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## From the Editor

Dear Readers,

Welcome to the first edition of 2025! We are excited to present this carefully curated collection of articles designed to engage and inspire healthcare professionals, with a special focus on our esteemed primary care physicians. Our commitment to providing essential guidance in navigating the ever-evolving healthcare landscape remains unwavering.

Inside, you'll find seven research articles, one review and a letter to the editor, each offering valuable insights into key advancements in critical healthcare areas.

As Türkiye's leading primary care journal, we are proud to fulfill our role as a vital resource for healthcare professionals across the region. We sincerely appreciate your continued interest in our journal, reinforcing our dedication to delivering the latest research and evidence relevant to primary care.

We invite you to explore the thought-provoking articles within, confident they will both challenge and inspire you. Your engagement and support are essential to our mission of promoting knowledge and innovation in primary care.

Look out for our next issue, which promises to be just as enlightening and stimulating.

**Prof. Dr. Ahmet Keskin**

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## Research Article

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# COMPREHENSIVE GERIATRIC ASSESSMENT FOR FALL RISK IDENTIFICATION IN NURSING HOME RESIDENTS: INSIGHTS AND IMPLICATIONS FOR MEDICAL PRACTITIONERS

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## Abstract

**Objectives:** To assess the suitability of the Comprehensive Geriatric Assessment (CGA) in detecting fall risk among nursing home residents, identify its key components associated with high fall risk, and provide practical guidance for medical practitioners.

**Materials and Methods:** This cross-sectional study included adults aged  $\geq 60$  residing in a nursing home. All participants underwent a CGA by geriatricians, with the evaluation process taking two months. All participants' medical and fall histories were recorded, including height, weight, calf circumference, muscle strength, and gait speed measurements. The relationship between participants' fall history in the previous year (none vs.  $\geq 1$  fall) and the CGA components was assessed.

**Results:** This study includes a total of 104 nursing home residents. 40 individuals (38.5%) had a history of at least one fall and 40% of individuals who fell had fallen two or more times within the last year. In multivariate analysis, malnutrition risk and malnutrition (OR 3.52 [95% CI 1.22-10.12],  $p=0.020$ ), muscle strength (OR 5.91 [95% CI 1.02-34.16],  $p=0.047$ ), and gait speed (OR 3.89 [95% CI 1.13-14.12],  $p=0.032$ ) were independently associated with the risk of falls, regardless of age, Charlson Comorbidity Index, dependence in activities of daily living, and frailty.

**Conclusion:** This study suggests that low grip strength, reduced gait speed, and malnutrition or malnutrition risk are associated with falls among nursing home residents. Instead of the CGA, which requires significant time, assessing these three components of the CGA may be more effective for medical practitioners evaluating fall risk in time-limited outpatient clinics.

**Keywords:** Accidental falls, geriatric assessment, nursing homes, walking speed, hand strength, malnutrition.

## Introduction

Older adults in nursing homes often have higher levels of comorbidities, increased medication use, functional decline, cognitive impairments, and greater dependency than their community-dwelling counterparts. Consequently, they are more prone to geriatric syndromes such as urinary incontinence, polypharmacy, dementia, depression, frailty, and sarcopenia, all of which heighten their fall risk. Nearly half of nursing home residents experience at least one fall annually, compared to about 30% of older adults living in the community.<sup>1,2</sup> Shared living spaces in nursing homes create unique hazards, such as uneven flooring, cluttered walkways, and inadequate handrails. Unlike hospitals, which provide continuous monitoring and medical supervision, nursing homes often have insufficient staff-to-resident ratios, limiting timely assistance and supervision. As a result, fall prevention in nursing homes presents major challenges.

Falls among older adults are a significant concern, leading to physical injuries, psychological consequences, and, in some cases, fatalities, with a rate of 78.0 deaths per 100,000 older adults reported in the United States in 2021.<sup>3</sup> In addition to the direct health impacts, falls lead to decreased independence, more hospital admissions, longer hospital stays, and increasing healthcare costs.<sup>4</sup> The economic burden of falls in older adults is substantial, with the annual cost of nonfatal falls estimated at approximately \$80 billion in the United States in 2020.<sup>5</sup> Therefore, identifying and addressing the factors that contribute to falls, and regularly assessing residents' fall risk, is crucial to preventing these adverse outcomes.

Falling is not a disease but a symptom and often results from multiple causes. Therefore, evaluating fall risk in older adults requires a multidisciplinary approach. The Comprehensive Geriatric Assessment (CGA) enables a thorough evaluation of their physical, psychological, and social well-being. While geriatricians commonly use CGA for elderly patients seeking medical care in hospital settings, it is not routinely applied to nursing home residents. This study aims to evaluate the suitability of CGA for detecting fall risk among nursing home residents and to identify the key components of CGA associated with a high risk of falls. By doing so, it is hoped that medical practitioners, who often care for older adults in time-limited visits, will have practical guidance for assessing fall risk and implementing targeted interventions to improve outcomes.

## Materials and Methods

### *Study Population and Design*

A cross-sectional design was utilized for this study, which was conducted with adults residing in the Ankara Seyranbağları Nursing Home and Rehabilitation Center in July and August 2018. The geriatric physicians of Ankara University Faculty of Medicine assessed the nursing home residents. Individuals aged 60 and over who

stated that they volunteered were included in the study. Individuals who declined to participate or who had communication problems (severe hearing impairment or inability to see), advanced dementia (MMSE score < 10), inadequate comprehension skills, bedridden status, amputated limbs, or severe pretibial edema were excluded from the study due to their inability to complete the study tasks satisfactorily, and/or the potential for their current condition to distort the measurements obtained. A total of 104 nursing home residents who fulfilled the specified criteria were enrolled in the study out of a total of 143 residents.

The study was approved by the Ankara University Ethics Committee on 26.02.2018 (#04-248-18). All participants signed a consent form that was prepared following the principles of the Declaration of Helsinki.

#### *Evaluation of Participants*

All participants' medical histories were collected. All individuals underwent CGA. Charlson Comorbidity Index (CCI) scores were calculated and recorded. Individual physical activity levels and functional capacities were evaluated with Katz's activities of daily living (ADL) and Lawton's instrumental activities of daily living (IADL) scales. Individuals who exhibited limitations in at least one activity on the ADL and IADL scales were categorized as dependent. Polypharmacy was considered as the use of 5 or more drugs. The anticholinergic drug burden was calculated by assessing the medications used by each individual according to the anticholinergic burden (ACB) scoring list.<sup>6</sup> A score of three or more was considered to indicate a high ACB. The Mini-Mental State Examination (MMSE), the Yesavage Geriatric Depression Scale, the Mini Nutritional Assessment Test (MNA), the Hendrich II Fall Risk Assessment Scale, and the Fried Frailty Scale were administered and scored according to each test's cut-off points.<sup>7-11</sup>

For each individual, we measured the calf circumference by encircling the widest part of their left calf while they were seated with knees bent at a 90-degree angle and feet flat on the ground. Hand grip strength was evaluated using an electronic hand dynamometer (Takei Scientific Instruments, Niigata, Japan), which underwent calibration by technical service two weeks before the study.<sup>12</sup> Measurements were conducted with individuals seated, elbows flexed at a 90-degree angle, exerting maximum force while squeezing the device. Three measurements were taken for each hand, and the highest value was recorded. Dynapenia, indicating low muscle strength, was defined as hand grip strength < 32 kg for men and < 22 kg for women.<sup>13</sup> The physical performance of participants was assessed using the 4-meter usual gait speed test, where the time taken to walk the distance was recorded using a stopwatch. Gait speeds ≤ 0.8 m/sec were categorized as low physical performance.<sup>13</sup>

Sarcopenia was assessed using two scales: SARC-F and SARC-CalF. The SARC-F scale, comprising five items with a maximum score of 10 points, categorized individuals scoring 0-3 points as healthy and 4-10 points as sarcopenic.<sup>14</sup> The SARC-CalF scale, an additional tool, incorporates calf circumference measurement. If the calf

circumference is <33 cm, 10 points are added to the SARC-F score; otherwise, no points are added. A SARC-CalF score  $\geq 11$  indicates sarcopenia.<sup>15</sup> Individuals scoring  $\geq 4$  points on the SARC-F scale and exhibiting low muscle strength (<32 kg in men, <22 kg in women) were classified as having probable sarcopenia.<sup>16</sup>

### *Statistical Analysis*

Continuous variables were presented as median and range, while categorical variables were presented as numbers and percentages. The Wilcoxon rank-sum test was utilized to compare continuous variables, and either the chi-square test or Fisher's exact test was employed to compare categorical variables. Logistic regression analysis was conducted to assess factors associated with falls, deriving odds ratios. The presence of falls served as the dependent variable, with independent variables selected based on clinical correlation and significant association in univariate analysis. Statistical significance was set at a threshold of <0.05 for the p-value. Data analysis was performed using "PASW Statistics" software (Version 18.0, Chicago, SPSS Inc).

