), 8.4% as "the adventurer" (type 7), 2.8% as "the challenger" (type 8) and 15.8% as "the peacemaker" (type 9) (Table 4).

FMIS total and subdimension scores did not differ significantly according to physicians' academic status. Among specialists, FMIS scores were similar across workplaces except for professional satisfaction ($p=0.021$). Post hoc tests indicated lower mean professional satisfaction scores in DHD/CHC (60.11) than in FHC (67.91) and hospitals

Table 3. Notable items in physicians' responses to the FMIS.

FMIS Items		Mean	SD
Item 4	I think I get enough respect in the eyes of patients.	2.76	1.09
Item 23	Being easy to reach the doctor for my patients affects the patient-physician relationship positively.	2.60	1.12
Item 32	Family medicine is a way of life for me.	2.93	1.16
Item 38	I think it is necessary to receive specialist training for the formation of a family medicine identity.	4.33	0.96

FMIS: Family Medicine Identity Scale

Table 4. Examination of physicians' personality types according to the TPPI.

Variables		n (%)	95% CI
Personality Types	The Perfectionist	60 (27.9)	[21.9%, 33.9%]
	The Helper	54 (25.1)	[19.3%, 30.9%]
	The Achiever	21 (9.8)	[5.8%, 13.8%]
	The Romantic	4 (1.9)	[0.1%, 3.7%]
	The Observer	8 (3.7)	[1.2%, 6.3%]
	The Loyalist	10 (4.7)	[1.8%, 7.5%]
	The Adventurer	18 (8.4)	[4.7%, 12.1%]
	The Challenger	6 (2.8)	[0.6%, 5.0%]
	The Peacemaker	34 (15.8)	[10.9%, 20.7%]
	Total	215 (100)	—

TPPI: Tastan Personality Types Inventory

Table 5. Comparison of FMIS scores according to physicians' sociodemographic characteristics.

Variables		Subdimensions (Mean ± SD)				
		Factor 1	Factor 2	Factor 3	Factor 4	Total Score
Academic Status	Resident (n=122)	72.80 ± 9.59	62.40 ± 12.19	73.85 ± 10.09	77.97 ± 12.68	71.13 ± 9.50
	Specialist (n=93)	72.94 ± 9.37	63.97 ± 11.13	73.43 ± 9.43	78.70 ± 15.26	71.48 ± 9.20
	t	-0.107	-0.970	0.318	-0.383	-0.274
	p*	0.915	0.333	0.751	0.702	0.785
Specialists' Workplace	FHC (n=23)	73.24 ± 8.30	67.91 ± 10.71	73.28 ± 7.36	77.68 ± 11.82	72.38 ± 8.03
	Hospital (n=33)	75.20 ± 9.50	65.33 ± 11.57	75.04 ± 10.12	81.21 ± 16.02	73.41 ± 9.62
	DHD/CDC (n=34)	70.69 ± 9.59	60.11 ± 9.76	72.13 ± 9.97	76.66 ± 17.15	69.13 ± 9.16
	F	2.002	4.035	0.799	0.770	2.001
	p*	0.141	0.021	0.453	0.466	0.141

*: The statistically significant difference was defined as $p < 0.05$

t: Independent Sample T Test, F: One Way ANOVA, r: Pearson Correlation Test

FMIS: Family Medicine Identity Scale, FHC: Family Health Center, DHD: District Health Directorate, CHC: Community Health Center

(65.33). In correlation analyses, age showed very weak negative correlations with FMIS physician-patient communication ($r=-0.149$, $p=0.029$), scope of work and comprehensive approach ($r=-0.175$, $p=0.010$), and total score ($r=-0.150$, $p=0.028$); these correlations explained less than 3% of the

variance ($r^2 < 0.03$) and should not be interpreted as clinically meaningful. In contrast, no significant associations were observed between FMIS subdimensions/total scores and the number of years spent in medical practice, residency or specialist practice (Table 5, Table 6 and Figure 2).

Table 6. Comparison of FMIS scores according to physicians' sociodemographic characteristics.

Variables		Subdimensions (mean SD)				
		Factor 1	Factor 2	Factor 3	Factor 4	Total score
Age (n=215)	r	-0.149	-0.090	-0.175	-0.102	-0.150
	p*	0.029	0.191	0.010	0.136	0.028
Years in Medical Practice (n=215)	r	-0.018	0.095	0.014	0.031	0.023
	p*	0.791	0.166	0.844	0.649	0.732
Years in Residency (n=122)	r	0.120	0.109	0.066	0.095	0.113
	p*	0.189	0.233	0.470	0.298	0.215
Years as Specialist (n=93)	r	-0.009	0.030	-0.018	-0.012	-0.002
	p*	0.932	0.772	0.861	0.912	0.984

*: The statistically significant difference was defined as $p < 0.05$

t: Independent Sample T Test, F: One Way ANOVA, r: Pearson Correlation Test

FMIS: Family Medicine Identity Scale, FHC: Family Health Center, DHD: District Health Directorate, CHC: Community Health Center

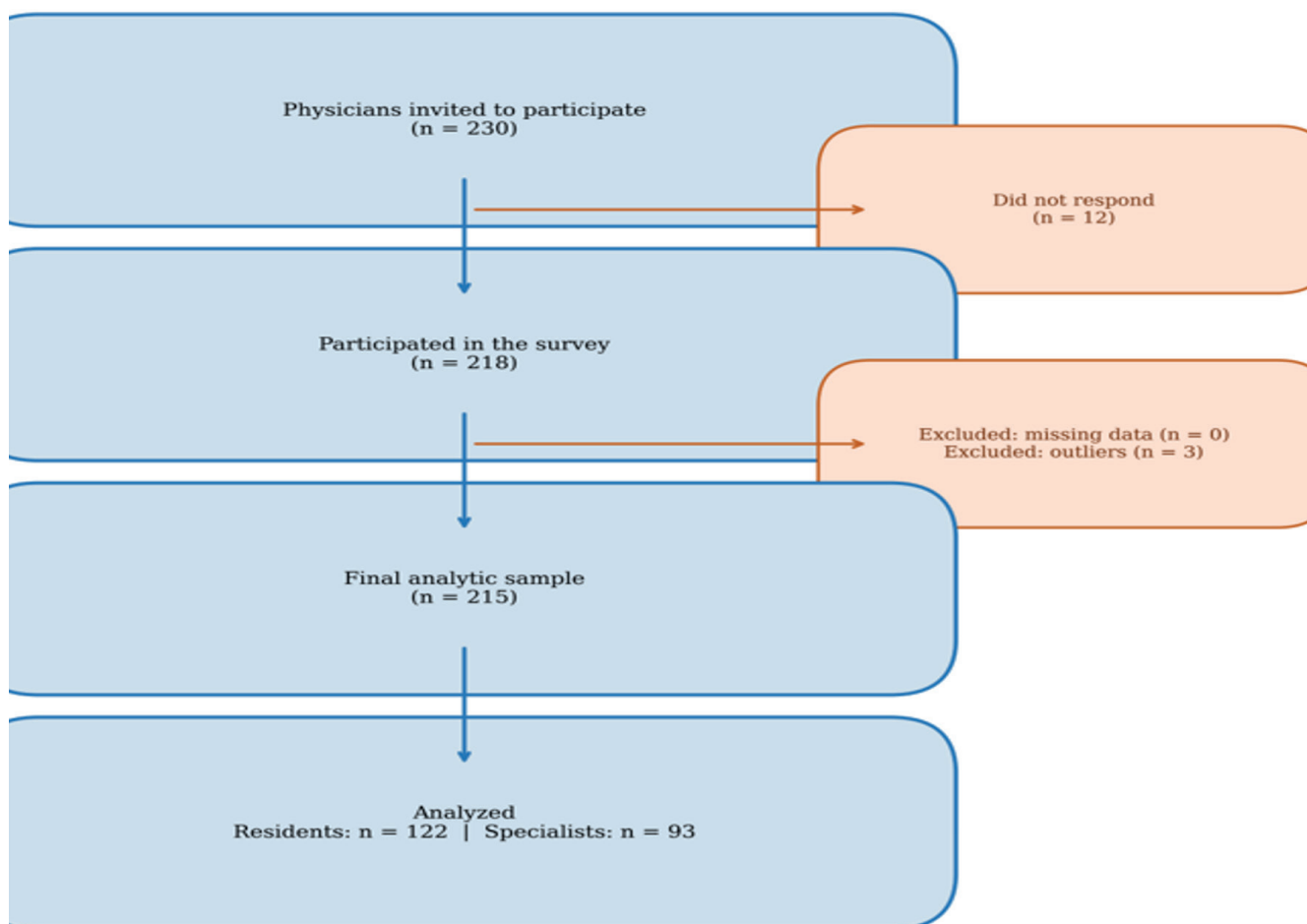
**Figure 2.** CONSORT-style participant flow diagram.

Table 7. Examination of the association between physicians' personality types and selected sociodemographic characteristics.

	Female n (%)	Male n (%)	Total n (%)	Single n (%)	Married n (%)	D/W n (%)	Total n (%)
The Perfectionist	35 (23.6)	25 (37.3)	60 (27.9)	19 (23.5)	39 (29.8)	2 (66.7)	60 (27.9)
The Helper	43 (29.1)	11 (16.4)	54 (25.1)	17 (21.0)	36 (27.5)	1 (33.3)	54 (25.1)
The Achiever	18 (12.2)	3 (4.5)	21 (9.8)	6 (7.4)	15 (11.5)	0 (0)	21 (9.8)
The Romantic	4 (2.7)	0 (0.0)	4 (1.9)	1 (1.2)	3 (2.3)	0 (0)	4 (1.9)
The Observer	5 (3.4)	3 (4.5)	8 (3.7)	5 (6.2)	3 (2.3)	0 (0)	8 (3.7)
The Loyalist	8 (5.4)	2 (3.0)	10 (4.7)	2 (2.5)	8 (6.1)	0 (0)	10 (4.7)
The Adventurer	13 (8.8)	5 (7.5)	18 (8.4)	8 (9.9)	10 (7.6)	0 (0)	18 (8.4)
The Challenger	3 (2.0)	3 (4.5)	6 (2.8)	3 (3.7)	3 (2.3)	0 (0)	6 (2.8)
The Peacemaker	19 (12.8)	15 (22.4)	34 (15.8)	20 (24.7)	14 (10.7)	0 (0)	34 (15.8)
Total	148 (100)	67 (100)	215 (100)	81 (100)	131 (100)	3 (100)	215 (100)

p*=0.034, Fisher Exact=16.606 (Gender) | p*=0.002, Fisher Exact=9.207 (Marital Status)

Cramér's V=0.265 (Gender); Cramér's V=0.194 (Marital Status)

The statistically significant difference was defined as $p < 0.05$

S: Single, M: Married, D/W: Divorced/Widowed, FMIS: Family Medicine Identity Scale

Table 8. Comparison of FMIS scores according to physicians' personality types.

FMIS Subdimension	df (between, within)	F	p	η^2
Physician–Patient Communication (Factor 1)	8, 206	0.584	0.791	0.022
Professional Satisfaction (Factor 2)	8, 206	0.870	0.543	0.032
Scope of Work and Comprehensive Approach (Factor 3)	8, 206	1.236	0.280	0.045
Biopsychosocial Approach (Factor 4)	8, 206	0.220	0.987	0.008
Total Score	8, 206	0.765	0.634	0.028

The statistically significant difference was defined as $p < 0.05$

F: One Way ANOVA, η^2 : eta squared (effect size). Full means and standard deviations for each personality type are presented in Supplementary Table S1.

FMIS: Family Medicine Identity Scale

A significant association was found between physicians' personality type and gender ($p=0.034$) as well as marital status ($p=0.002$). Effect sizes were small for both associations (Cramér's $V=0.265$ for gender; Cramér's $V=0.194$ for marital status), indicating limited practical magnitude. A sensitivity analysis excluding the two smallest personality type groups (Type 4, $n=4$; Type 8, $n=6$) yielded consistent null findings for FMIS comparisons across personality types. The most common type among women was the “helper” (29.1%, $n=43$), whereas among men it was the “perfectionist” (37.3%, $n=25$). By marital status, the “peacemaker” was most frequent among single

physicians (24.7%, $n=20$), while the “perfectionist” predominated among married (29.8%, $n=39$) and divorced/widowed physicians (66.7%, $n=2$) (Table 7). Regarding our primary outcome, FMIS total and subscale scores did not differ significantly across personality types (Table 8, Supplementary Table S1 and Figure 3): physician–patient communication ($F=0.584$, $p=0.791$), professional satisfaction ($F=0.870$, $p=0.543$), scope of work and comprehensive approach ($F=1.236$, $p=0.280$), biopsychosocial approach ($F=0.220$, $p=0.987$), and total score ($F=0.765$, $p=0.634$). Effect sizes for all non-significant comparisons were small (η^2 range=0.008–0.045).