## **Results**

The study enrolled 104 nursing home residents, comprising 32 females (30.8%) and 72 males (69.2%). Within this cohort, 40 individuals (38.5%) reported experiencing falls in the past year, with 60% experiencing a single fall and 40% reporting two or more falls. Table 1 outlines the basic characteristics of individuals based on their fall status. The median age of participants was 78 (range: 61-98). Among those who fell, the median age was 80 (range: 63-98), while among non-fallers, it was 75 (range: 61-90), demonstrating a significant age difference ( $p=0.004$ ). Furthermore, individuals aged 75 and above were found to have a higher propensity for falls ( $p=0.003$ ). Moreover, individuals with a history of falls exhibited a significantly higher median CCI score (5, range: 2-7) compared to those without falls (4, range: 2-9) ( $p=0.015$ ).

Table 2 shows a significant association between antihypertensive (47.5%) and vasodilator (85.7%) use and increased fall risk in the past year ( $p=0.023$  and  $p=0.008$ , respectively), while no such association was found for other medication groups.

**Table 1.** Basic characteristics of individuals according to their fall status

Basic Characteristics	Falls in a year			
		None	≥1 time	p-value
<b>Age (median)</b>		75 (61-90)	80 (63-98)	0.004**
<b>Age groups</b>	<75 age	33 (78.6%)	9 (21.4%)	0.003**
	≥75 age	31 (50%)	31(50%)	
<b>Gender</b>	Female	16 (50%)	16 (50%)	0.107
	Male	48 (66.7%)	24 (33.3%)	
<b>Number of falls*</b>	Once	0 (0%)	24 (60%)	
	≥2 times	0 (0%)	16 (40%)	
<b>Marital Status</b>	Married	13 (76.5%)	4 (23.5%)	0.147
	Single	23 (67.6%)	11 (32.4%)	
	Widowed	28 (52.8%)	25 (47.2%)	
<b>Length of stay in nursing home (month)(median)</b>		16 (0-180)	29.5 (2-192)	0.392
<b>Use of Assistive Devices</b>	Yes	11 (44%)	14 (56%)	0.040**
	No	51 (67.1%)	25 (32.9%)	
<b>BMI (kg/m<sup>2</sup>) (median)</b>		26.63 (19-52)	26.16 (18-40)	0.960
<b>CCI (median)</b>		4 (2-9)	5 (2-7)	0.015**

Abbreviations: BMI; Body Mass Index, CCI; Charlson Comorbidity Index

Values are median (range) or frequency (percent).

\*Column percentage is given for the number of falls.

\*\* indicates statistically significant values with  $p < 0.05$ .

**Table 2.** Habits and medication groups of individuals according to their fall status

Habits and medication groups		Falls in a year		p-value
		None	≥1 time	
<b>Smoking</b>	Non-smoker	33 (54.1%)	28 (45.9%)	0.063
	Active smoker	31 (72.1%)	12 (27.9%)	
<b>Alcohol</b>	None	48 (58.5%)	34 (41.5%)	0.445
	1 or 2 days a week	12 (70.6%)	5 (29.4%)	
	≥3 days per week	4 (80%)	1 (20%)	
<b>Antihypertensive</b>	Yes	32 (52.5%)	29 (47.5%)	0.023**
	No	32 (74.4%)	11 (25.6%)	
<b>Diuretics</b>	Yes	18 (54.5%)	15 (45.5%)	0.318
	No	46 (64.8%)	25 (35.2%)	
<b>Vasodilators</b>	Yes	1 (14.3%)	6 (85.7%)	0.008**
	No	63 (64.9%)	34 (35.1%)	
<b>Antipsychotics</b>	Yes	4 (66.7%)	2 (33.3%)	0.790
	No	60 (61.2%)	38 (38.8%)	
<b>Antiepileptics</b>	Yes	11 (64.7%)	6 (35.3%)	0.769
	No	53 (60.9%)	34 (39.1%)	
<b>SSRIs</b>	Yes	7 (46.7%)	8 (53.3%)	0.201
	No	57 (64%)	32 (36%)	
<b>Benzodiazepines</b>	Yes	0 (0%)	1 (100%)	0.204
	No	64 (62.1%)	39 (37.9%)	

Abbreviations: SSRIs; Selective Serotonin Receptor Inhibitors

Values are median (range) or frequency (percent).

\*\* indicates statistically significant values with  $p < 0.05$ .

Tables 3 and 4 outline CGA results by fall status over the past year. Among participants with ADL dependence, 52.9% reported falls, compared to 28% with IADL dependence. ADL dependence was significantly associated with falls ( $p=0.034$ ), while IADL dependence was not ( $p=0.243$ ). The fall rate in the past year was 60% among individuals identified as a high fall risk and 34.8% among those classified as low fall risk according to the Hendrich fall risk scale. However, when considering frailty and fall status, 29.2% of robust individuals, 38.5% of prefrail individuals, and 64.7% of frail individuals experienced falls in the past year, although this difference was not statistically significant ( $p=0.064$ ). Frail and prefrail individuals exhibited significantly more falls ( $p=0.035$ ). Additionally, the fall rate in the past year was 29.4% among individuals with normal nutritional

status, 51.6% among those at risk of malnutrition, and 80% among those with malnutrition. Individuals at risk of malnutrition and those with malnutrition experienced significantly more falls ( $p=0.016$ ).

**Table 3.** CGA results of individuals according to their fall status

CGA Parameters		Falls in a year		p-value
		None	≥1 time	
<b>Polypharmacy</b>	Yes	34 (54.8%)	28 (45.2%)	0.088
	No	30 (71.4%)	12 (28.6%)	
<b>Anticholinergic Drug Burden</b>	High	24 (57.1%)	18 (42.9%)	0.448
	Low	40 (64.5%)	22 (35.5%)	
<b>ADL</b>	Dependent	16 (47.1%)	18 (52.9%)	0.034**
	Independent	48 (68.6%)	22 (31.4%)	
<b>IADL</b>	Dependent	46 (59%)	32 (41%)	0.243
	Independent	18 (72%)	7 (28%)	
<b>Malnutrition</b>	No Malnutrition	48 (70.6%)	20 (29.4%)	0.016**
	Malnutrition risk	15 (48.4%)	16 (51.6%)	
	Malnutrition	1 (20%)	4 (80%)	
<b>Depression</b>	Yes	29 (56.9%)	22 (43.1%)	0.375
	No	34 (65.4%)	18 (34.6%)	
<b>Cognitive Dysfunction</b>	Yes	8 (38.1%)	13 (61.9%)	0.015**
	No	55 (67.1%)	27 (32.9%)	
<b>Urinary Incontinence</b>	Yes	22 (56.4%)	17 (43.6%)	0.405
	No	42 (64.6%)	23 (35.4%)	

Abbreviations: ADL; Activities of Daily Living, IADL; Instrumental Activities of Daily Living

Values are median (range) or frequency (percent).

\*\* indicates statistically significant values with  $p<0.05$ .

Individuals identified as sarcopenic using either the SARC-F or SARC-CalF scale exhibited a significantly higher incidence of falls in the past year compared to those without sarcopenia. Among those classified as sarcopenic using the SARC-F scale, the fall rate was 81.3%, while for those classified using the SARC-CalF scale, it was 70%. The incidence of falls was significantly higher among individuals identified as sarcopenic using either scale ( $p<0.001$  and  $p=0.001$ , respectively). Additionally, individuals evaluated as "possible sarcopenic" had a significantly higher fall rate (81.3%,  $p<0.001$ ).

Individuals without a fall history had a median muscle strength of 25.6 kg (range: 8-47), while those with a fall history had 19.1 kg (range: 9-42), with muscle strength significantly lower in fallers ( $p=0.006$ ). Among participants, 43.2% with dynapenia and 10.5% without dynapenia reported falls, with a significantly higher fall incidence in those with dynapenia ( $p=0.008$ ).