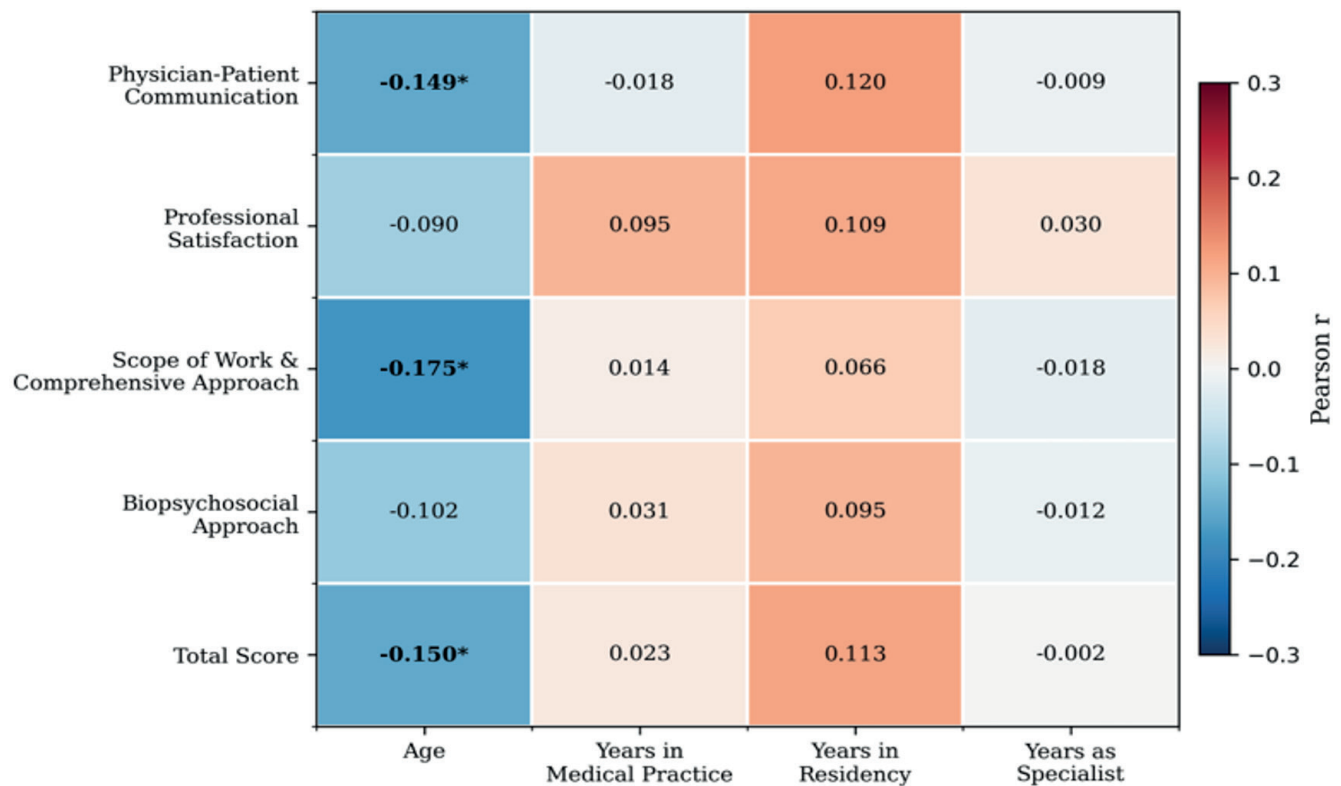


Figure 3. Correlation heatmap of FMIS subscales with continuous variables.

*r: pearson correlation test. FMIS: Family medicine identity scale.

Discussion

In this study, we aimed to examine the relationship between Enneagram-based dominant personality types and scores on the Family Medicine Identity Scale among family physicians. To the best of our knowledge, no studies have examined the relationship between family medicine professional identity and Enneagram-based personality types in the literature.

Considering the relationship between professional identity and personality typologies, Everett et al. compared Enneagram personality types with multidimensional professionalism and interpersonal communication measures among general surgery residents and found no significant associations.^[20]

Similarly, our study found no significant differences in FMIS subdimension or total scores across dominant Enneagram types. This does not imply that family medicine professional identity is independent of personality; rather, shared training goals, role expectations, and clinical practice norms within the specialty may have contributed to the convergence of identity scores across groups. Contemporary perspectives emphasize that professional identity is a dynamic construct shaped through socialization and influenced by contextual factors such as educational and workplace conditions, team interactions and feedback.^[18,21]

Examining the highest- and lowest-scoring FMIS items, the low scores for Item 4 and Item 32 suggest a link between societal recognition of family medicine and physicians' internalization of their

professional role. Low perceived respect from patients may reflect limited visibility and perceived value of the family physician role, which is closely related to professional satisfaction. Consensus work highlights mutual trust and respect in the physician–patient relationship and recognition of family medicine as a reputable specialty as key determinants of job satisfaction.^[22] Moreover, the blurring of role boundaries may limit physicians' ability to define their profession as an identity and to internalize family medicine as a “way of life”.^[23]

The lowest and highest mean scores were observed for Item 23 and Item 38, respectively. The low mean score for Item 23 does not suggest that family physicians view accessibility as unimportant; rather, it indicates that accessibility alone is not seen as the key driver of the patient–physician relationship. Clinically, this underscores that mutual trust and continuity of care built over time are more central to family medicine identity than structural elements such as rapid communication. Continuity literature highlights that mutual familiarity between patients and physicians is more critical than the quantity of access.^[24]

Item 38 had the highest mean score, suggesting that participants view family medicine as a distinct specialty with specific competencies. Clinically, this indicates that professional identity in family medicine is not merely a workplace definition but is grounded in standardized medical expertise acquired through specialty training. Consistent with this, Ustunol et al. developed the scale within the World Organization of National Colleges, Academies, and Academic Associations of General Practitioners/Family Physicians (WONCA) core competency framework, linking professional identity not only to the practice setting but also to competencies acquired through specialty training.^[9]

We found no association between academic status and professional identity scores. Similarly, Nazlıgül and Ayraler (2023) reported that academic

status was not a determinant of family physicians' professional satisfaction or professional self-concept.^[25] This may reflect early internalization of core clinical responsibilities and care philosophy during training, resulting in residents' identity scores comparable to those of specialists.

Emiroglu and Pala reported that physicians working in FHCs in Bursa had lower professional satisfaction than those in other settings.^[26] In our study, however, specialists working in DHD/CHCs had lower professional satisfaction than those in FHCs and hospitals. This finding should be interpreted as hypothesis-generating rather than conclusive, given the small subgroup size (DHD/CHC: n=34) and the fact that this was one of multiple workplace comparisons across four FMIS subscales. Nevertheless, this pattern may tentatively reflect a greater focus on administrative coordination and reporting and less clinical continuity and direct patient contact in DHD/CHC settings.

Age showed a negative association with professional identity scores, whereas Li et al. reported higher professional identity with increasing age.^[27] This discrepancy may reflect early-career enthusiasm declining over time as work-related challenges accumulate, potentially undermining professional identity.

Among the 215 physicians, the most common personality types according to the TPTI were the perfectionist and the helper, whereas the romantic and the challenger types were observed at lower rates. This distribution resembles the profile reported by Taştan in a mixed sample using the same inventory, with Type 1 (the perfectionist) and Type 2 (the helper) being the most prominent types in both samples.^[15] The higher proportion of Type 1 compared with Type 2 in our physician sample may tentatively reflect the structural demands of the profession; aspects of family medicine such as responsibility, organization, and adherence to rules could potentially be associated with

this pattern, though this interpretation remains speculative given the sample size. This pattern is also consistent with findings from studies examining the relationship between Enneagram types and medical specialty choice. On the other hand, the relatively high proportion of Type 9 (the peacemaker) in our sample may tentatively reflect key demands of family medicine—conflict avoidance, a conciliatory role, and sustaining long-term patient–physician relationships—though causal interpretations should be made with caution. Likewise, Bacik et al. reported that physicians with a Type 9 profile more often prefer specialties perceived as having lower workload and acute stress (e.g., family medicine, radiology, psychiatry, pathology).^[28]

The low frequency of Type 8 in our sample is consistent with studies suggesting that Type 8—characterized by traits such as “risk-taking, rapid decision-making and assertiveness/strength”—is expected to be more common in surgical specialties.^[28] In fields such as family medicine, where procedural intensity is relatively lower and team authority/hierarchical structures differ from those in surgical disciplines, it may be expected that Type 8–like patterns are less represented. The low frequency of Type 4 may be related to the relatively low sensitivity reported for discriminating Type 4 (66.7%) in the validity study of the TPTI.^[15]

When personality type categories were compared with sociodemographic variables, a significant association was found between dominant personality type and gender. Type 2 was more prevalent among women, whereas the Type 1 was more prevalent among men. In a Turkish sample, Type 1 was reported to be more common in men and a study conducted among physicians similarly found that Type 1 was more frequent in men and Type 2 in women.^[28,29] Together, these findings suggest that the distribution observed in our study

is consistent with the literature and may represent a reproducible pattern.

The higher prevalence of Type 1 among married physicians may indicate that Type 1’s emphasis on order and responsibility could be associated with maintaining long-term relationships. The higher prevalence of Type 9 among single physicians does not indicate a direct causal relationship. However, this finding may be interpreted as a pattern consistent with Type 9’s characteristics related to avoiding interpersonal conflict and maintaining harmony. Alexander and Schnipke noted that, in clinical/interpersonal contexts, Type 9 is conceptualized in terms of these tendencies. These tendencies may become more salient in relationship formation and maintenance processes, particularly when the goal of avoiding conflict/tension is predominant.^[30]

Limitations

Study limitations include limited generalizability due to the small sample sizes in certain personality types and subgroups and the restriction of the sample to a single clinic. Furthermore, findings may not be directly transferable to healthcare systems with different family medicine training structures, levels of societal recognition, or degrees of professional autonomy. The sample size was calculated to detect moderate effects (Cohen’s $f = 0.50$); accordingly, the study was not powered to detect small effects (e.g., $d = 0.20$ – 0.30), which may have gone undetected. Small but clinically relevant differences between personality types therefore cannot be ruled out. It should also be noted that personality assessments such as the Enneagram, if misused, could contribute to stigmatization, labeling, or biased selection decisions. The findings of the present study do not support the use of the Enneagram as a selection or screening tool for family medicine residency programs. Finally, given the exploratory nature of this study and the absence of validated interpretive thresholds for

the FMIS, it was not possible to determine what magnitude of score difference would constitute a clinically or educationally meaningful change. As the FMIS is the first scale developed in Türkiye for this domain, no established minimal clinically important difference (MCID) currently exists. Accordingly, statistical thresholds were used as the primary basis for assessing group differences, and longitudinal studies are needed to establish score ranges corresponding to meaningful distinctions in practice. A key measurement limitation also warrants acknowledgment: the FMIS assesses the strength of agreement with professional identity statements, not the behavioral expression or stylistic enactment of identity. It remains possible that different Enneagram types express family medicine identity in qualitatively different ways — for instance, a Type 1 physician may emphasize rule-based comprehensiveness while a Type 2 may prioritize empathetic communication — while still producing identical Likert-scale scores. Future research employing qualitative or observational methods may better capture such stylistic differences. In addition, assessing the Enneagram solely based on “dominant type” classification may fail to capture finer variations in personality patterns (e.g., wing features and stress/security orientations). Additionally, the low frequency of Type 4 (romantic) and Type 8 (challenger) in our sample may reflect true population differences or measurement artifacts of the TPTI; the relatively low sensitivity reported for Type 4 (66.7%) in the original validation study suggests that its low frequency should be interpreted with caution. The absence of a comparison group from other medical specialties represents a further limitation. Without a control group (e.g., surgical residents or internists), it remains unclear whether the absence of personality–identity associations is specific to family medicine or generalizable across specialties. Finally, because the measures were self-report–based, social desirability and response biases may have influenced both the personality

and identity scales. Physicians may have endorsed items presenting themselves favorably — as empathetic, rule-following, or harmonious — potentially inflating the prevalence of certain Enneagram types (e.g., Type 1, Type 2, Type 9) and reducing variability in both personality and identity scores.

Conclusion

In this study, we aimed to examine the association between Enneagram-based personality patterns and the subdimensions of family medicine professional identity and to provide an integrated framework describing how these patterns co-occur with demographic and professional variables. Our results do not support a simple, direct association between dominant Enneagram personality type and the strength of professional identity in family medicine, as measured by the FMIS. This suggests that contextual factors, including residency training, shared role expectations, and clinical practice norms, may overshadow personality-driven differences in identity scale scores. These findings should be interpreted in light of several limitations, including the single-center design, small subgroup sizes for certain personality types (Type 4, $n=4$; Type 8, $n=6$), the potential for self-report bias, and the absence of multiple comparison correction. Future research directions include: (1) longitudinal cohort studies following residents from entry through independent practice to track identity formation over time; (2) multi-center studies with larger samples to provide adequate power for small effects and stable estimation within rare personality types; (3) cross-specialty comparisons to determine whether personality–identity associations differ between family medicine and other disciplines; (4) qualitative studies exploring the lived experience of professional identity formation across Enneagram types; and (5) studies employing multiple personality frameworks (e.g., the Big Five alongside the Enneagram) to compare predictive

validity for professional identity outcomes. Furthermore, the findings of this study do not support the use of the Enneagram as a selection or screening tool for family medicine residency programs — an important practical implication given the growing popularity of personality assessments in medical education.

Ethical approval

This study has been approved by the Ankara Bilkent City Hospital No. 1 Scientific and Ethical Evaluation Board for Medical Research (approval date 04/06/2025, number TABED 1-25-1385). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: MMD, İK, ES; data collection: MMD; analysis and interpretation of results: MMD, İK, ES; draft manuscript preparation: MMD, İK, ES. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

The authors declare that there is no conflict of interest to disclose.