**Table 4.** CGA results of individuals according to their fall status (continued from Table 3)

CGA Parameters		Falls in a year		p-value
		None	≥1 time	
<b>Fall Risk (Hendrich II)</b>	High	6 (40%)	9 (60%)	0.064
	Low	58 (65.2%)	31 (34.8%)	
<b>Frailty</b>	Robust	34 (70.8%)	14 (29.2%)	0.035**
	Prefrail	24 (61.5%)	15 (38.5%)	
	Frail	6 (35.3%)	11 (64.7%)	
<b>SARC-F</b>	Healthy	61 (69.3%)	27 (30.7%)	<0.001**
	Sarcopenic	3 (18.8%)	13 (81.3%)	
<b>SARC-CalF</b>	Healthy	58 (69%)	26 (31%)	0.001**
	Sarcopenic	6 (30%)	14 (70%)	
<b>Probable Sarcopenia</b>	Yes	3 (18.8%)	13 (81.3%)	<0.001**
	No	61 (69.3%)	27 (30.7%)	
<b>Muscle Strength (kg)</b>	<b>(median)</b>	25.6 (8-47)	19.1 (9-42)	0.006**
<b>Dynapenia</b>	Yes	46 (56.8%)	35 (43.2%)	0.008**
	No	17 (89.5%)	2 (10.5%)	
<b>Gait Speed (sec)</b>	<b>(median)</b>	5.06 (3-23)	6.38 (3-38)	0.005**
<b>Physical Performance</b>	Low	33 (52.4%)	30 (47.6%)	0.003**
	Normal	31 (81.6%)	7 (18.4%)	
<b>Calf Circumference (cm)</b>	<b>(median)</b>	35 (29-42)	34 (25-44)	0.215

Values are median (range) or frequency (percent).

\*\* indicates statistically significant values with  $p<0.05$ .

Individuals who fell had a slower median gait speed of 6.38 seconds (range: 3-38), compared to 5.06 seconds (range: 3-23) in those who did not fall ( $p=0.005$ ). In the past year, 47.6% of individuals with low physical performance and 18.4% of individuals with normal physical performance experienced falls, with a significantly higher fall incidence in those with low physical performance ( $p=0.003$ ).



Logistic regression analysis was conducted to evaluate the factors associated with falls (Table 5). In univariate analysis, age (odds ratio [OR] 1.08 [95% confidence interval [CI] 1.03-1.15, p=0.004), CCI (OR 1.39 [95% CI 1.02-1.89], p=0.036), ADL (OR 2.46 [95% CI 1.06-5.69], p=0.036), malnutrition risk and malnutrition (OR 3.0 [95% CI 1.30-6.94], p=0.010), frailty (OR 4.45 [95% CI 1.38-14.39], p=0.013), muscle strength (OR 6.46 [95% CI 1.40-29.86], p=0.017), and gait speed (OR 4.03 [95% CI 1.54-10.49], p=0.004) were significantly associated with the risk of falls. In multivariate analysis, malnutrition risk and malnutrition (OR 3.52 [95% CI 1.22-10.12], p=0.020), muscle strength (OR 5.91 [95% CI 1.02-34.16], p=0.047), and gait speed (OR 3.89 [95% CI 1.13-14.12], p=0.032) were found to be significantly associated with the risk of falls.

**Table 5.** Results of univariate and multivariate analyses of predictors of falls

		Univariate analysis		Multivariate analysis	
		OR (95%CI)	p-value	OR (95%CI)	p-value
<b>Age</b>	<b>Continuous</b>	1.08	0.004**	1.07	0.092
		(1.03-1.15)		(0.99-1.16)	
<b>CCI</b>	<b>Continuous</b>	1.39	0.036**	0.96	0.851
		(1.02-1.89)		(0.61-1.49)	
<b>ADL</b>	<b>Independent</b>	Reference		Reference	
	<b>Dependent</b>	2.46	0.036**	0.69	0.522
		(1.06-5.69)		(0.22-2.16)	
<b>Malnutrition</b>	<b>Normal</b>	Reference		Reference	
	<b>Malnutrition and MR</b>	3.0	0.010**	3.52	0.020**
		(1.30-6.94)		(1.22-10.12)	
<b>Frailty</b>	<b>Robust</b>	Reference		Reference	
	<b>Prefrail</b>	1.52	0.362	0.39	0.119
		(0.62-3.72)		(0.12-1.27)	
	<b>Frail</b>	4.45	0.013**	0.82	0.805
		(1.38-14.39)		(0.16-4.11)	
<b>Muscle Strength</b>	<b>Normal</b>	Reference		Reference	
	<b>Dynapenia</b>	6.46	0.017**	5.91	0.047**
		(1.40-29.86)		(1.02-34.16)	
<b>Gait Speed</b>	<b>Normal</b>	Reference		Reference	
	<b>Low Physical</b>	4.03	0.004**	3.89	0.032**
	<b>Performance</b>	(1.54-10.49)		(1.13-14.12)	

Abbreviations: ADL; Activities of Daily Living, CCI; Charlson Comorbidity Index,

MR; Malnutrition Risk, OR; Odds Ratio

\*\* indicates statistically significant values with p<0.05.

## Discussion

In this study, low muscle strength, low physical performance, malnutrition risk, and malnutrition were found to be associated with falls in nursing home residents, independently of parameters such as age, CCI, dependence on ADL, and frailty.

The annual rate of falls among individuals aged 65 and over residing in nursing homes ranged from 30% to 50% in previous studies.<sup>17,18</sup> A history of falls is considered one of the most significant predictors of future falls, with 50% of individuals who may fall experiencing a repeat fall.<sup>19</sup> In this study it was found that 38.5% of individuals fell within the last year and 40% of individuals who fell had fallen two or more times which is comparable to literature data.

In our study, we utilized the Hendrich II fall risk assessment scale, chosen for its broad applicability across various settings and populations, including hospitalized patients, nursing home residents, and outpatient clinic attendees, to evaluate fall risk in elderly individuals. However, we did not find a significant difference in fall occurrence between those classified as low-risk and high-risk falls according to the scale's criteria. The scale assigns a higher score for fall risk to factors such as confusion/disorientation, symptomatic depression, and use of antiepileptic drugs and benzodiazepines. However, the specific criteria for confusion/disorientation and symptomatic depression are not well-defined, which may limit the scale's applicability in certain populations. Our exclusion criteria, which ruled out individuals with advanced dementia (MMSE scores <10) and severe communication issues, may have contributed to the scale's inability to accurately predict fall risk. Although participants with mild to moderate dementia and depression were included, the Hendrich II scale still failed to accurately predict those with a history of falls. Additionally, factors not captured by the Hendrich II scale, such as environmental influences and individual health conditions beyond its scope, may limit its predictive accuracy. Based on our results, the Hendrich II scale does not appear to be an appropriate tool for assessing fall risk among nursing home residents. For this population, a more comprehensive and multidimensional fall risk assessment tool is needed.

Frailty, resulting from decreasing physiological reserves due to aging, is a geriatric syndrome that renders individuals vulnerable to diseases and other stresses, leading to negative health outcomes. Falls are one of the main negative outcomes of frailty, and frailty has been found to increase the risk of falls.<sup>20</sup> In our study, individuals who were prefrail or frail fell more often. However, frailty and falls are part of a vicious cycle. Frail individuals fall frequently, and falls can further exacerbate their frailty, leading to even more falls. The reverse is also true. Therefore, unfortunately, it was not possible to establish a cause-and-effect relationship between these in this study.

Malnutrition and sarcopenia are frequently observed together in elderly individuals and share common physiological mechanisms. In older adults, both conditions may lead to adverse consequences, including reduced functionality, decreased quality of life, heightened fall risk, hospitalization, morbidity, and mortality.<sup>21</sup> In this study, both malnutrition and malnutrition risk were found to increase the risk of falls in elderly individuals. Due to vitamin and mineral deficiencies, malnutrition can result in various health conditions such as anemia, cognitive dysfunction, and reduced proprioception. These conditions, in turn, may contribute to an elevated risk of falls. It has been demonstrated that muscle loss may occur even when there is no calorie restriction or weight loss but only inadequate protein intake.<sup>22</sup> Loss of muscle mass can be caused by an imbalance between protein synthesis and breakdown due to insufficient protein intake in the body. Additionally, inadequate protein intake can decrease the body's capacity to create and repair muscle tissue by reducing the levels of anabolic hormones such as insulin-like growth factor-1 (IGF-1) and testosterone.<sup>23</sup>

Sarcopenia is a skeletal muscle disease characterized by a decrease in muscle mass, muscle strength, and physical performance.<sup>16</sup> Aging is known to diminish hormone levels such as testosterone, estrogen, and GH, as well as increase the levels of pro-inflammatory cytokines (TNF- $\alpha$ , IL-1, IL-6) linked to inflammaging. These conditions and malnutrition, can disrupt the anabolic impact on muscle and cause muscle catabolism, ultimately resulting in sarcopenia.<sup>24,25</sup> Apart from its impact on muscle tissue, inflammaging can heighten the risk of falls through its association with age-related vision disorders such as macular degeneration and cataracts.<sup>26,27</sup> The decrease in physical activity and increase in sedentary lifestyle in elderly individuals can lead to loss of muscle mass and strength, resulting in an increased risk of falls.<sup>28</sup> In our study, it was found that individuals identified as sarcopenic according to SARC-F and SARC-CalF scales and possible sarcopenia diagnosis fell more frequently. As falls are already included in the questions of these scales related to the individual's fall status within the last year, the result may be an anticipated outcome. To further investigate, we evaluated the associations of muscle strength and gait speed with falls and found that individuals with low grip strength and slow gait speed had a higher incidence of falls.