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, we used ChatGPT (OpenAI) in February 2026 to ensure compliance with the journal's formatting and writing requirements and for language/stylistic editing. After using this tool, we reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Migration status, maternal anaemia assessed at delivery and perinatal outcomes: a comparative study of Turkish and immigrant pregnant women

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ABSTRACT

Objective: This study aimed to investigate the association of migration status with maternal anaemia assessed at delivery and perinatal outcomes among Turkish and immigrant pregnant women (Syrian women under temporary protection status).

Methods: This retrospective cross-sectional study evaluated the sociodemographic, obstetric, and laboratory characteristics of Turkish and immigrant pregnant women who delivered at a tertiary care hospital in Türkiye. Maternal haemoglobin concentrations measured at admission for delivery were used to define maternal anaemia according to World Health Organisation criteria. Maternal and neonatal characteristics were compared between groups. Multivariable logistic regression analyses were performed to identify factors independently associated with maternal anaemia and neonatal birth weight.

Results: The study comprised 1,216 pregnant women (609 Turkish and 607 immigrant women) and 1,251 newborns (1,181 singleton and 70 twin newborns). Maternal anaemia at the time of delivery was more prevalent among immigrant women than Turkish women (42.8% vs. 28.7%, $p<0.001$). Migration status (OR=1.63, 95% CI: 1.26–2.10), younger maternal age (OR=0.96, 95% CI: 0.94–0.98), and multiparity (OR=2.09, 95% CI: 1.57–2.79) were independently associated with maternal anaemia. Birth weight, birth length, and head circumference did not differ significantly according to migration status. However, stillbirth rates were higher among immigrants than Turks (1.8% vs. 0.2%, $p=0.004$). Maternal anaemia was not independently associated with low birth weight or low 5-minute Apgar scores. Increasing gestational age (OR=2.22, 95% CI: 1.97–2.49; $p<0.001$) and multiparity (OR= 2.05, 95% CI: 1.22–3.45; $p=0.007$) were associated with higher odds of normal birth weight. Conversely, multifetal pregnancy was associated with lower odds of normal birth weight (OR=0.05, 95% CI: 0.02–0.12).

Conclusions: Maternal anaemia at delivery was more common among immigrant women than Turkish women. Similarly, the stillbirth rate was significantly higher among immigrant women. These findings underscore the importance of addressing social and structural determinants of maternal and perinatal health.

Keywords: Anaemia, immigrants, maternal health, newborn

Introduction

Anaemia during pregnancy remains a major global public health issue disproportionately affecting women in low- and middle-income settings and socially vulnerable population groups. According to the World Health Organization (WHO), nearly one-third of all pregnant women worldwide are affected by anaemia, with iron deficiency being the most common underlying cause.^[1] Maternal anaemia has traditionally been considered a risk factor for adverse perinatal outcomes such as preterm birth, low birth weight (LBW), and increased neonatal morbidity.^[2] Consequently, many countries, including Türkiye, have implemented universal prenatal iron supplementation programmes to reduce these risks.^[3] Anaemia in pregnancy is increasingly recognised as a condition shaped by broader social, economic, and structural determinants, such as poverty, nutritional insecurity, limited access to prenatal care, and gender-based vulnerabilities.^[4] Migration has been identified by WHO and the International Organisation for Migration as an important determinant of health, as the migration process may expose women to cumulative social, economic, and structural disadvantages that can adversely affect maternal and reproductive health outcomes.^[5]

Türkiye hosts one of the largest populations of displaced individuals worldwide, making it a unique setting for investigating maternal health inequalities within a universal healthcare system. In the period immediately following the large-scale migration from Syria to Türkiye, immigrant populations may initially exhibit more favourable health outcomes despite socioeconomic disadvantage, a phenomenon known as the “healthy migrant effect”. However, these initial advantages may decline over time due to accumulating social and structural barriers.^[6] Recent population-based studies have further emphasised the

role of social determinants, such as education, income, and migration status, in shaping maternal health outcomes, even in settings with universal healthcare coverage.^[7] These findings underscore the need to move beyond simplistic causal interpretations and to contextualise biological risk factors within broader social and demographic frameworks.

Despite the established importance of maternal anaemia and migration as determinants of maternal and child health, relatively few studies have examined these factors simultaneously within the same healthcare setting. In particular, evidence regarding the prevalence of anaemia among immigrant women and its relationship with neonatal outcomes in the early period following large-scale migration remains limited. Therefore, this study aimed to compare the prevalence of maternal anaemia assessed at delivery and perinatal outcomes between Turkish women and immigrant women and to evaluate factors associated with maternal anaemia and neonatal birth weight.

Materials and Methods

The study was approved by the İzmir Tepecik Training and Research Hospital Ethics Committee (date: 07.03.2017, number: 18). This retrospective cross-sectional study was conducted using the hospital data system and included all pregnant women who delivered at a tertiary care hospital in Türkiye between 1 January and 31 December 2016. This hospital, where the study was conducted, serves both Turkish and immigrant populations and functions as a referral center, providing comprehensive prenatal, natal, and postnatal care. ‘Immigrant pregnant women’ were defined as Syrian women under temporary protection status in Türkiye. Participants were classified as Turkish or immigrant based on their nationality records at hospital admission. A sample size was

estimated for the comparison of maternal anaemia prevalence between Turkish and immigrant pregnant women using a two-sided alpha of 0.05 and a power of 80%. Based on a previous study reporting anaemia prevalences of 35.5% in pregnant women, the minimum required sample size was calculated as 352 pregnant women.^[1] A total of 3,048 pregnant women were initially identified, including 610 immigrant pregnant women. Women with incomplete delivery or laboratory records were excluded. No additional exclusions were applied for chronic diseases or obstetric risk conditions. Specifically, 3 immigrant pregnant women and 16 Turkish pregnant women were excluded due to incomplete birth and laboratory records. After applying these exclusion criteria, 607 immigrant pregnant women were included in the study. To construct a comparison group of similar size, Turkish pregnant women were selected from the remaining eligible population using simple random sampling. All eligible Turkish pregnant women were listed from the hospital database and assigned unique identification numbers, and a computer-based random selection method was used to include 609 women without replacement. After applying the exclusion criteria, 607 immigrant pregnant women, 609 Turkish pregnant women, and 1,181 singleton and 70 twin newborns were included in the final analysis. Multifetal pregnancies were included in neonatal analyses; therefore, neonatal totals exceed the number of mothers.

Data collection tools

Sociodemographic and obstetric data of pregnant women, along with neonatal birth information, were routinely recorded in the hospital data system and the National Ministry of Health database. From these records, maternal age, gravidity, parity, gestational age, mode of delivery, and pregnancy outcome (live birth or stillbirth) were obtained. Neonatal variables included sex, birth weight, birth length, head circumference,

and 1- and 5-minute Apgar scores. Erythrograms of the pregnant women were examined. The erythrogram parameters performed by the hospital laboratory included haemoglobin (Hb), haematocrit (Hct), red blood cell count (RBC), mean corpuscular volume (MCV), and red cell distribution width (RDW). Maternal anaemia was defined as Hb concentration <11.0 g/dL in the first and third trimesters and <10.5 g/dL in the second trimester, in accordance with WHO criteria.^[8] Maternal anaemia was defined using Hb concentration measured at admission for delivery. Therefore, throughout this study, the term 'maternal anaemia' refers to anaemia assessed at delivery rather than anaemia diagnosed during routine antenatal follow-up. In microcytic anaemia, the MCV value was considered to be below 80 fL, in normocytic anaemia between 80 and 100 fL, and in macrocytic anaemia above 100 fL. The Mentzer index was calculated using the "MCV/RBC" formula. A Mentzer index value below 13 was interpreted as suggestive of the beta-thalassaemia trait and used as a screening indicator for carrier risk.^[9] Termination after 20 and before 37 weeks of gestation was considered a preterm birth with a premature newborn.^[10,11] Newborns with a birth weight below 2,500 g were evaluated as LBW, and those with a 5th-minute Apgar score below 7 were evaluated as having a low Apgar score.^[11]

Statistical analysis

Maternal variables were analysed according to the number of pregnant women, whereas neonatal outcomes were analysed according to the number of newborns. However, because neonatal outcomes among twins may not be statistically independent, we performed sensitivity analyses restricted to live-born infants, including one randomly selected newborn per mother from multiple pregnancies. These sensitivity analyses formed the basis of the LBW and low Apgar score analyses. Descriptive statistics were used to summarise maternal and

neonatal characteristics. Continuous variables with normal distribution were expressed as mean $\pm$ standard deviation, whereas non-normally distributed continuous variables were presented as median (minimum–maximum). The categorical variables were summarised as frequencies and percentages. Categorical variables were compared using the chi-square test. Continuous variables with normal distribution were compared using Student's t-test, whereas non-normally distributed continuous variables were compared using the Mann–Whitney U test. The association between maternal age and Hb level was evaluated using Pearson correlation analysis. Multivariable logistic regression analysis was performed to identify independent factors associated with binary outcomes and to adjust for potential confounding

variables. Odds ratios (OR) with 95% confidence intervals (CI) were reported. Chi-square tests and OR with 95% CI were calculated to assess subgroup-specific associations. All analyses were performed using IBM SPSS Statistics for Windows, version 24.0 (IBM Corp., Armonk, NY, USA).

Results

The study comprised 1,216 pregnant women (609 Turkish, 607 immigrant) and 1,251 newborns (1,181 singleton, 70 twin). The mean age of all pregnant women was 26.37 ± 6.37 . The mean age of Turkish pregnant women was higher than the mean age of immigrant pregnant women (28.58 ± 6.19 vs. 24.15 ± 5.76 , $p < 0.001$). The obstetric characteristics and the erythrogram parameters of the pregnant women were included in Table 1.

Table 1. The obstetric histories and the erythrogram parameters of Turkish and immigrant pregnant women.

	All pregnant women (n=1,216)	Turkish pregnant women (n=609)	Immigrant pregnant women (n=607)	p
Parity, Median (Min-Max)	2 (1 - 11)	2 (1 - 9)	2 (1 - 11)	0.012*
Primiparous pregnant women, n (%)	403 (33.1)	183 (30.0)	220 (36.2)	0.022†
Multiparous pregnant women, n (%)	813 (66.9)	426 (70.0)	387 (63.8)	
Singleton pregnancy, n (%)	1,181 (97.1)	591 (97.0)	590 (97.2)	0.872†
Multifetal pregnancy, n (%)	35 (2.9)	18 (3.0)	17 (2.8)	0.807†
≥ 37 weeks of gestation, n (%)	973 (80.0)	489 (80.3)	484 (79.7)	
< 37 weeks of gestation, n (%)	243 (20.0)	120 (19.7)	123 (20.3)	< 0.001†
Vaginal delivery, n (%)	653 (53.7)	261 (42.9)	392 (64.6)	
Caesarean delivery, n (%)	563 (46.3)	348 (57.1)	215 (35.4)	
The Blood Parameters				
RBC Levels, Mean $\pm$ SD	4.31 $\pm$ 0.44	4.29 $\pm$ 0.41	4.33 $\pm$ 0.47	0.126‡
Hb Levels, Mean $\pm$ SD	11.3 $\pm$ 1.42	11.6 $\pm$ 1.33	11.1 $\pm$ 1.47	<0.001‡
Hct Levels, Mean $\pm$ SD	35.4 $\pm$ 3.88	35.9 $\pm$ 3.69	34.9 $\pm$ 4.00	<0.001‡
MCV Levels, Mean $\pm$ SD	82.5 $\pm$ 8.01	84.1 $\pm$ 7.19	81 $\pm$ 8.49	<0.001‡
RDW Levels, Median (Min-Max)	14.8 (11.6-37.5)	14.4 (11.8-37.5)	15.3 (11.6-26.7)	<0.001*
The Mentzer Index ≥ 13 , n (%)	1,185 (97.5)	598 (98.2)	587 (96.7)	0.100†
The Mentzer Index < 13 , n (%)	31 (2.5)	11 (1.8)	20 (3.3)	
Maternal anaemia, n (%)	435 (35.8)	175 (28.7)	260 (42.8)	<0.001†
Non-anaemic, n (%)	781 (64.2)	434 (71.3)	347 (57.2)	

*Mann Whitney U-test, †Chi-square test, ‡ Student's T-test. Hb: Haemoglobin, Hct: Haematocrit, RBC: Red blood cell count, MCV: Mean corpuscular volume, RDW: Red cell distribution width. Unit of analysis: 1,216 pregnant women.

Table 2. The birth information of newborns.

	All newborns (n=1,205)	Turkish newborns (n=608)	Immigrant newborns (n=597)	p
Female, n (%)	646 (51.6)	326 (52.0)	279 (44.7)	0.010*
Male, n (%)	605 (48.4)	301 (48.0)	345 (55.3)	
Birth length (cm), Mean±SD	48.5±3.72	48.4±3.99	48.6±3.42	0.423†
Birth weight (g), Mean±SD	2,996±682	3,007.5±728.03	2,985.4±632.91	0.568†
Head circumference (cm), Mean±SD	34±2.56	34±2.77	34±2.33	0.808†
1st-minute Apgar score, Median (Min-Max)	7(0-8)	7(0-8)	7(0-8)	0.948‡
5th-minute Apgar score, Median (Min-Max)	8(0-9)	8(0-9)	8(0-9)	0.772‡
Live birth, n (%)	1,239 (99.0)	626 (99.8)	613 (98.2)	0.004*
Stillbirth, n (%)	12 (1.0)	1 (0.2)	11 (1.8)	

*Chi-square test, †Student's T-test, ‡Mann Whitney U-test. Unit of analysis: 1,251 newborns.

Table 3. Comparison of low birth weight and 5-minute Apgar scores between Turkish and immigrant live-born newborns.

	All newborns (n=1,251)	Turkish newborns (n=627)	Immigrant newborns (n=624)	p
≥ 2,500 g birth weight, n (%)	1,029 (85.4)	508 (83.6)	521 (87.3)	0.068*
< 2,500 g birth weight, n (%)	176 (14.6)	100 (16.4)	76 (12.7)	
5th-minute Apgar score ≥ 7, n (%)	1,012 (84.0)	504 (82.9)	508 (85.1)	0.298*
5th-minute Apgar score < 7, n (%)	193 (16.0)	104 (17.1)	89 (14.9)	

*Chi-square test, Unit of analysis: 1,205 live-born infants corresponding to 1,205 pregnancies. In multiple pregnancies, one newborn was randomly selected per mother.

The median of parity was 2 (1-11) in immigrants and 2 (1-9) in Turks ($p=0.012$). The vaginal delivery rate was higher in immigrant women and the caesarean section rate was higher in Turkish women (64.6% vs. 57.1%; $p<0.001$). Immigrant pregnant women had significantly lower Hb and Hct levels compared with Turkish pregnant women ($p<0.001$). The prevalence of all pregnant women was calculated as 35.8% (28.7% in Turkish vs. 42.8% in immigrant; $p<0.001$).

Among all newborns, 51.6% were female and 48.4% were male, with a significantly higher proportion of males among immigrant newborns compared with Turkish newborns (55.3% vs. 48.0%, $p=0.01$). The mean birth length, birth weight, head circumference, and the median 1st-minute and 5th-minute Apgar scores were similar between

groups, with no significant differences observed. The stillbirth rate was significantly higher among immigrant women than Turkish women (1.8% vs. 0.2%, $p=0.004$) (Table 2). The prevalence of LBW was 14.6% overall and did not differ significantly between Turkish and immigrant newborns (16.4% vs. 12.7%, $p=0.068$). Likewise, the newborns with low Apgar scores did not differ significantly between Turkish and immigrant groups (17.1% vs. 14.9%, $p=0.298$) (Table 3).

The mean maternal age was lower among pregnant women with anaemia than among those without anaemia (25.49 ± 6.20 vs. 26.86 ± 6.42 , $p<0.001$). Although a statistically significant association was observed in the overall population and among Turkish women, no clinically meaningful correlation was observed (Figure 1).

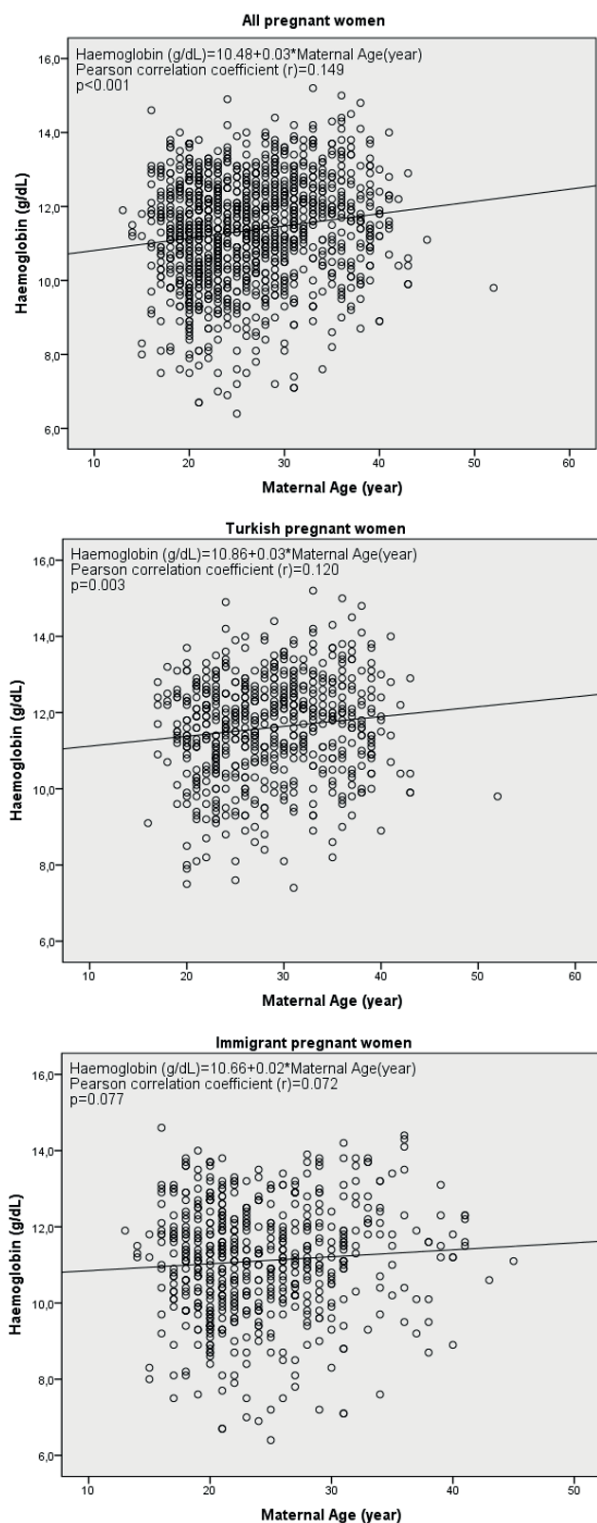


Figure 1. Scatterplots showing the relationship between maternal age and haemoglobin level in the overall study population, Turkish pregnant women, and immigrant pregnant women.

The maternal anaemia was more frequent among multiparous women than primiparous women (39.1% vs. 29.0%, $p=0.001$). No significant differences were observed between pregnant women with and without anaemia with respect to singleton or multifetal pregnancy, preterm birth, or mode of delivery (Table 4).

In multivariable logistic regression analysis for maternal anaemia, migration status (OR=1.63, 95% CI: 1.26–2.10; $p<0.001$), maternal age (OR=0.96, 95% CI: 0.94–0.98; $p<0.001$), and multiparity (OR=2.09, 95% CI: 1.57–2.79; $p<0.001$) were independently associated with maternal anaemia. Specifically, immigrant women and multiparous women had higher odds of maternal anaemia, whereas increasing maternal age was associated with lower odds of maternal anaemia. The area under the curve (AUC) of this model was 0.631 (Table 5).

The prevalence of LBW was 12.7% among women with anaemia and 15.7% among women without anaemia ($p=0.161$). Likewise, the proportion of newborns with low 5th-minute Apgar scores did not differ according to maternal anaemia status (15.7% vs. 16.2%, $p=0.825$) (Table 6).

In multivariable logistic regression analysis, gestational age, parity, and multifetal pregnancy were independently associated with neonatal birth weight. Each additional week of gestation was associated with higher odds of delivering a newborn with normal birth weight (OR=2.22, 95% CI: 1.97–2.49; $p<0.001$). Multiparous women had higher odds of delivering a newborn with normal birth weight compared with primiparous women (OR= 2.05, 95% CI: 1.22–3.45; $p=0.007$). In contrast, multifetal pregnancies were associated with substantially lower odds of normal birth weight (OR=0.05, 95% CI: 0.01–0.17; $p<0.001$). Maternal anaemia, migration status, maternal age, and the anaemia–migration interaction term were not independently associated with neonatal birth weight. The AUC for this model was 0.891 (Table 7).

Table 4. The obstetric histories of pregnant women according to anaemia.

	Pregnant women with anaemia (n=435)	Pregnant women without anaemia (n=781)	p
Primiparous pregnant women, n (%)	117 (26.9)	286 (36.6)	0.001* (OR=0.64, 95% CI: 0.49–0.82)
Multiparous pregnant women, n (%)	318 (73.1)	495 (63.4)	
Singleton pregnancy, n (%)	426 (97.9)	755 (96.7)	0.208*
Multifetal pregnancy, n (%)	9 (2.1)	26 (3.3)	
≥ 37 weeks of gestation, n (%)	350 (80.5)	623 (79.8)	0.773*
< 37 weeks of gestation, n (%)	85 (19.5)	158 (20.2)	
Vaginal delivery, n (%)	196 (45.1)	367 (47.0)	0.517*
Caesarean delivery, n (%)	239 (54.9)	414 (53.0)	

*Chi-square test. OR: Odds ratio, CI: Confidence Intervals. Unit of analysis: 1,216 pregnant women.

Table 5. Multivariate logistic regression analysis for anaemia.

	B (SE)	Z	p*	OR	95% CI
Migration status	0.488 (0.131)	3.736	<0.001	1.63	1.26-2.10
Maternal age	-0.044 (0.012)	-3.802	<0.001	0.96	0.94-0.98
Multiparity	0.738 (0.148)	5.004	<0.001	2.09	1.57-2.79

*Multivariable logistic regression. B: regression coefficient, SE: standard error, Z: Z statistic, OR: Odds ratio, CI: Confidence Intervals. Area under the ROC curve (AUC): 0.631. Unit of analysis: 1,216 pregnant women.

Table 6. The birth information of newborns according to anaemia.

	Pregnant women with anaemia (n=433)	Pregnant women without anaemia (n=772)	p
≥ 2,500 g birth weight, n (%)	378 (87.3)	651 (84.3)	0.161*
< 2,500 g birth weight, n (%)	55 (12.7)	121 (15.7)	
5th-minute Apgar score ≥ 7, n (%)	365 (84.3)	647 (83.8)	0.825*
5th-minute Apgar score < 7, n (%)	68 (15.7)	125 (16.2)	

*Chi-square test. Unit of analysis: 1,205 live-born infants corresponding to 1,205 pregnancies. In multiple pregnancies, one newborn was randomly selected per mother.

Table 7. Multivariate logistic regression analysis for low birth weight.

	B (SE)	Z	p*	OR	95% CI
Migration status	0.345 (0.302)	1.144	0.253	1.41	0.78-2.55
Maternal age	0.028 (0.021)	1.296	0.195	1.03	0.99-1.07
Gestational age (weeks)	0.796 (0.060)	13.373	<0.001	2.22	1.97-2.49
Multiparity	0.719 (0.265)	2.717	0.007	2.05	1.22-3.45
Multifetal pregnancy	-3.077 (0.671)	-4.584	<0.001	0.05	0.01-0.17
Anaemia	0.216 (0.370)	0.583	0.560	1.24	0.60-2.56
Anaemia x Migration status	0.322 (0.503)	0.641	0.522	1.38	0.52-3.70

*Multivariable logistic regression. B: regression coefficient, SE: standard error, Z: Z statistic, OR: Odds ratio, CI: Confidence Intervals. Area under the ROC curve (AUC): 0.891. Unit of analysis: 1,205 live-born infants corresponding to 1,205 pregnancies. In multiple pregnancies, one newborn was randomly selected per mother.

Discussion and Conclusion

In this study, maternal anaemia assessed at delivery was more prevalent among immigrant pregnant women than Turkish pregnant women and was independently associated with migration status, a younger maternal age, and multiparity. In addition, immigrant women experienced significantly higher stillbirth rates despite receiving care within the same healthcare system. In contrast, maternal anaemia was not independently associated with neonatal outcomes evaluated in this study, including low birth weight and low 5-minute Apgar scores. These findings suggest that maternal anaemia in this population may be more closely linked to social and reproductive determinants than to the neonatal outcomes evaluated in the present study.

This study found that the mean age of immigrant pregnant women was lower than that of Turkish pregnant women. The researchers may have arrived at this conclusion based on the belief that early marriages provide social protection for immigrant women.^[12] Erenel et al.^[13] observed that the maternal age was younger in the immigrant population, and adolescent pregnancy rates were high in their study. They attributed this result to sociocultural differences.^[13] When the obstetric histories of the pregnant women were examined, the caesarean delivery rate was higher in Turkish pregnant women. This study was conducted in a tertiary healthcare institution. High-risk Turkish pregnancies were monitored more closely, leading to the perception that the rates of caesarean sections were elevated. The higher rates of systemic disease in Turkish pregnant women and the indications for caesarean section in our study support this result. Although previous studies have reported higher rates of emergency caesarean sections due to lower health literacy levels among pregnant immigrant women, our study found that a previous caesarean section was the most common indication for caesarean delivery.^[14]

The evaluation of the blood parameters of the pregnant women revealed a mean Hb level exceeding 11 g/dl. In our study, Hb and Hct levels of Turkish pregnant women were significantly higher compared to the levels of immigrant pregnant women. It was observed that similarly, significantly higher Hb and Hct levels were found in Turkish pregnant women in the studies of Inal et al.^[15], while Turkay et al.^[16] reported no significant difference between these two groups. In addition, 28.7% of Turkish pregnant women and 42.8% of immigrant pregnant women had anaemia. The higher prevalence of anaemia observed among immigrant women in this study is consistent with previous research conducted in Türkiye and other host countries.^[17] The studies have attributed this situation to nutritional deficiencies, lower socioeconomic status, limited health literacy, and barriers to accessing antenatal care.^[16,18] Iron supplementation therapy is given to prevent anaemia in pregnant women in Türkiye. The high prevalence of anaemia in immigrant pregnant women indicates insufficient access to antenatal care.^[19] Therefore, due to the limited health literacy among migrants, it becomes even more crucial to provide adequate information.^[20] However, it has been found that the language barrier not only leads to “misunderstanding” but also to misdiagnosis and incorrect treatment due to a lack of professional interpreters.^[21] The Ministry of Health in Türkiye provides interpreting services in health care facilities to address the language issue faced by immigrants.