Muscle strength is the most reliable way to measure muscle function, and it can better predict adverse outcomes than muscle mass.<sup>16</sup> The presence of low muscle strength serves as a robust predictor of cardiovascular and all-cause mortality, alongside functional decline and an increased risk of falls.<sup>29</sup> Another way to assess the physical performance of older individuals is to measure their gait speed. It has been shown that gait speed predicts adverse outcomes such as disability, cognitive impairment, hospitalization, falls, and death.<sup>30</sup>

Our study has several limitations. First, due to its cross-sectional design, it cannot establish causality between falls and the parameters assessed by CGA. Second, it excluded individuals with advanced dementia, who are more vulnerable to falls. The diagnosis of sarcopenia did not include muscle mass assessment, and visual and

hearing impairments, known fall risk factors, were not evaluated. The sample size was relatively small, and although participants lived in similar conditions, the study did not fully assess the social and environmental factors contributing to falls. However, a notable strength of our study lies in its ability to provide valuable data on the prevalence of falls and other geriatric syndromes among nursing home residents, in addition to identifying the CGA components most associated with falls—an area where research on nursing home populations in Türkiye is limited. Future research could benefit from longitudinal designs and larger, multi-center cohorts to explore environmental, social, and behavioral factors, providing deeper insights into fall risks and prevention strategies.

In conclusion, the risk of falls in elderly individuals is influenced by a multitude of factors beyond the physiological changes associated with aging, and even a fall risk assessment scale may not be adequate to precisely determine fall risk. Therefore, a holistic assessment is necessary to identify fall risk more accurately. CGA can be an appropriate tool for determining fall risk by evaluating an individual's functional, physical, cognitive, and social aspects, and can also be used to assess fall risk in elderly individuals living in nursing homes. However, it's essential to acknowledge that implementing CGA requires time and experience, and in many regions, including our country, there is a shortage of geriatricians, particularly in smaller cities. Hence, healthcare providers, especially general practitioners and family medicine physicians who often care for older adults, can greatly benefit from the insights provided by our study. Given these constraints, these healthcare providers can play a crucial role in fall risk assessment by screening for malnutrition and measuring grip strength and gait speed. This approach may offer greater accuracy in identifying fall risk compared to other parameters of CGA. To establish a clear causality between CGA and falls, prospective studies are warranted.

**Ethical Considerations:** The study was approved by the Ankara University Ethics Committee on 26.02.2018 (#04-248-18). All participants signed a consent form that was prepared following the principles of the Declaration of Helsinki.

**Conflict of Interest:** The authors declare no conflict of interest.

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## Research Article

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# DO CAREGIVERS HAVE AN EFFECT ON EXTENDED HOSPITALIZATION IN PATIENT-FOLLOWED PALLIATIVE CARE CENTER? A STUDY FROM TÜRKİYE

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## Abstract

**Objectives:** Since palliative care clinics are clinics that strive to solve the pain caused by the disease as well as other physical and psychological symptoms and social problems as a caregiver burden, the length of stay becomes important in our clinics with high demand from patients. One of the purposes of palliative care centers is to evaluate the patient for discharge. We aimed to investigate whether the length of stay is caused by the caregivers as well as clinical conditions.

**Materials and Methods:** In this study, we retrospectively investigated the days of hospitalization of 915 patients followed in a palliative care center and the factors that prolong hospitalization in patients with extended hospitalization.

**Results:** The average length of stay of the patients was found to be  $15.65 \pm 11.43$  days. Hospitalization longer than 28 days was found in 97 (10.60%) patients. The most common reason for extended hospitalization was the reluctance of caregivers to discuss discharge in 47 (48.45%) patients. The second most frequent discharge was delayed in 25 (25.8%) patients due to clinical instability. 23 (23.71%). A significant relationship was detected between length of stay and TPN nutrition. A significant relationship was detected between patients with cancer ( $P: 0.042$ ) and coronary artery disease ( $P < 0.01$ ) on extended stay.

**Conclusion:** With the aging of the world population and the improvement of health care services, the need for palliative care is increasing daily. To use resources efficiently, there is a need to optimize the length of stay in palliative care with a multidisciplinary approach.

**Keywords:** Palliative care, length of stay, caregiver.

## Introduction

The impact of palliative care, which includes symptom management that impairs the quality of life at the end of life, has come forth as a new concern in the last three decades. As the elderly population in society rises, its popularity also increases among health professionals and caregivers.<sup>1</sup> Since palliative care centers aim to treat the disease itself in addition to other physical and psychological symptoms, and social problems, the length of hospitalization comes forth as an issue with solving due to high demand for such health care services.

Another aim of palliative care centers is to evaluate the patient for discharge, to provide devices that the patient needs at home or in a nursing home, and to provide caregivers with care and device usage training.<sup>2</sup> While there are very limited studies on the emotional states of caregivers in the end-of-life management of cancer patients, we have not come across a study investigating the effects of medical discharge decisions on patients' prolonged hospital stays.<sup>3,4</sup>

Although there is a concept such as prolonged hospitalization in intensive care units, prolonged hospitalization for palliative care centers is still a matter of debate.<sup>5</sup> Although it is known that palliative care is cost-effective, it is also known that it prolongs the length of stay, but the underlying causes remain unclear.<sup>6</sup>

In this study, we aimed to investigate the data of the patients who were followed as inpatients in our palliative care center, their discharge status, and the factors affecting prolonged hospitalization.

## Materials and Methods

This study is cross-sectional and retrospective. The data of patients aged 18 and over who were followed consecutively at Ankara Bilkent City Hospital and Ankara Etilik City Hospital, palliative care centers between January 2020 and October 2023 were taken from the hospital database. Those with more than one hospitalization and those with hospitalizations other than their first hospitalization were excluded.

Demographics, medical diagnosis, major morbidities (cancer, Alzheimer's disease, cerebrovascular disease), comorbid conditions such as; congestive heart failure, hypertension, diabetes mellitus, coronary artery disease, chronic kidney failure, medications used, nutrition style, caregiver status, history of tracheostomy were recorded. Pressure ulcer presence, pain scores, length of hospital stay, and discharge status were noted. As in intensive care units, there is no exact cut-off value for long hospital stays in palliative care centers, but in other studies, the average length of stay is generally found to be 25 days or more. We consider the 28 days as

sufficient time for caregivers to develop their ability to care for the patient and to adapt to the care and the patient's symptoms. Patients are evaluated for discharge at the end of the 28th day at the latest. Those with a length of stay of 28 days or more were considered as prolonged hospitalization.<sup>7</sup> Since it is mandatory to keep all patient-related data in nurse and doctor observation forms daily, there were no patients with missing data in our study. In patients with prolonged hospitalization, data regarding potential factors were obtained from the hospital database, and nurse and doctor observation forms.

The nutritional status of the patients at the time of admission to our service was recorded with the nutritional risk score (NRS 2002) form. According to the NRS 2002 score, patients with a score of  $\geq 3$  were interpreted as a malnutrition risk group.<sup>8</sup> Feeding routes of the patients were recorded. It was recorded whether the patient was fed via oral, nasogastric (NG), percutaneous gastrostomy (PEG), percutaneous jejunostomy (PEJ), or total parenteral nutrition (TPN).