Neonatal anthropometric outcomes, including birth weight, length, and head circumference, were similar between Turkish and immigrant newborns. However, the stillbirth rate was substantially higher among immigrant women. This finding is consistent with previous evidence indicating that migrant populations in Europe experience an increased burden of stillbirth and adverse perinatal outcomes. Andersen et al.^[22] reported that the elevated risk of stillbirth among

migrant women may be partly explained by differences in congenital anomaly prevalence, as well as disparities in access to and utilization of antenatal care services. Similarly, a recent systematic review and meta-analysis by Behboudi-Gandevani et al.^[23] demonstrated that immigrant women had a significantly higher risk of stillbirth, perinatal mortality, and neonatal mortality compared with native-born populations. These inequalities have been attributed not only to socioeconomic disadvantage but also to delayed access to obstetric care, language barriers, limited health literacy, and challenges in navigating healthcare systems.^[22,23] Although the underlying causes of stillbirth could not be determined in the present study because of its retrospective design, the observed disparity highlights the importance of strengthening culturally responsive antenatal care services and ensuring equitable access to perinatal healthcare for vulnerable migrant populations. Addressing these structural barriers may be essential for reducing preventable adverse pregnancy outcomes and improving maternal and neonatal health equity.

The overall prevalence of LBW in our study was 14.6%, which was higher than the 11.9% prevalence reported in the 2018 Türkiye Demographic and Health Survey.^[24] Maternal risk factors for LBW include smoking, alcohol, and substance use, particularly in high-income settings.^[25] Additional established determinants include adolescent or advanced maternal age, low socioeconomic status, low pre-pregnancy body mass index, inadequate gestational weight gain, hypertensive disorders of pregnancy, and short interpregnancy interval.^[26] Nevertheless, LBW was numerically less frequent among immigrant newborns than among Turkish newborns (12.7% vs. 16.4%). This finding may be compatible with certain aspects of the healthy migrant effect, whereby some recently arrived immigrant populations experience more favourable birth outcomes than expected, despite socioeconomic disadvantage.^[6] However,

the higher prevalence of maternal anaemia and stillbirth among immigrant women suggests that this framework alone is insufficient to explain the maternal and neonatal health patterns observed in our study.

In our study, women with maternal anaemia were younger on average, and both younger maternal age and multiparity remained independently associated with maternal anaemia in multivariable analyses. Adolescent pregnancy and short interpregnancy intervals are known to be risk factors for anaemia.^[27,28] Among women in refugee communities, early marriage has been found to be seen as a “protective mechanism” or a means of escaping economic hardship. It has also been stated that “husband’s consent” and “religious/cultural beliefs” are decisive in accessing family planning methods, and women have limited say over their own reproductive rights.^[12] Therefore, it can be considered that immigrants’ access to protective social rights directly influences health outcomes. The higher crude prevalence of anaemia among multiparous women may be explained by cumulative nutritional depletion associated with repeated pregnancies. Previous studies have reported higher rates of anaemia and iron deficiency among multiparous women, suggesting progressive depletion of maternal iron reserves with increasing parity.^[29] In addition, short interpregnancy intervals may prevent adequate restoration of iron stores before a subsequent conception, thereby increasing vulnerability to anaemia in later pregnancies.^[30]

In our study, maternal anaemia was not independently associated with LBW or low 5-minute Apgar scores. One possible explanation is that maternal haemoglobin concentrations were measured at the time of admission for delivery rather than earlier in pregnancy, whereas fetal growth is influenced by exposures occurring throughout gestation. Consequently, haemoglobin levels assessed at delivery may not adequately

reflect maternal physiological conditions during the critical periods of fetal development. Furthermore, because the study relied on routinely collected retrospective data, important factors such as adherence to iron supplementation, maternal nutritional status, smoking, and the adequacy of antenatal care could not be evaluated. Therefore, the timing of haemoglobin assessment and the limitations of the available data may have reduced the ability of this study to adequately evaluate the relationship between maternal anaemia and neonatal outcomes.

In the multivariable analysis, gestational age, parity, and multifetal pregnancy emerged as the only factors independently associated with neonatal birth weight. The positive association between increasing gestational age and normal birth weight is consistent with the well-established contribution of prematurity to reduced birth weight and adverse neonatal outcomes. Similarly, the lower odds of normal birth weight observed among multifetal pregnancies are consistent with previous evidence indicating that fetal growth restriction is a common complication of twin pregnancies and contributes substantially to adverse neonatal outcomes.^[31] In addition, multiparity was associated with higher odds of delivering a newborn with normal birth weight. This finding is in agreement with previous studies demonstrating that infants born to nulliparous women are more likely to have lower birth weight than those born to multiparous women. In a large multicountry cohort study conducted in low- and middle-income settings, Garces et al. reported^[32] that nulliparity was independently associated with lower birth weight and higher neonatal mortality, even after adjustment for maternal and socioeconomic factors. More recently, Wijesiriwardhana et al.^[33] showed that birthweight-reducing maternal genetic influences predominantly affected fetal growth among nulliparous women, whereas these associations were not observed among multiparous women,

suggesting that prior pregnancies may induce physiological adaptations that support subsequent fetal growth. Several mechanisms have been proposed to explain this relationship, including improved uteroplacental perfusion, enhanced cardiovascular adaptation, and immunological tolerance acquired through previous pregnancies.^[32,33] Therefore, the higher odds of normal birth weight observed among multiparous women in our study may reflect these cumulative physiological adaptations rather than parity itself acting as an isolated protective factor. In contrast, maternal anaemia and migration status were not independently associated with birth weight after adjustment for potential confounders. These findings underscore the multifactorial nature of birth weight and emphasize the necessity of taking into account a broad range of maternal and obstetric factors when evaluating neonatal outcomes.

Limitations of this study include its retrospective design, whereby maternal Hb levels were based on blood tests performed at hospital admission for delivery, while Hb measurements during routine antenatal follow-up were unavailable. Data on iron supplementation, treatment adherence, dietary iron intake, and other micronutrient statuses were also lacking. In addition, several potential confounders, including maternal body mass index, smoking, alcohol use, chronic diseases, education, household income, and other socioeconomic factors, were not available in the hospital database and could not be included in the analyses. Finally, because of the observational design, causal inferences cannot be made, and the findings should be interpreted as associations rather than direct causal effects.

In conclusion, maternal anaemia assessed at delivery was more common among immigrant women and was independently associated with migration status, younger maternal age, and multiparity. Although immigrant women

exhibited a higher burden of maternal anaemia, maternal anaemia was not independently associated with the neonatal outcomes evaluated in this study, including low birth weight and low 5-minute Apgar scores. Because haemoglobin concentrations were measured at the time of delivery rather than during pregnancy, these findings should not be interpreted as evidence against a potential relationship between antenatal anaemia and adverse neonatal outcomes. Despite comparable neonatal anthropometric outcomes between Turkish and immigrant newborns, the significantly higher stillbirth rate observed among immigrant women highlights persistent inequalities in perinatal health. These disparities may reflect broader social and structural determinants, including barriers to antenatal care utilisation and access to timely obstetric services. Overall, the findings emphasise the importance of culturally responsive, equity-orientated maternal healthcare approaches that address both biomedical and social determinants of health.

Ethical approval

This study has been approved by the İzmir Tepecik Training and Research Hospital Ethics Committee (approval date 07.03.2017, number 18).

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: BA, AAY; data collection: BA, AAY; analysis and interpretation of results: BA, AAY, UG; draft manuscript preparation: BA, UG. All authors reviewed the results and approved the final version of the article.

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The authors declare that there is no conflict of interest to disclose.

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Evaluation of pre-myopia risk factors in children aged 6-10 years: pediatric vision screening

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ABSTRACT

Background: The aim of this study was to evaluate pre-myopia risk factors in children aged 6–10 years and to investigate whether a simple risk-based questionnaire could help identify children at increased risk of pre-myopia in primary healthcare settings.

Methods: This cross-sectional study was conducted in Erzurum, Türkiye, over a three-week period beginning on October 28, 2025. A total of 652 children were invited to participate in the study; those with active visual complaints and those not within the 6–10 age range were excluded. A total of 453 children who met the inclusion criteria were analyzed. Based on questionnaire scores, low-, medium-, and high-risk groups were formed; biometric measurements of 44 children in the high-risk group who attended the examination were evaluated. The relationships between risk groups and demographic variables were analyzed using the chi-square test, and the relationship between biometric parameters and SE was assessed using Pearson correlation. An AL/CR ratio ≥ 2.90 was accepted as the biometric high-risk threshold. Sample adequacy was verified using G*Power 3.1.

Results: The mean age was 7.91 ± 1.26 years, and 51.7% of participants were male. The mean AL/CR ratio in the examined children was 2.90 ± 0.12 . SE values ranged from -0.50 to $+0.50$ D, indicating that all examined children were within the refractive pre-myopia range. No significant correlation was found between questionnaire risk score and AL/CR ratio (Pearson $r = -0.08$, $p = 0.666$) or SE (Pearson $r = -0.11$, $p = 0.535$). Questionnaire risk score was not a significant predictor of an AL/CR ratio ≥ 2.90 in univariable logistic regression analysis (OR = 1.14, 95% CI: 0.64–2.03; $p = 0.67$).

Conclusion: The findings suggest that a simple risk-based questionnaire may assist primary care physicians in identifying children who could benefit from ophthalmologic evaluation. Further validation studies are required before routine implementation.

Keywords: Child, pre-myopia, refractive error, primary health care, screening

Introduction

The prevalence of myopia worldwide has shown a dramatic increase in recent years. Predictions estimate that by 2050, approximately half of the

world's population will be myopic. Considering the difficulties in preventing myopia progression, it is evident that especially high myopia will predispose individuals to serious complications such as retinal detachment, glaucoma, and macular

degeneration.^[1,2] For these reasons, detecting the presence of risk factors and identifying myopia in its early developmental stages (pre-myopia) will provide a significant advantage in preventing the onset of myopia by allowing the implementation of various preventive interventions. The literature reports that numerous factors contribute to the development of myopia, including parental myopia, the effects of sunlight and light intensity and diversity, prolonged accommodative effort, near work, and increased screen exposure.^[3,4] Children with a family history of myopia, those who spend limited time outdoors, or those with more than two hours of daily screen exposure are known to be in the high-risk group for myopia.^[5]

The definition of pre-myopia includes individuals at increased risk for developing myopia, with cycloplegic spherical values between +0.75 diopters and -0.50 diopters. This refractive state is important in childhood as an early indicator of progressive myopia.^[6] Studies state that pre-myopic individuals have a high probability of developing myopia in the future, and an early onset of myopia—meaning reduced hyperopic reserve—is associated with a faster progression.^[7,8] It is thought that refractive values close to emmetropia in childhood may be a strong predictor of future myopia.^[9]

The National Vision Screening Program implemented by the Turkish Ministry of Health in 2018 aims to contribute to the early diagnosis of visual disorders in childhood and is carried out through primary healthcare services.^[10] Within the scope of the program, the visual levels of children in certain age groups are evaluated in family health centers, and those found to have reduced vision are referred to ophthalmology clinics. However, the screening only detects children with visual impairment, which leads to certain cases being overlooked. The current program does not include a specific risk assessment for myopia,

lifestyle counseling, or behavioral preventive factors. Detecting myopia at a preventable stage—prior to its development—could mean a 2–3 year gain in myopia control.^[11] Studies have shown that proven interventions are critical in delaying the onset of myopia in at-risk children.^[12]

Therefore, developing short risk assessment methods for screening in primary care and adding a pre-myopia-focused formula to the national screening protocol may significantly strengthen preventive services. Additionally, ensuring bidirectional communication between ophthalmologists and family physicians will support continuity of follow-up after evaluation. The aim of this study was to evaluate genetic and environmental risk factors associated with myopia in children aged 6–10 years, and to detect pre-myopia through refractive and biometric measurements in high-risk children.

Materials and Methods

This study was conducted over a three-week period starting on October 28, 2025. Parents of eligible children aged 6–10 years were invited to complete an online questionnaire using Google Forms. The questionnaire was designed to be completed by the parents or legal guardians of children aged 6–10 years. A total of 652 children with no vision-related complaints were included. Children with a previous diagnosis of myopia, a history of ocular disease, or current spectacle use were excluded.

Data were collected using an 11-item questionnaire designed to assess pre-myopia risk. Demographic characteristics and factors such as parental myopia, daily outdoor time, uninterrupted screen time, compliance with the 20-20-20 rule (looking at an object approximately 20 feet [6 meters] away for at least 20 seconds after every 20 minutes of near work), and social jet lag (weekday–weekend sleep time difference) were evaluated (Table 1).

Table 1. Pre-myopia risk assessment questionnaire.