Braden risk assessment scale was used for pressure ulcer evaluation immediately after the patients were admitted to the palliative care center. According to this scale,  $\leq 12$  points were considered high risk, 13-14 points were considered risky, and 15-18 points were considered low risk. Preventive practices for pressure ulcers were reviewed in all patients. Pressure ulcer staging was performed.<sup>9,10</sup>

Pain was determined using the visual pain scale (VAS) in patients who could be contacted for pain scores, and the behavioral pain score (DAS) in others. At the same time, the analgesics used by patients with pain were recorded.<sup>11,12</sup>

For this study, local ethics committee approval numbered E1-23-4076 was received from the Ankara Bilkent City Hospital, Ethics Committee. Since this study was retrospective, informal consent could not be obtained. The principles of the Declaration of Helsinki were followed accordingly.

### *Statistical Analysis*

The data obtained from the Hospital Information Management Systems (HIMS) notes, and nurse, dietitian, and doctor daily evaluations were entered into SPSS for Windows v26.0 (IBM Corp., Armonk, NY, USA). The normality of the data was analyzed both visually and analytically. Descriptive analyses were performed. In the comparison of two independent variables, an analysis of T-tests was used. In the presence of more than two variables, analysis of variance (ANOVA) was used. Correlations were investigated by Spearman's Rho. p values  $< 0.05$  was considered statistically significant.

## Results

Nine hundred and fifteen consecutively followed-up patients from January 2020 to September 2023 were included in the study. The mean±SD age of the patients was found to be 71.77±15.22. Among the patients, 478 (52.24%) were female. Eastern Cooperative Oncology Group (ECOG) performance scales of all patients were 3-4. The most common morbidity in patients was cerebrovascular disease with 345 (37.70%) patients. The second common morbidity was end-stage cancer 294 [32.13%]. The third most common disease was advanced-stage Alzheimer's disease (27.54%). A significant relationship was detected between patients with cancer (p=0.042) and cerebrovascular disease (p=0.034) and prolonged stay. The majority of diseases that caused the patients to be admitted to the palliative care center are given in Table 1.

**Table 1.** Major diseases that affect the length of hospital stay

	Length of Stay >28 Days n /%		Length of Stay <28 Days n /%		Total	%	p
	n	%	n	%			
Cerebrovascular disease	27/97	27.84%	318/818	38.88%	345	37.70%	<b>0.034</b>
Cancer (End- stage)	40/97	41.24%	254/818	31.05%	294	32.13%	<b>0.042</b>
Alzheimer's Disease (Advanced-stage)	23/97	23.71%	229/818	28.00%	252	27.54%	0.372

673 (73.55%) of the patients were transferred from intensive care units to the palliative care center. 190 (20.77%) patients were transferred from inpatient clinics. 52 (5.68%) patients were admitted to the palliative care center upon the demand from the home health unit and the patient's relatives. Mortality was observed in 282 (30.82%) patients from the entire patient population during hospitalization. A significantly higher mortality was observed in the group with prolonged hospital stay (p=0.02). Nutritional problems were the most frequently observed during admission, and pain was the third most common in 304 (33.22%) patients. When the patients were evaluated in terms of feeding methods, 484(52.90%) were fed orally, the second most common was 209 (22.84%) patients who received total parenteral nutrition (TPN). The third most common was 161 (17.60%) patients who received tube feeding. No significant relationship was found between prolonged hospitalization and TPN nutrition (p=0.42) Low-potency tramadol/oxycodone was the most preferred painkiller in 211 (23.06%) patients with pain. The use of morphine was preferred in 12(1.31%) patients. In terms of pressure ulcers, all patients received <12 points according to the Braden risk score. While 18 (18.56%) patients in the group with prolonged hospitalization had at least stage 1 pressure ulcers, pressure ulcers were detected in 175 (21.39%) patients in the group without prolonged hospitalization, and there was

no significant difference between them ( $p=0.518$ ). Our rate of delirium, which contributes to the deterioration of the general condition of inpatients, was found to be 193 (21.10%). Anxiolytics were preferred in 216 (23.61%) patients during their hospitalization. The most preferred anxiolytic drug was quetiapine, with the first frequency in patients 124 (13.55%), and haloperidol with the 67 (7.32%) second frequency in patients. Lorazepam was used in 25 (2.73%) patients. No significant difference was found between prolonged stay and anxiolytic use ( $p=0.051$ ). It was determined that 481 (52.57%) of the patients had relatives and no caregiver relatives of three patients could be found. The demographic data of the patients are shown in Table 2.

**Table 2.** Comparison of length of stay times according to patient characteristics

	Length of Stay>28		Length of Stay<28 days		Total	%	p
Gender(female)	50/97	51.55%	428/818	52.32%	478	52.24%	0.885
Diabetes mellitus	14/97	14.43%	71/818	8.68%	85	9.29%	0.650
Hypertension	13/97	13.40%	109/818	13.33%	122	13.33%	0.983
Coronary artery disease	23/97	23.71%	64/818	7.82%	87	9.51%	<b>0.003</b>
Chronic renal failure	5/97	5.15%	38/818	4.65%	43	4.70%	0.823
Congestive heart failure	8/97	8.25%	36/818	4.40%	44	4.81%	0.094
<b>Nutrition</b>					915	100.00%	
Orally	52/97	53.61%	432/818	52.81%	484	52.90%	0.882
Percutan gastrostomy	14/97	14.43%	147/818	17.97%	161	17.60%	0.388
TPN	19/97	19.59%	190/818	23.23%	209	22.84%	0.42
<b>Conditions</b>					915	100.00%	
Pain	39/97	40.21%	265/818	32.40%	304	33.22%	0.123
General condition disorder	43/97	44.33%	438/818	53.55%	481	52.57%	0.086
Oral intake disorder	43/97	44.33%	440/818	53.79%	483	52.79%	0.78
<b>Nonsurvivors</b>	46/97	47.42%	236/818	28.85%	282	30.82%	<b>0.02</b>
<b>Tracheostomy</b>	15/97	15.46%	5/818	0.61%	20	2.19%	<b>0.003</b>
<b>Pressure ulcer</b>	18/97	18.56%	175/818	21.39%	193	21.09%	0.518
<b>Pain killer</b>					463	50.60%	
Paracetamol	17/68	25.00%	133/395	33.67%	150	16.39%	<b>0.04</b>
NSAID/steroid	0/68	0.00%	8/395	2.03%	8	0.87%	
Tramadol/Oxycodone	33/68	48.53%	178/395	45.06%	211	23.06%	0.39
Fentanyl	13/68	19.12%	69/395	17.47%	82	8.96%	0.07
Morphine	5/68	7.35%	7/395	1.77%	12	1.31%	<b>0.001</b>
<b>Anxiolytic use</b>					216	23.61%	
Quetiapine	20/42	47.62%	104/174	59.77%	124	13.55%	0.05
Haloperidol	16/42	38.10%	51/174	29.31%	67	7.32%	0.06
Lorazepam	6/42	14.29%	19/174	10.92%	25	2.73%	0.05
<b>Caregiver</b>					915	100.00%	0.53
Relatives	46/97	47.	435/818	53.18%	481	52.57%	0.05
Paid caregiver	51/97	52.58%	380/818	46.45%	431	47.10%	0.05
No caregiver	0/97	0.00%	3/818	0.37%	3	0.33%	

The average length of stay of the patients was found to be  $15.65 \pm 11.43$  days. The rate of hospitalization longer than 28 days was found to be 10.60% (97). The most common reason for extended hospitalization was the reluctance of caregivers to discuss discharge in 47 (48.45%) patients. The second most common cause was clinical instability in 25 (25.77%) patients. Table 3 shows the factors that cause a prolonged stay. A significant difference was detected between the length of stay and the presence of tracheostomy. ( $p=0.003$ ).

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**Table 3.** The factors that cause a prolonged stay.

	n	%
Using antibiotics for infections	23	23,71
Caregivers do not want to discharge	47	48,05
Waiting for the device supply	2	2,06
Unstable vital signs	25	25,77
<b>Total</b>	97	100

## Discussion

Today, palliative care deals with various issues, such as the rehabilitation of patients, identifying and meeting all their social and physical needs, and training and supporting caregivers, in addition to end-of-life care. Although there are studies on the length of stay in palliative care in Türkiye, all reasons for an extended stay have been considered in a medical situation. To our knowledge, there is no study investigating the effect of caregivers in Turkey.

In this study, the most common co-morbidity during hospitalization was cerebrovascular disease. The second most common was cancer patients, who form the basis of palliative care. Cerebrovascular disease was found to be compatible with the study conducted by Yürüyen et al. from Türkiye. Even though cancer was the second most common reason for hospitalization, we found a significant relationship with the prolonged stay. The reason for this may be that even if patients want to die at home, their relatives might prefer them to be in the hospital environment.<sup>13</sup>

In addition to inpatient services, patients' relatives can apply to palliative care centers through home care services or at their request. In our study, we found that the majority of patients admitted to the palliative care

center were from intensive care units. In the study conducted by Miniksar et al., home health services come first in the applications.<sup>14</sup> This data seems contradictory to our results. Still, due to the high number of intensive care beds in our hospital, which serves as a tertiary center, outpatients can be transferred to other palliative care centers with home care

Indications for admission to palliative care may vary depending on the heterogeneity of patients, or there may be more than one indication. While palliative care deals with symptoms of pain, breathlessness, nausea and vomiting, and fatigue<sup>14</sup>, in our study, the most common reasons for hospitalization were poor general condition and nutritional problems. In the study conducted by Dinçer et al., nutritional problems were the most common reason for hospitalization.<sup>16</sup> Even though nutrition is still a controversial issue in palliative care, for Türkiye, sociodemographically, nutrition is at least as important as the pain perceived by caregivers in palliative care. There is even a dialogue between healthcare professionals and caregivers: 'Sir, this patient does not eat or drink, let's stay in the hospital a little longer.' The most common form of nutrition in our study was oral nutrition. The factor prolonging the hospital stay was determined to be the patient receiving total parenteral nutrition. Similar to the relationship between persistent total parenteral nutrition and in-hospital mortality, it was also found to be associated with prolonged hospitalization in our study.<sup>17</sup>

Pain is the main focus of palliative care. In our study, pain was the third most common symptom after admission. Since pain is a subjective symptom, pain is tried to be understood using different methods. The most preferred painkillers in patients with pain were low-potency painkillers such as oxycodone and tramadol. The World Health Organization has also recommended the use of low-potency analgesics in pain palliation, followed by the use of high-potency ones.<sup>18</sup> According to a study conducted in Slovenia, opioid use varies widely in European countries. Even though our opioid use is not yet at the desired levels, it does not seem to be related to the length of stay. The biggest reason for this is that specialists are concerned that patients will become addicted in our country.<sup>19</sup>

We see that in patients with accompanying symptoms such as delirium and anxiety, the most common drugs used were quetiapine followed by haloperidol. Delirium is a hyperactive or hypoactive complex syndrome that has a wide range of symptoms and findings and is seen at very variable frequencies in hospitalized patients. In addition to nonpharmacological measures, pharmacological treatments are frequently needed to prevent delirium in patients. In pharmacological treatments, haloperidol, atypical antipsychotics, as well as benzodiazepines can be used. We believe that haloperidol is the second most preferred drug due to its side effect profile. The use of benzodiazepines has been much reduced because they can cause delirium to become more severe.<sup>20,21</sup>

Palliative care is a complex structure that includes doctors, nurses, other healthcare professionals, as well as caregivers. Caregivers are included in the system to determine all the needs of the patients, to provide optimal care, to determine the needs of the caregivers, and to support the patient psychosocially before the patient's death and during the mourning period.<sup>22</sup> Caregivers may be relatives or provide salaried/voluntary services. Unfortunately, we did not have any volunteer caregivers in our study. In our study, the first factor that affected the prolongation of hospitalization was the caregiver's desire for an extended hospitalization and their desire to prolong the hospitalization as a result of not feeling competent in care. In the multidisciplinary approach, there are caregivers as well as health professionals. However, we cannot think that the caregiver burden is adequately understood even by palliative care center teams. Because clinicians often think patient-oriented, the medical literacy and sociocultural needs of caregivers are often ignored.<sup>23</sup> The second factor for extended hospitalization is the patient's inability to be discharged due to unstable conditions. These patients may choose to die in the hospital or by the joint decision of the clinician and caregivers to let the death occur in the hospital.<sup>24</sup> The third factor that extended hospitalization was infections. In palliative care, determining which treatments to administer and their appropriate dosages remains a topic of debate. However, in Türkiye, where treatment withdrawal or withholding is not practiced, the infection status of patients cannot be overlooked. With expert guidance, infections are managed by completing the optimal duration of antibiotic therapy. This situation was one of the reasons that extended the hospitalization of patients.<sup>25/26</sup>

There are several limitations of the study. Since our study was single-center and retrospective, we could not reach the caregivers' thoughts, concerns, and results regarding the prolongation of hospitalization and discharge. Palliative care requires different approaches due to many different modalities. It is necessary to conduct multi-center prospective studies on palliative care, length of stay, and caregivers. Moreover, to understand the burden of caregivers, national programs are needed to provide necessary training to health professionals and to support caregivers' needs and sociocultural aspects.

The findings of this study highlight several key factors that influence the length of stay for patients in palliative care. Due to various reasons, the data collected from the patient group in palliative care settings may contain numerous variables. Nevertheless, this remains the most thorough investigation into the impact of infectious agents and clinical characteristics in this patient population. Further research involving larger and more diverse patient cohorts is needed to better identify the factors that affect length of stay.

Strengthening home care policies as well as palliative care in hospitals is very important to ensure cost-effectiveness. Collaboration between hospital-based palliative care teams and home-based care teams may increase patient comfort as well as reduce the demand for hospitalization.



With the aging of the world population and the improvement of health care services, the need for palliative care is increasing day by day. To use resources efficiently, there is a need to optimize the length of stay in palliative care with a multidisciplinary approach. New prospective studies are needed on home palliative care and home end-of-life management models.

**Ethical Considerations:** Local ethics committee approval numbered E1-23-4076 was received Ankara Bilkent City Hospital Ethics Committee.

**Conflict of Interest:** The authors declare no conflict of interest.

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## Research Article

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# ASSESSING THE ACCURACY, READABILITY AND UNDERSTANDABILITY OF WEBSITES, CHATGPT, COPILOT, AND BARD ANSWERS ON THE RADIATION DURING PREGNANCY

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## Abstract

**Objectives:** The study aims to evaluate the accuracy of answers to frequently asked questions (FAQ) about the impact of radiation during pregnancy on websites, ChatGPT, Copilot, and Bard. Secondly, to assess the readability and understandability of answers.

**Materials and Methods:** The answers to these questions were scored in terms of accuracy (completely correct, partially correct, incorrect). The Automated Readability Index (ARI), Flesch Reading Ease (FRE), and Gunning Fog Readability (GFR) scores were calculated. The understandability score was assessed using the Patient Education Materials Assessment Tool (PEMAT).

**Results:** The accuracy was calculated as 100% for the websites, 66.67% for ChatGPT, 73.33% for Copilot, and 93.33% for Bard. Readability scores ranking was ChatGPT (ARI=16.15, FRE=24.47, GFR=20.52), Copilot (ARI=14.00, FRE=37.60, GFR=18.27), websites (ARI=13.59, FRE=43.67, GFR=15.56), Bard (ARI=10.92, FRE=48.73, GFR=14.86). ChatGPT's readability was statistically the most challenging. PEMAT understandability scores were 79.53% for Bard, below the acceptable limit of 70% for others.

**Conclusion:** While the responses from chat tools and websites may be largely accurate, it is observed that they are not suitable for patients in terms of readability and understandability. Internet information sources should be developed, especially to ensure that the content is understandable by a broad readership.

**Keywords:** Artificial intelligence, ChatGPT, Bard, Copilot, Chat Tool, readability.

## Introduction

Artificial intelligence (AI)-supported programs are utilized in various fields within the healthcare system, such as aiding physicians in diagnosis, determining treatment options, helping patients understand their illnesses, and providing answers to their questions. They also contribute to medical education for students.<sup>1,2</sup> The introduction of ChatGPT into the public sphere in November 2022 has led to increased use of AI resources by the community.<sup>3</sup> Following the release of ChatGPT, Microsoft Copilot, and Google Bard subsequently entered the scene, resulting in a rise in the number of AI-powered chat tools available. These models facilitate information access and integration by providing a natural language interface and enabling interactive conversations that deliver real-time, instant responses to questions.<sup>4</sup>

As information sources on the internet and people's access to the internet have increased, the rate of patients accessing health information online has also risen.<sup>5</sup> It is known that individuals conduct online research not only about their illnesses, symptoms, and treatments but also generally about health information.<sup>6,7</sup> The positive and negative effects of accessing web-based information about their illnesses by patients have been studied in the literature.<sup>8</sup> Due to the easy accessibility and ability to provide instant responses, AI-powered chat tools have become frequently used resources in various fields for information research today.<sup>9</sup> However, due to their novelty, there is not a sufficient number of studies available in the literature about these chat tools. Nevertheless, studies in the literature have explored the ability of AI-powered chat tools, especially ChatGPT, to respond to specific patient questions and the accuracy of their responses in certain subjects.<sup>10,12</sup> It is not enough for these chat tools to simply respond to questions or provide correct answers. The readability and understandability of the answers by patients are also important. While these parameters have been frequently studied about websites in the literature,<sup>10</sup> there is limited research in the literature evaluating the readability and understandability of AI-powered tool responses.<sup>11,15</sup>

Most radiological diagnostic methods involve ionizing radiation. However, in pregnant patients, these diagnostic modalities may need to be used for diagnostic and therapeutic purposes when necessary. Sometimes, patients may have used these modalities without knowing they are pregnant.<sup>16</sup> Therefore, pregnant or potentially pregnant patients seek answers to numerous questions regarding which modalities involve radiation, what doses can affect the fetus, and what these effects are. The study seeks to assess responses to frequently asked questions regarding the impact of radiation during pregnancy on websites, while also evaluating the accuracy rates of answers provided by ChatGPT, Copilot, and Bard. Secondly, the readability and understandability of both websites and AI-powered chat tool responses will be evaluated from the perspective of patients.