Question / Variable	Response Options	Score
1. Does your child have any vision-related complaints?	☐ Yes ☐ No	–
2. Child's age	☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 years	–
3. Sex	☐ Female ☐ Male	–
4. Are the mother and/or father diagnosed with myopia?	No	0
	One parent	1
	Both parents	2
5. Daily outdoor time	0–60 min	3
	60–120 min	2
	120–180 min	1
	≥180 min	0
6. Average uninterrupted screen time per sitting	0–20 min	0
	20–40 min	1
	40–60 min	2
	≥60 min	3
7. Adherence to the 20-20-20 rule	Regularly follows	0
	Occasionally	1
	Rarely or never	2
8. Weekday–weekend sleep onset difference (social jet lag)	<1 hour	0
	1–2 hours	1
	2–3 hours	2
	>3 hours	3
9. Has your child had an eye examination in the past 12 months?	☐ Yes ☐ No	–
10. Would you like to receive information about pre-myopia assessment?	☐ Yes ☐ No	–
11. Phone number (optional)		–

* The questionnaire was completed by parents or legal guardians of children aged 6–10 years. The questionnaire score was calculated by summing the scores of the risk-related items. Higher total scores indicated a greater estimated risk of pre-myopia. Based on the total score, children were classified as low risk (0–4 points), moderate risk (5–7 points), and high risk (≥8 points).

According to total scores, 0–4 was classified as “low risk,” 5–7 as “moderate risk,” and ≥8 as “high risk.” Children classified as high risk according to the questionnaire were referred to the ophthalmology clinic for cycloplegic refraction and ocular biometry. Cycloplegia was induced with 1% cyclopentolate hydrochloride. Three drops were instilled into each eye at 5-minute intervals, and cycloplegic refraction was performed 60 minutes after the final drop. Cycloplegic refraction was measured using an autorefractometer (Topcon KR-800, Topcon Corporation, Tokyo, Japan). Spherical equivalent refraction (SER) was calculated as the spherical value plus half of the cylindrical value.

According to the International Myopia Institute criteria, eyes with an SER between -0.50 D and $+0.75$ D were considered to be in the pre-myopia range. Axial length (AL) and corneal radius (CR) were measured using the LenStar LS 900 optical biometer (Haag-Streit AG, Köniz, Switzerland). The device automatically performs repeated measurements and provides the average value once acceptable measurement quality is achieved. An AL/CR ratio ≥ 2.90 was used as a predefined biometric risk threshold in the present analysis. To avoid inter-eye correlation, only one eye from each participant was included in the statistical analysis.^[13]

Ethical approval for the study was obtained from the Clinical Research Ethics Committee of Erzurum of the University of Health Sciences [Decision no: 2025-10-277; Date: 27.10.2025], and written informed consent was obtained from all parents. The study was planned as a cross-sectional analytic study. A power analysis using the G*Power 3.1 program, based on values reported in the literature, assumed an effect size of $w = 0.30$ (medium effect). For a 95% confidence level ($\alpha = 0.05$) and 80% power ($1-\beta = 0.80$), the minimum required sample size was calculated as $n = 88$. The number of participants exceeded this, and thus the sample size was considered statistically sufficient.

Statistical analysis

Statistical analyses were performed using IBM SPSS version 21.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean $\pm$ standard deviation (SD), and categorical variables as numbers and percentages. Data from all 453 children were used to summarize demographic characteristics, questionnaire responses, and risk categories. Associations between categorical variables were analyzed using the chi-square test. Biometric analyses, including axial length (AL), corneal radius (CR), AL/CR ratio, and spherical equivalent refraction (SER), were performed only in the 44 children who attended the ophthalmologic examination. The relationship between questionnaire risk score and the biometric parameters (AL/CR ratio and SER) was evaluated using Pearson and Spearman correlation analyses. Univariable logistic regression analysis was used to examine the association between questionnaire risk score and an AL/CR ratio ≥ 2.90 . Results are presented as odds ratios (ORs) with 95% confidence intervals (95% CIs). A p value of <0.05 was considered statistically significant.

Results

A total of 652 children were invited to participate in the study. Of these, 596 had no vision-related complaints. Thirty-eight children were excluded because they were outside the 6–10-year age range, and 105 were excluded because they reported current spectacle use despite indicating no vision-related complaints on the questionnaire. As a result, 453 children were included in the final analysis. Based on the questionnaire scores, 104 children were classified as high risk and referred for ophthalmologic examination. Of these, 44 attended the examination and underwent cycloplegic refraction and ocular biometry. The mean age of participants was 7.91 ± 1.26 years; 51.7% were male, 48.3% were female. Parental myopia was absent in 65.3%, present in one parent in 28.3%, and in both parents in 6.4%. Daily outdoor time was reported as 0–1 hour in 17.7%, 1–2 hours in 34.7%, 2–3 hours in 21.4%, and ≥ 3 hours in 26.3% of children. Uninterrupted screen time was reported as 0–20 min in 20.5%, 21–40 min in 38.4%, 41–60 min in 26.7%, and ≥ 60 min in 14.3%. Only 9.9% regularly followed the 20-20-20 rule, while 47.9% occasionally and 42.2% rarely or never complied. Weekday-weekend sleep time differed by less than 1 hour in 64.5% of children and by 1–2 hours in 30.7%. Information included in this study, including the Pre-Myopia Risk Assessment Questionnaire as well as the demographic characteristics and lifestyle-related factors of the participating children, is presented in Table 1 and Table 2.

The mean total questionnaire risk score was 5.06 ± 2.06 . Based on the questionnaire scores, 170 children (37.5%) were classified as low risk, 179 (39.5%) as moderate risk, and 104 (23.0%) as high risk. The distribution of questionnaire risk scores and risk categories is summarized in Table 3. Forty-four of the 104 high-risk children underwent biometric examination. Mean AL was 22.59 ± 1.00 mm, CR was 7.79 ± 0.24 mm, the AL/CR ratio was

Table 2. Demographic characteristics and lifestyle factors of the children participating in the study.

Variable	n (%) / Mean $\pm$ SD
Total sample [n]	453
Age [years]	7.91 $\pm$ 1.26
Sex	
Male	234 (51.7)
Female	219 (48.3)
Parental history of myopia	
None	296 (65.3)
One parent	128 (28.3)
Both parents	29 (6.4)
Daily outdoor time	
0–1 hour	80 (17.7)
1–2 hours	157 (34.7)
2–3 hours	97 (21.4)
>3 hours	119 (26.3)
Uninterrupted screen time	
0–20 min	93 (20.5)
21–40 min	174 (38.4)
41–60 min	121 (26.7)
>60 min	65 (14.3)
Adherence to the 20-20-20 rule	
Always	45 (9.9)
Sometimes	217 (47.9)
Rarely/Never	191 (42.2)
Sleep-onset difference [weekday–weekend]	
<1 hour	292 (64.5)
1–2 hours	139 (30.7)
2–3 hours	17 (3.8)
>3 hours	5 (1.1)

2.90 $\pm$ 0.12, and spherical equivalent (SE) was -0.05 ± 0.42 D. AL/CR ratios ranged from 2.68 to 3.07, whereas SE ranged from -0.50 to $+0.50$ D, with all SE values remaining within the pre-myopia range. An AL/CR ratio ≥ 2.90 was observed in 25 children (56.8%). Correlation analysis demonstrated no significant association between questionnaire risk score and either the AL/CR ratio (Pearson $r = -0.08$, $p > 0.05$; Spearman's $\rho = -0.067$, $p = 0.666$) or SE (Pearson $r = -0.11$, $p > 0.05$; Spearman's $\rho = -0.096$, $p = 0.535$). Logistic regression analysis also showed that questionnaire risk score was

Table 3. Distribution of questionnaire risk categories and demographic associations.

Variable	n (%) / Mean $\pm$ SD
Risk score, mean $\pm$ SD	5.06 $\pm$ 2.06
Risk categories	
Low (0–4 points)	170 (37.5)
Moderate (5–7 points)	179 (39.5)
High (≥ 8 points)	104 (23.0)

not significantly associated with an AL/CR ratio ≥ 2.90 (OR = 1.14, 95% CI: 0.64–2.03; $p = 0.67$). The biometric characteristics of the examined high-risk children are presented in Table 4.

Table 4. Biometric characteristics, correlation analyses, and logistic regression results in children who underwent ophthalmologic examination.

Variable	Mean $\pm$ SD / n (%)
Axial length (AL), mm	22.59 $\pm$ 1.00
Corneal radius (CR), mm	7.79 $\pm$ 0.24
AL/CR ratio	2.90 $\pm$ 0.12
Spherical equivalent (SE), D	-0.05 $\pm$ 0.42
AL/CR range	2.68–3.07
SE range	-0.50 to +0.50
AL/CR $\geq$ 2.90	25 (56.8)

AL, axial length; CR, corneal radius; SE, spherical equivalent.

Discussion

A screening questionnaire based on risk factors associated with myopia development in childhood was administered. Results indicated that most children spent 1–3 hours outdoors daily, whereas uninterrupted screen time was usually 20–40 minutes. Compliance with the 20-20-20 rule was low, and most children had less than a one-hour difference in sleep onset time between weekdays and weekends. Risk score distribution showed that the majority of children fell into the moderate- and high-risk categories. One of the main findings of this study was the absence of a significant correlation between questionnaire risk scores and either the AL/CR ratio or spherical equivalent. This finding does not necessarily reduce the value of the questionnaire. Rather than reflecting the severity of biometric changes, the questionnaire was designed to identify children who may be at increased risk of developing pre-myopia based on behavioral and familial risk factors. In addition, biometric measurements were available only in the subgroup of children who attended the ophthalmologic examination, which may have limited the ability to detect significant correlations. Therefore, the questionnaire appears to be more useful as a practical screening tool for identifying children who should undergo further ophthalmologic evaluation than as a predictor of the magnitude of biometric changes.

Studies have reported increasing prevalence of myopia and pre-myopia in school-age children, particularly in education systems with intense near work.^[1] Near work and screen time increase myopia risk, whereas outdoor activities have a protective effect.^[14-17] Behavioral models including irregular sleep, academic workload, and limited outdoor time have been defined, especially in East Asian populations.^[16,18] Research has consistently shown an inverse relationship between outdoor activities and myopia risk. Yang et al. stated that increased outdoor time may prevent myopia development by supporting ocular health and slowing progression.^[19,20] Sunlight may influence biochemical processes in the eye by increasing dopamine release and supporting correct muscle function. Exposure to high levels of natural light plays an important role in preventing the development of myopia.^[20,21] School-based interventions aimed at increasing outdoor time have also been shown to reduce the incidence of myopia in children.^[17,22] This association is further supported by meta-analyses, systematic reviews, and large population-based studies.^[23-25] In addition to the duration of outdoor exposure, daylight characteristics and broader environmental and lifestyle factors may also influence refractive development^[26,27].

Studies show that family history is strongly linked to myopia development. Wang et al. found that individuals with a family history of myopia had a higher risk compared to those without.^[28] Low et al. reported that genetic factors may play a more significant role than environmental influences.^[29] Although myopia has strong genetic foundations, interaction with environmental factors is also crucial. Children with myopic parents progress faster when exposed to prolonged near work.^[29,30] The risk is higher when both parents are myopic. These findings increase the importance of genetic factors and highlight the role of family history in risk evaluation.

In 2023, Chen et al. examined the relationship between hyperopia reserve and future myopia risk in Chinese children. They reported that mean SE values shifted toward myopia and onset age decreased, with increasing pre-myopia rates in children aged 4–6.^[12] A negative correlation was found between SE below +1.50 D and rapid increase in myopia risk. Wang et al. reported age-specific normative values for hyperopia reserve that may facilitate early identification of children at increased risk of myopia.^[31] The CLEERE Study identified cycloplegic spherical equivalent refractive error as the strongest single predictor of future myopia onset^[9]. Longitudinal CLEERE data also demonstrated that refractive error became progressively less hyperopic and axial length increased during the years preceding myopia onset^[32].

The Turkish National Screening Program mainly focuses on amblyopia, strabismus, and pronounced refractive errors.^[10] Limitations include variability in screening quality, interpretation differences, and lack of risk-based classification involving family history, outdoor time, screen exposure, or sleep rhythm. A strength of this study is demonstrating that a short, easy questionnaire in primary care can identify high-risk pre-myopia candidates. Programs in countries like China, Singapore, and Taiwan integrate risk factor evaluation and outdoor counseling.^[16,33] The questionnaire in this study could be integrated into national screening programs.

The strengths of this study include its relatively large sample size and the use of a simple screening questionnaire. The main limitation is that ophthalmologic examinations were performed only in children classified as high risk, so the diagnostic performance of the questionnaire could not be fully assessed. In addition, this was a single-center study without long-term follow-up. Future studies including all risk groups are needed.

In conclusion, this study described the distribution of pre-myopia risk factors among children aged 6–10 years and demonstrated that a simple questionnaire can be used to stratify children according to their estimated pre-myopia risk in a primary healthcare setting. Although no significant association was found between questionnaire scores and ocular biometric parameters in the examined subgroup, children classified as high risk exhibited ocular characteristics compatible with pre-myopia. Therefore, the questionnaire may represent a practical and low-cost screening tool to assist primary care physicians in identifying children who could benefit from ophthalmologic evaluation. However, further prospective studies including children from all risk groups, together with formal validation of the questionnaire, are required before routine clinical implementation.