## Materials and Methods

The study was planned as a methodological study. This study does not require ethics committee approval as it does not involve human participants or sensitive personal data.

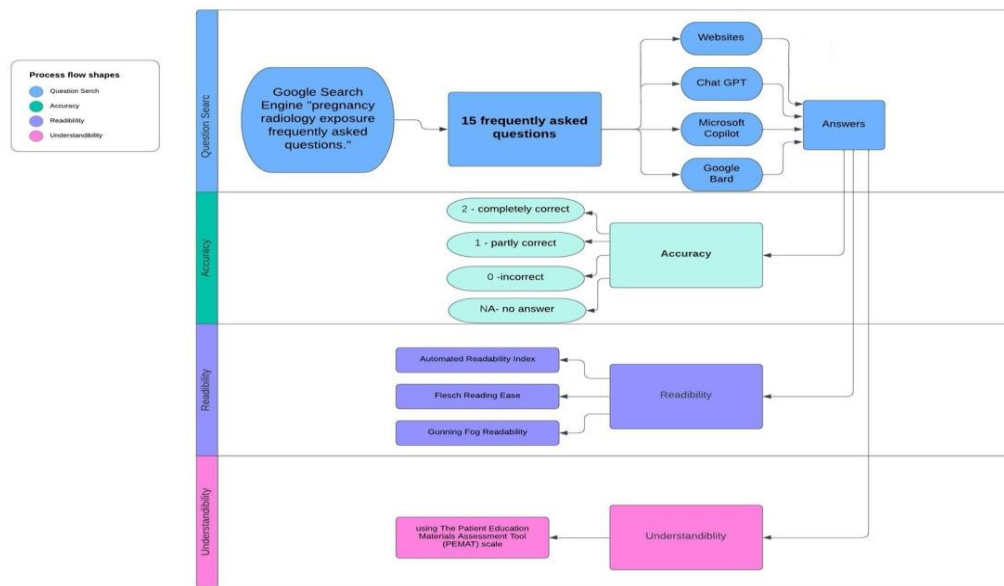
### *Search and accuracy analysis*

A search was conducted on the Google search engine using the keywords "pregnancy radiology exposure frequently asked questions." The first 20 websites that appeared in the search results were evaluated. Non-profit associations and organizations' websites that provided answers to questions related to radiation during pregnancy in a question-and-answer format were identified. The questions and answers within these websites were recorded, totaling 15 questions. These questions were individually posed to ChatGPT, Copilot, and Bard Chat tools. Due to the premium membership requirement of ChatGPT 4o, it was not preferred, and ChatGPT 4 was chosen as it is freely accessible to everyone and easily accessible for patients. To avoid influencing the dialogue, each question was asked in a new tab, and the responses were recorded. The answers to each question were randomly recorded in a single document without indicating the source. All parameters related to the answers were evaluated by an observer with no knowledge of the sources, possessing 8 years of experience in the field of radiology and 4 years of ongoing work in medical education (Appendix A).

### Appendix A. Websites accessed as a result of an internet search

1	<a href="https://www.iaea.org/resources/rpop/health-professionals/radiology/pregnant-women">https://www.iaea.org/resources/rpop/health-professionals/radiology/pregnant-women</a>
2	<a href="https://hps.org/physicians/radiology_pregnant_patient_qa.html">https://hps.org/physicians/radiology_pregnant_patient_qa.html</a>
3	<a href="https://www.aafp.org/pubs/afp/issues/1999/0401/p1813.html">https://www.aafp.org/pubs/afp/issues/1999/0401/p1813.html</a>
4	<a href="https://www.cdc.gov/nceh/radiation/emergencies/prenatalphysician.htm">https://www.cdc.gov/nceh/radiation/emergencies/prenatalphysician.htm</a>
5	<a href="https://www.beaumont.org">https://www.beaumont.org</a>
6	<a href="https://4rai.com/2016/06/08/radiology-imaging-and-pregnancy-what-you-need-to-know/">https://4rai.com/2016/06/08/radiology-imaging-and-pregnancy-what-you-need-to-know/</a>
7	<a href="https://www.cdc.gov/nceh/radiation/pregnant-and-children.html">https://www.cdc.gov/nceh/radiation/pregnant-and-children.html</a>
8	<a href="https://www.epa.gov/radiation/frequent-questions-radiation-medicine">https://www.epa.gov/radiation/frequent-questions-radiation-medicine</a>
9	<a href="https://www.mayoclinic.org/healthy-lifestyle/pregnancy-week-by-week/expert-answers/x-ray-during-pregnancy/faq-20058264">https://www.mayoclinic.org/healthy-lifestyle/pregnancy-week-by-week/expert-answers/x-ray-during-pregnancy/faq-20058264</a>
10	<a href="https://www.ehs.washington.edu/radiation/radiation-exposure-during-pregnancy">https://www.ehs.washington.edu/radiation/radiation-exposure-during-pregnancy</a>
11	<a href="https://www.acog.org/clinical/clinical-guidance/committee-opinion/articles/2017/10/guidelines-for-diagnostic-imaging-during-pregnancy-and-lactation">https://www.acog.org/clinical/clinical-guidance/committee-opinion/articles/2017/10/guidelines-for-diagnostic-imaging-during-pregnancy-and-lactation</a>
12	<a href="https://ehs.virginia.edu/Radiation-Safety-Pregnancy.html">https://ehs.virginia.edu/Radiation-Safety-Pregnancy.html</a>
13	<a href="https://www.aapm.org/org/policies/documents/CARES_FAQs_Patient_Shielding.pdf">https://www.aapm.org/org/policies/documents/CARES_FAQs_Patient_Shielding.pdf</a>
14	<a href="https://www.purdue.edu/ehps/rem/laboratory/Personal/preg.html">https://www.purdue.edu/ehps/rem/laboratory/Personal/preg.html</a>
15	<a href="https://aci.health.nsw.gov.au/networks/eci/clinical/ed-factsheets/medical-imaging-in-pregnancy">https://aci.health.nsw.gov.au/networks/eci/clinical/ed-factsheets/medical-imaging-in-pregnancy</a>
16	<a href="https://www.sor.org/learning-advice/professional-body-guidance-and-publications/documents-and-publications/policy-guidance-document-library/inclusive-pregnancy-status-guidelines-for-ionising">https://www.sor.org/learning-advice/professional-body-guidance-and-publications/documents-and-publications/policy-guidance-document-library/inclusive-pregnancy-status-guidelines-for-ionising</a>
17	<a href="https://www.rch.org.au/kidsinfo/fact_sheets/Radiation_and_pregnancy/">https://www.rch.org.au/kidsinfo/fact_sheets/Radiation_and_pregnancy/</a>
18	<a href="https://www.acr.org/-/media/acr/files/practice-parameters/pregnant-pts.pdf">https://www.acr.org/-/media/acr/files/practice-parameters/pregnant-pts.pdf</a>
19	<a href="https://www.insideradiology.com.au/radiation-risk-preg/">https://www.insideradiology.com.au/radiation-risk-preg/</a>
20	<a href="https://kidshealth.org/en/parents/xray-pregnancy.html">https://kidshealth.org/en/parents/xray-pregnancy.html</a>

The accuracy of the answers was assessed on a scale of 2 for "completely correct," 1 for "partly correct," 0 for "incorrect," and "no answer." The methodology of the article has been illustrated in Figure 1.