Ethical approval

This study has been approved by the Scientific Research Ethics Committee of the University of Health Sciences, Erzurum Medical Faculty (approval date 08.10.2025, number 2025/10-277). Written informed consent was obtained from the participants.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: ESU; data collection: BU,EDK; analysis and interpretation of results: ESU; draft manuscript preparation: BU,EDK. All authors reviewed the results and approved the final version of the article.

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Distinguishing orthostatic hypotension from POTS: A diagnostic challenge in older adults

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ABSTRACT

Orthostatic intolerance represents a broad clinical continuum encompassing orthostatic hypotension (OH) and postural orthostatic tachycardia syndrome (POTS). Although both entities share overlapping manifestations, such as dizziness, presyncope, and palpitations, their underlying autonomic mechanisms differ substantially. Distinguishing between these disorders is crucial yet often diagnostically challenging, particularly in older adults and those with multimorbidity. We report the case of a 78-year-old woman with recurrent episodes of dizziness and presyncope, initially suspected to have orthostatic hypotension and possible arrhythmic etiology. During active standing, her heart rate increased by more than 30 bpm without a significant fall in blood pressure, fulfilling diagnostic criteria for POTS. Continuous 24-hour Holter electrocardiography revealed a tachycardic response to orthostasis without arrhythmogenic events. Comprehensive cardiovascular, neurological and endocrine evaluations were unremarkable, excluding secondary causes of orthostatic intolerance such as anemia, hypovolemia, endocrine disorders, or structural heart disease. The patient's symptoms improved markedly with non-pharmacological measures, gradual mobilization and low-dose beta-blocker therapy. This case underscores the diagnostic complexity within the orthostatic intolerance spectrum and highlights the need for meticulous assessment of autonomic responses. OH and POTS may appear clinically similar but differ fundamentally in pathophysiology. OH is characterized by impaired vasoconstriction and an inadequate, often blunted heart rate response due to autonomic dysfunction, whereas POTS involves excessive sympathetic activation with a pronounced tachycardic response. Recognition of POTS in the older adults is critical, as misclassification can delay management. Comprehensive autonomic testing and individualized therapy remain key to optimizing outcomes.

Keywords: Orthostatic hypotension, postural orthostatic tachycardia syndrome, orthostatic intolerance, autonomic dysfunction, older adults

Introduction

Orthostatic intolerance encompasses a diverse range of autonomic disorders marked by symptoms of reduced cerebral blood flow, including dizziness, palpitations, dyspnea, presyncope and syncope

upon assuming the upright position. The two most clinically significant conditions in this spectrum are orthostatic hypotension (OH) and postural orthostatic tachycardia syndrome (POTS), which exhibit similar symptoms but differ greatly in their fundamental pathophysiology.^[1] Orthostatic

hypotension, defined as a sustained reduction of systolic blood pressure (SBP) ≥ 20 mmHg or diastolic blood pressure (DBP) ≥ 10 mmHg within 3 minutes of standing (with measurements taken at 1 and 3 minutes) or during head-up tilt, primarily due to impaired baroreflex-mediated sympathetic activation that results in inadequate vasoconstriction, reduced vascular resistance, and an insufficient heart rate (HR) response to postural change.^[1,2] It predominantly occurs in older adults, patients with neurodegenerative disorders, diabetes, or drug-induced autonomic failure, and is associated with an increased risk of falls, cardiovascular events, and mortality.^[3] In contrast, POTS is defined by a HR increase of ≥ 30 beats per minute (≥ 40 beats per minute in adolescents) within 10 minutes of standing without orthostatic hypotension, usually indicating hyperadrenergic activation, hypovolemia, or peripheral denervation.^[4] Although their underlying mechanisms differ, these syndromes may clinically overlap, posing significant diagnostic challenges.

POTS is often overlooked in older adults because it is traditionally regarded as a condition of younger individuals, while orthostatic symptoms in this population are more commonly attributed to age-related autonomic dysfunction, comorbidities, polypharmacy, or classical orthostatic hypotension, leading to under recognition despite fulfillment of diagnostic criteria.^[3-5]

Given that even experienced clinicians seldom encounter both conditions concurrently, and considering their overlapping features that can obscure clinical interpretation, we present a case illustrating the diagnostic complexity between OH and POTS. This case report not only underscores the difficulty of differentiating these entities in practice but also provides deeper insight into their shared and divergent autonomic mechanisms, clinical characteristics, and therapeutic implications.

Case Presentation

A 78-year-old woman was admitted for evaluation of recurrent episodes of palpitations, dyspnea, and symptoms of orthostatic intolerance. Following hospital discharge in June 2023, she experienced daily attacks lasting several minutes, typically triggered by standing or initiating physical activity. The episodes were characterized by sudden weakness, visual dimming, a sensation of impending fainting, and marked palpitations, described as a "flopping heart". The symptoms resolved spontaneously upon sitting or lying down, after which she felt profoundly fatigued and often slept for several hours. She noticed that very slow positional changes alleviated her symptoms. Her past medical history was unremarkable apart from mild, well-controlled asthma until she was diagnosed with lung adenocarcinoma (pathological stage pT1c pN0 R0, indicating a primary tumor measuring between 2 and 3 cm, without nodal involvement and with clear resection margins), treated with a right lower lobectomy in 2020. In 2022, she underwent right-sided pneumonectomy for recurrence, followed by 30 sessions of radiotherapy and three cycles of platinum-pemetrexed chemotherapy, during which she involuntarily lost 20 kg. In April 2023, she developed pneumonia complicated by empyema and septic shock, requiring prolonged intensive care, mechanical ventilation, and treatment for critical illness neuromyopathy. After prolonged treatment in the intensive care unit (ICU), she was successfully extubated and transferred to the pulmonology department for respiratory and locomotor rehabilitation. However, at that time, she remained profoundly weak and bedridden, and due to her frailty and multiple comorbidities, the treating physicians considered her prognosis extremely poor and decided that, in the event of clinical deterioration, reintubation or invasive ventilation would not be appropriate. Nevertheless, her condition gradually improved with supportive care and rehabilitation. After discharge, inpatient

rehabilitation was initiated but interrupted because of the recurrence of orthostatic episodes. On readmission, her general condition had improved compared to the period following her ICU stay, though she exhibited reduced muscle tone and diminished exercise tolerance. Supine

blood pressure (BP) was normal, and bedside orthostatic testing revealed no significant drop in BP, while there was a marked tachycardic response upon standing. Orthostatic vital signs are summarized in Table 1. The orthostatic test was repeated several times and was consistently

Table 1. Orthostatic vital signs. Supine and orthostatic blood pressure and heart rate measurements, showing preserved blood pressure and a marked heart rate increase on standing, consistent with POTS without orthostatic hypotension.

Time point	Systolic BP (mmHg)	Diastolic BP (mmHg)	Heart rate (bpm)	Notes
Supine (baseline)	118	72	72	Normal baseline
1 minute standing	114	74	112	Marked tachycardia, no hypotension
3 minutes standing	116	73	120	Posture-related symptoms: dizziness, palpitations
10 minutes standing	115	72	124	Presyncope during prolonged standing; resolves on sitting

HR: heart rate; BP: blood pressure.

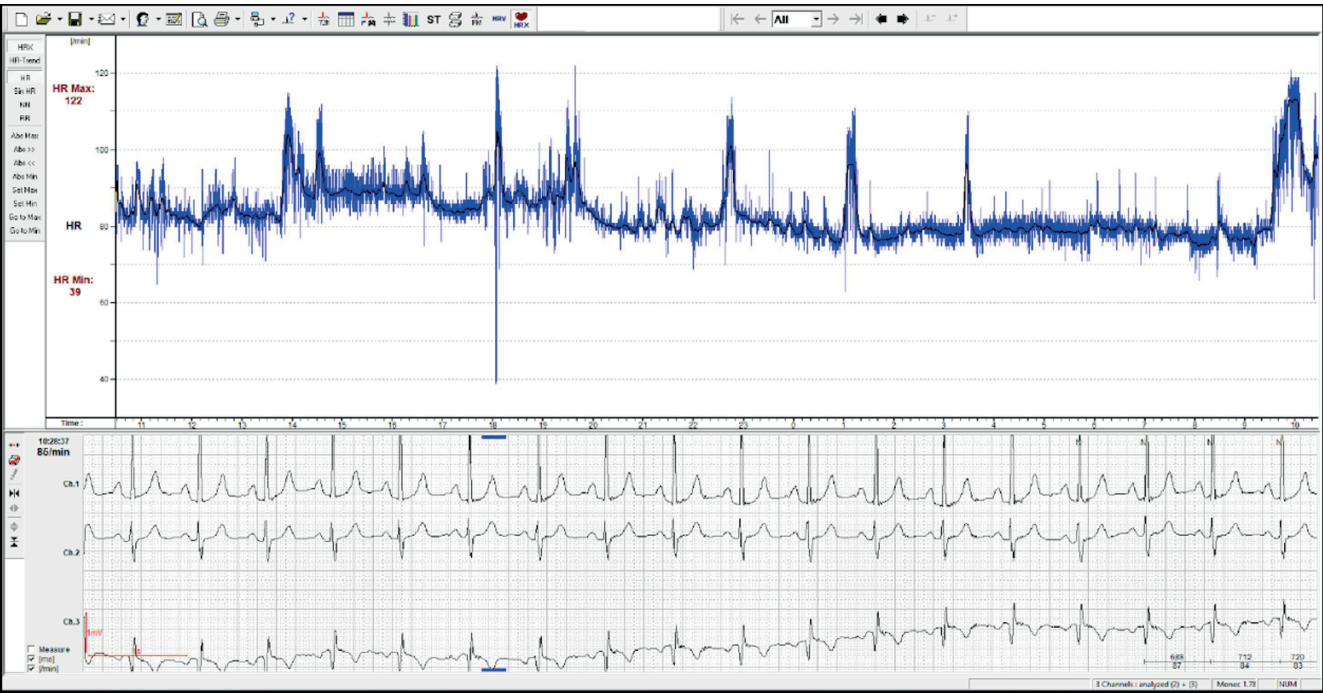


Figure 1. Twenty-four-hour Holter electrocardiography (ECG) in the patient. The figure illustrates continuous 24-hour Holter ECG monitoring. The upper panel (blue trace) shows the heart rate trend throughout the recording period, depicting physiological fluctuations during daily activities and rest. The lower panel displays the corresponding three-lead ECG tracing, enabling detection of potential arrhythmic events. The 24-hour Holter ECG confirmed abrupt heart rate increases during standing and ambulation, without any change in pacing rate and without evidence of significant arrhythmias. A mild excess of supraventricular ectopic beats was observed, but no sustained tachyarrhythmias or bradyarrhythmic episodes were recorded.

symptomatic, reproducing the patient's complaints of dizziness, palpitations, and presyncope, with a reproducible HR increase without hypotension. Echocardiography demonstrated preserved left ventricular systolic function and mild diastolic function without structural abnormalities. 24-hour Holter electrocardiogram (ECG) confirmed abrupt HR increases during standing and ambulation, without arrhythmic events, though mild excess of supraventricular ectopic beats was noted (Figure 1). Laboratory evaluation excluded anemia, electrolyte imbalance, and endocrine disorders. On the basis of the patient's clinical features and bedside orthostatic assessment OH was ruled out, while the pronounced tachycardic response met diagnostic criteria for POTS. Treatment focused on non-pharmacological strategies, including adequate fluid and salt intake, nutritional support to promote gradual weight gain, use of elastic compression stockings, and cautious positional changes, along with gradual beta-blocker titration (bisoprolol). Individualized physiotherapy and progressive mobilization were also implemented. Over the following weeks, the patient demonstrated significant symptomatic improvement, and at one-year follow up she

remained asymptomatic and functionally independent, with only mild limitations during strenuous exertion, having returned to regular daily exercise and independent driving.

Discussion

Orthostatic intolerance encompasses a broad spectrum of hemodynamic disturbances that arise from impaired autonomic regulation during the transition from a supine to an upright posture. Differentiating OH from POTS in practice is often challenging, even for experienced clinicians, due to overlapping symptoms such as dizziness, presyncope, palpitations, and generalized weakness (Table 2).^[5] Current consensus guidelines distinguish OH by a sustained decrease in SBP of ≥ 20 mmHg or DBP of ≥ 10 mmHg within 3 minutes of standing, reflecting impaired baroreflex-mediated vasoconstriction.^[6] In contrast, POTS is characterized by an excessive increase in HR of ≥ 30 beats per minute within 10 minutes of standing in the absence of significant OH, typically indicating excessive sympathetic activation and/or relative hypovolemia.^[7] These criteria provide a useful diagnostic framework, although real-world differentiation is frequently complicated

Table 2. Key Distinctions Between Orthostatic Hypotension and Postural Orthostatic Tachycardia Syndrome. Adapted from reference.^[2,4,16,17]

Parameter	Orthostatic Hypotension (OH)	Postural Orthostatic Tachycardia Syndrome (POTS)
Typical age group	Predominantly older adults	More frequent in younger women
Pathophysiology	Impaired baroreflex-mediated sympathetic vasoconstriction, venous pooling and reduced vascular resistance	Excessive sympathetic activation, relative hypovolemia and impaired venous return
Hemodynamic response	Drop in BP with absent or minimal HR increase	Stable BP with marked HR increase (≥ 30 beats per minute) within 10 min of standing
Typical signs and symptoms	Dizziness, blurred vision, fatigue, presyncope, weakness on standing	Palpitations, tremor, dyspnea, cognitive "fog," exercise intolerance
Electrocardiographic and hemodynamic findings	BP drop, mild or absent HR increase	Sustained sinus tachycardia without hypotension or arrhythmia
Common triggers	Rapid standing, dehydration, warm environment, antihypertensive drugs	Prolonged standing, heat exposure, postprandial state, hormonal changes

HR: heart rate; BP: blood pressure.

by overlapping symptoms and mixed autonomic phenotypes.

From a pathophysiological perspective, OH results from inadequate baroreflex-mediated sympathetic vasoconstriction with venous pooling in splanchnic and lower extremity circulations, leading to reduced venous return and a consequent drop in arterial pressure. Although a compensatory increase in HR normally accompanies vasoconstriction, this chronotropic response is blunted or insufficient in neurogenic OH ($\Delta\text{HR}/\Delta\text{SBP} < 0.5$ beats per minute/mmHg), reflecting impaired sympathetic outflow, whereas in non-neurogenic OH the HR response is preserved or exaggerated.^[5-7]

Although physiologically distinct, OH and POTS frequently overlap in clinical practice, particularly among older adults or critically ill patients, where partial autonomic dysfunction, cardiovascular deconditioning, hypovolemia, or medication effects may coexist.^[8]

Moreover, bedside orthostatic testing is frequently suboptimal, often performed without adequate supine rest or standardized timing of measurements, leading to underrecognition of POTS or misclassification as OH. Accurate diagnosis requires standardized hemodynamic assessment following 5–10 minutes of supine rest, with serial recordings during active standing or head-up tilt testing at 1, 3, and 10 minutes.^[9] In older adults, diagnostic interpretation is further complicated by blunted baroreceptor sensitivity, polypharmacy, and reduced vascular compliance, as well as by limited mobility and poor physical conditioning, which may hinder adequate performance of active standing tests.^[8-10] Additionally, medications commonly used in this population, including antihypertensives, diuretics, and antidepressants may further confound hemodynamic responses.^[10]

In the present case, the patient's history of critical illness, prolonged immobilization, and

neuromyopathic weakness likely contributed to secondary autonomic dysfunction and marked cardiovascular deconditioning. Furthermore, cumulative effects of chemotherapy, radiotherapy, and concurrent effects of chemotherapy, radiotherapy and concomitant medications may have exacerbated autonomic instability and blunted baroreceptor responsiveness, thereby obscuring the classical distinction between OH and POTS. Despite advanced age, multiple comorbidities, and extensive thoracic surgery, the hemodynamic profile revealed a pronounced tachycardic response upon standing without a significant fall in BP, consistent with a POTS pattern rather than neurogenic or hypovolemic hypotension. This observation highlights that postural tachycardia can occur even in older, frail individuals, particularly following prolonged critical illness or major thoracic procedures that disrupt autonomic homeostasis.^[11,12] Interpretation of orthostatic responses in such patients is inherently complex, as physiological aging diminishes baroreceptor sensitivity and vascular compliance, while polypharmacy and systemic deconditioning further modulate hemodynamic adaptation.^[12]

In this patient, additional factors, including critical illness neuromyopathy, significant weight loss, and prior exposure to vasodilatory and chemotherapeutic agents most likely compounded autonomic dysfunction, resulting in an atypical presentation within the orthostatic intolerance spectrum. This intermediate phenotype, characterized by tachycardia without hypotension, underscores the need for meticulous hemodynamic assessment and nuanced diagnostic reasoning rather than reliance on rigid categorical criteria.^[13] Comprehensive evaluation, including active standing testing and 24-hour Holter monitoring, was pivotal in identifying the predominant mechanism and excluding reversible causes such as anemia, dehydration, or endocrine dysfunction. The hemodynamic

pattern of isolated tachycardia with preserved BP supported a diagnosis consistent with POTS and guided an appropriate, targeted management strategy.^[14] Therapeutic intervention focused on re-establishing autonomic balance through non-pharmacologic measures, such as adequate hydration and salt intake, compression therapy, and gradual mobilization, combined with low-dose beta-blocker therapy for symptomatic tachycardia.^[14,15] The patient's progressive recovery and sustained symptom resolution over one year underscore the importance of early recognition and individualized care in post-critical illness dysautonomia.

Management of orthostatic intolerance requires a tailored, pathophysiology-guided approach based on the patient's hemodynamic profile. Accurate differentiation between OH and POTS is essential, as therapeutic strategies differ substantially (Table 3). In OH, treatment aims to restore effective circulating volume and maintain cerebral perfusion through correction of hypovolemia, withdrawal of precipitating medications, use of compression garments, and, when indicated, pharmacologic agents such as midodrine, droxidopa, or fludrocortisone.^[3,8,15]

Conversely, management of POTS focuses on attenuating excessive sympathetic activation and improving venous return. Non-pharmacologic measures, including adequate fluid and salt intake, compression therapy, gradual mobilization, and structured physical reconditioning form the cornerstone of therapy, while pharmacologic interventions such as beta-blockers, ivabradine, or low-dose midodrine are reserved for persistent or severe symptoms.^[5,7,16]

Misclassification between these entities may lead to iatrogenic harm. For example, vasopressors may aggravate tachycardia in POTS, whereas inappropriate beta-blockade in OH may precipitate syncope. Therefore, precise diagnostic confirmation and individualized treatment planning are critical to achieving optimal clinical outcomes.^[17] In the present case, the exclusion of secondary causes, together with a favorable response to volume expansion, graded rehabilitation, and low-dose beta-blocker therapy, supported the diagnosis of a functional autonomic disturbance and consistent with POTS and underscored the importance of a personalized, dynamically adjusted management approach.

Table 3. Key Diagnostic and Therapeutic Approach in Orthostatic Hypotension and Postural Orthostatic Tachycardia Syndrome. Adapted from reference.^[3,5,7,8,15,16]

Assessment / Action	Findings Suggestive of Orthostatic Hypotension	Findings Suggestive of Postural Orthostatic Tachycardia Syndrome
Clinical assessment	Dizziness, presyncope, blurred vision, weakness on standing; associated with diabetes and/or neurodegenerative disease	Palpitations, tremor, fatigue, 'brain fog,' exercise intolerance; associated with autoimmune disorders or post-viral syndromes
Active standing or tilt test	Decrease of SBP ≥ 20 mmHg or DBP ≥ 10 mmHg within 3 minutes; absent or blunted compensatory HR increase	Increase of HR ≥ 30 beats per minute (≥ 40 in adolescents) within 10 minutes of standing; without orthostatic hypotension (no SBP drop ≥ 20 mmHg or DBP drop ≥ 10 mmHg)
Confirmatory or supportive testing	Beat-to-beat BP monitoring	24-h Holter ECG
Therapeutic strategy	Volume repletion, salt intake, compression garments, midodrine or fludrocortisone	Fluid and salt loading, compression, graded exercise, β -blocker or ivabradine (if needed)
Follow-up	Evaluate BP stability, risk of falls, renal and cardiovascular outcomes	Monitor HR control, exercise tolerance, and symptom improvement

SBP: systolic blood pressure; DBP: diastolic blood pressure; BP: blood pressure; HR: heart rate.

This case illustrates several key aspects of orthostatic intolerance in older adults. First, it demonstrates how systematic, hemodynamically guided evaluation can prevent misclassification between OH and POTS. An initial assumption of OH was revised following active standing testing and 24-hour Holter ECG monitoring, which revealed a tachycardic response without a corresponding BP fall, consistent with POTS.

Second, it highlights how secondary autonomic impairment following major thoracic surgery, critical illness, severe deconditioning, and muscle mass loss can produce a mixed or transitional phenotype, blurring the traditional distinction between OH and POTS. Recent studies have described such atypical phenotypes, especially in older or frail patients, where overlapping mechanisms complicate the clinical picture.^[18,19]

Third, the case demonstrates that meaningful functional recovery is achievable even in advanced age when therapy is individually tailored. In this patient, non-pharmacologic interventions, graded rehabilitation, and cautious low-dose pharmacotherapy resulted in durable symptom remission. Finally, the broader implication is that clinicians should view orthostatic intolerance as a continuum rather than a set of rigid categories. In older adults, it often represents a multifactorial condition where autonomic impairment, polypharmacy, sarcopenia, and cardiovascular deconditioning coexist. Early recognition through structured orthostatic assessment and hemodynamically guided interpretation is essential to prevent misdiagnosis and inappropriate therapy. Individualized, multidimensional management, incorporating medication review, tailored rehabilitation, and targeted non-pharmacologic strategies, may substantially reduce the risk of falls, recurrent hospitalizations, and functional decline, ultimately improving overall quality of life.^[20] A multidisciplinary approach integrating geriatric, cardiologic, and autonomic expertise

should therefore represent the cornerstone of care in such complex clinical scenarios.

This case highlights that orthostatic intolerance in older adults represents a fluid continuum rather than distinct entities such as OH or POTS. Precise hemodynamic assessment and individualized, targeted management based on the underlying pathophysiological mechanisms are essential for achieving favorable outcomes. Even in older frail patients recovering from critical illness, restoration of autonomic stability through structured rehabilitation and carefully tailored pharmacotherapy can lead to meaningful functional recovery and sustained symptom control. Such an approach underscores the importance of comprehensive and individualized care in managing autonomic dysfunction in older frail patients.

Ethical approval

Written informed consent for publication of this case report has been obtained from the patient and is available upon request.

Author contribution

The authors declare contribution to the paper as follows: Study conception and design: AK, TM; data collection: AK, TM; analysis and interpretation of results: AK, TM; draft manuscript preparation: AK, TM. All authors reviewed the results and approved the final version of the article.

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Conflict of interest

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Potential implications of the 2026 ACC/AHA dyslipidemia guideline for family medicine practice in Türkiye

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Dear Editor,

The 2026 American College of Cardiology/American Heart Association (ACC/AHA) Dyslipidemia Management Guideline offers a more comprehensive, lifelong, risk-focused approach than previous guidelines. Key changes include earlier intervention to reduce lifelong exposure to atherogenic lipoproteins, replacing the Pooled Cohort Equations (PCE) with the Predicting Risk of Cardiovascular Disease Events—Atherosclerotic Cardiovascular Disease (PREVENT-ASCVD) equation, setting explicit LDL and non-HDL cholesterol targets, measuring Lipoprotein(a) (Lp(a)) once in adulthood, and selectively using Apolipoprotein B (Apo B) and coronary artery calcium (CAC) scores for risk assessment.^[1] The most significant feature of this guideline for family medicine in Türkiye is its potential to accelerate the transition from a focus on periodic risk assessment in middle age to a lifelong approach to risk accumulation. Dyslipidemia is a major public health issue affecting approximately one in every two people in Türkiye.^[2] However, in primary care, adults aged ≥40 years undergo cardiovascular risk

assessment through the Disease Management Platform (HYP) rather than disease-specific dyslipidemia assessment screening.^[3]

Transition from periodic risk assessment to lifetime risk assessment

The most significant implication of this guideline for family medicine in Turkey is the shift from risk assessment conducted after age 40 to a lifelong risk assessment. The new guideline recommends screening individuals with a family history of familial hypercholesterolemia, severe hypercholesterolemia, or a first/second-degree relative with early-onset ASCVD starting from age 2. If not previously evaluated, lipid profile screening between ages 9 and 11 is also suggested. In adults, screening begins at age 19.^[4] Current HYP cardiovascular risk assessment begins at age 40, potentially delaying identification of younger individuals with elevated lifetime lipid-related cardiovascular risk. Conducting opportunistic lipid screening prior to routine HYP eligibility assessments could help identify younger individuals at high risk.

Integration of biomarkers into family medicine

Another significant issue pertains to the integration of biomarkers into family medicine. The guideline recommends a single Lp(a) measurement in adulthood, ApoB-guided treatment, and CAC scoring for selected high-risk patients.^[5,6] In family medicine practice in Turkey, the use of CAC scores recommended by the guideline may be limited due to access to testing centers. In high-risk cases, gradually adopting Lp(a) and ApoB measurements in family medicine could be a more realistic starting point. National primary care guidelines, such as the 2026 Primary Care Diagnostic and Treatment Guidelines, may play an important role in adapting international recommendations to local clinical workflows.^[7]

LDL/Non-HDL target-oriented monitoring

Explicit targets for LDL and non-HDL cholesterol provide a clear framework for monitoring within primary care settings. The guideline recommends LDL targets of <100 mg/dL for borderline/moderate-risk individuals, <70 mg/dL for high-risk individuals, and <55 mg/dL (non-HDL <85 mg/dL) for very high-risk secondary prevention.^[1] Family medicine follow-ups can be made more structured, especially regarding statin adherence, dose titration, target-based stepwise intensification of lipid-lowering therapy, and timely referral of high-risk patients to higher levels of care. Considering our country's reimbursement policies for dyslipidemia treatments at the primary care level, the focus is expected to be on follow-up rather than on treatment itself.^[8]

Conclusion

In conclusion, the main contributions of the new dyslipidemia guideline to family medicine practice in Turkey include earlier assessment of dyslipidemia, the use of biomarkers in selected

patients, and more systematic follow-up based on LDL/non-HDL targets. The recommendations of this new guide should be evaluated in the context of national risk assessment strategies, health infrastructure, reimbursement policies, and local evidence.

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Conflict of interest

The author declare that there is no conflict of interest to disclose.

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