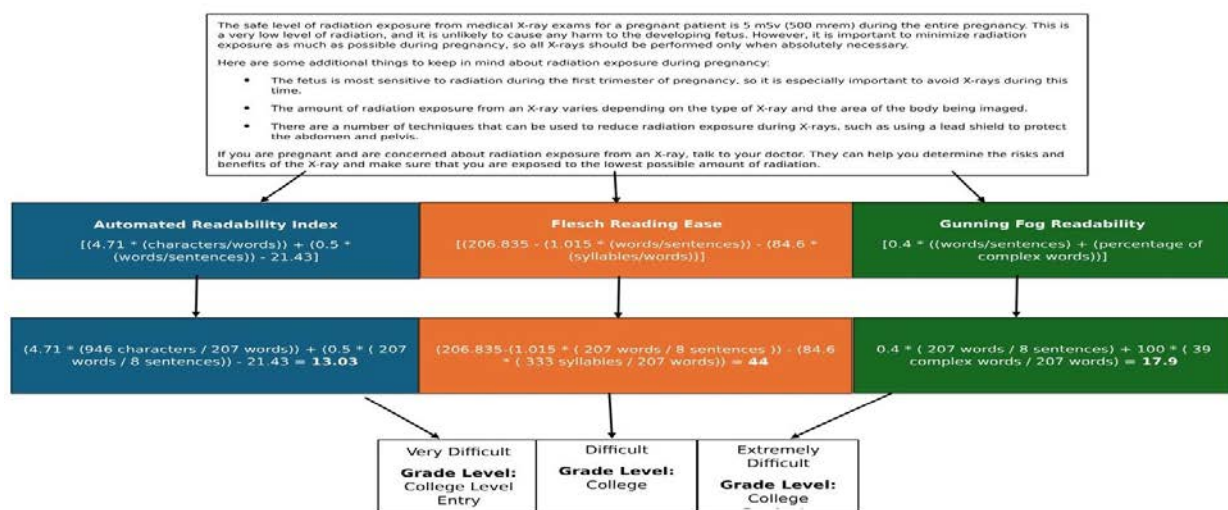
**Figure 1.** The methodology of the article has been illustrated

### Readability scores assessment

Readability is related to how easy or difficult it is to read a text. Readability depends on factors such as the presentation of a text (for example, font choice, font size, spacing, or colors) and its context (such as syllables, words, and sentences on the page). Various scoring systems have been developed to assess readability.<sup>17-19</sup> The readability scores of the answers were evaluated using free web-based tools.<sup>20</sup> For each answer, Automated Readability Index (ARI), Flesch Reading Ease (FRE), and Gunning Fog Readability (GFR) scores were calculated. ARI score calculates readability based on the average number of characters per word and the average number of words per sentence [ $ARI = (4.71 * (\text{characters/words})) + (0.5 * (\text{words/sentences})) - 21.43$ ]. The target is to obtain a score between 1 and 14 on this index, corresponding to the 14 grades in the United States education system. In some cases, scores above 14 can also be obtained, in which case the level is classified as college graduate.<sup>17</sup> FRE score is calculated based on the total number of words, sentences, and syllables in a text [ $FRE = (206.835 - (1.015 * (\text{words/sentences})) - (84.6 * (\text{syllables/words})))$ ]. According to this index, the most readable texts are those with shorter sentences and words. The scores obtained from the



FRE index are expressed as 90-100 very easy, 80-89 easy, 70-79 fairly easy, 60-69 standard, 50-59 fairly difficult, 30-49 difficult, and 0-29 very confusing.<sup>18</sup> GFR score is calculated based on the average number of words per sentence and the percentage of complex words in the text [GFR = 0.4 \* ((words/sentences) + (percentage of complex words))]. Complex words are typically defined as words with three or more syllables or technical jargon that may be difficult for readers to understand. In this scoring, scores ranging from 6 (sixth grade) to 20 (postgraduate plus) are obtained.<sup>19</sup> (Figure 2).



**Figure 2.** The calculation of readability scores for Google Bard's response to the first question

### Understandability score assessment

From the perspective of patients, understandability is defined as the ability of patient education materials to be understood and expressed by individuals with diverse backgrounds and varying levels of health literacy. Scales have been developed to assess this, and the most important scale used is The Patient Education Materials Assessment Tool (PEMAT).<sup>21</sup> Therefore, in the study, responses have been evaluated in terms of understandability using the PEMAT scale. This scale is designed to evaluate the understandability and actionability of patient education materials. It has different instruments for written and audio-visual materials.<sup>21</sup> In this section, considering the answers as patient education materials, the understandability scores for written materials were calculated using the PEMAT scale. The actionability part was not evaluated since it was deemed inappropriate for the study questions, and the scale includes items related to the necessity of visual materials.

### Data Analysis

Statistical analysis was conducted using SPSS, version 25.0, for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were expressed as mean and standard deviation for continuous data and as percentages for categorical data. The Shapiro-Wilk test was employed to assess normality, and the Levene test was used to examine the homogeneity of variance. One-way ANOVA was applied to detect interactions between variables, and post-hoc tests were performed to conduct pairwise comparisons between groups. The significance level (p-value) was set at 0.05 (95% confidence interval) for all tests.

## Results

### *Accuracy results*

Through keyword-based searches on the Google search engine, four websites providing information on this topic in a question-answer format were found on the first two pages of the search results.<sup>22-25</sup> When excluding repeated questions from these websites, a total of 15 questions were included in the study. The questions are provided in Table 1. When assessing the accuracy of the answers to these questions, 100% (15/15) of the websites' answers, 66.67% (10/15) for ChatGPT, 73.33% (11/15) for Copilot, and 93.33% (14/15) for Bard were considered completely correct. The findings for each answer are summarized in Appendix B.

**Table 1.** Questions reached as a result of the website query

Q	Questions
1	Is there a safe level of radiation exposure from medical x-ray exams for a pregnant patient?
2	Can radiation cause birth defects?
3	What are the possible effects of X-rays (for fetus)*?
4	What is the "10-day rule" (about pregnancy-related radiation exposure)*?
5	How safe are x-ray exams of the chest and extremities during pregnancy?
6	What if a patient underwent an abdominal or pelvic x-ray exam before realizing that she was pregnant?
7	Is it necessary to put a lead apron over my abdomen for X-ray exams (when pregnant)*?
8	Can I undergo a CT scan while I am pregnant?
9	Is it important to know if I am pregnant or undergoing a CT scan?
10	What if a patient underwent an abdomen CT before realizing that she is pregnant?
11	Can cardiac catheterization be performed on a pregnant patient?
12	Are there recommendations regarding the termination of pregnancy after radiation exposure?
13	Can a patient become sterile after undergoing a diagnostic x-ray examination?
14	What are the effects of radiation exposure in utero?
15	Is it okay to have an MRI exam for back pain when pregnant?

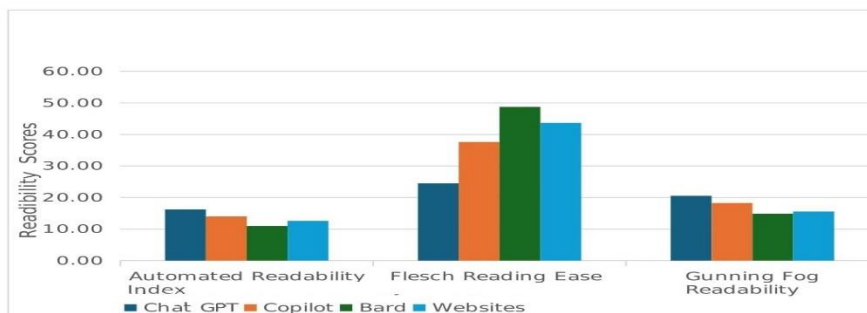
\*While the expressions in brackets are not expressed on websites, they are added to ensure the integrity of meaning in chat tools.

**Appendix B.** Accuracy and Global Quality Score scores of the answers

Questions	Accuracy			
	ChatGPT	Copilot	Bard	Websites
1	1	2	1	2
2	2	2	2	2
3	2	2	2	2
4	0	2	2	2
5	1	2	2	2
6	2	2	2	2
7	2	2	2	2
8	1	2	2	2
9	2	1	2	2
10	2	1	2	2
11	2	2	2	2
12	1	1	2	2
13	2	2	2	2
14	2	2	2	2
15	2	1	2	2
<b>Mean</b>	1.6	1.73	1.93	2

*Readability scores*

Readability scores for all answers are summarized in Table 2. When the average of the readability scores for all three measures was considered, the difficulty level was ranked as ChatGPT, Copilot, websites, and Bard. In ARI scores for ChatGPT were higher than Bard and websites' answers ( $p < 0.001$ ,  $p = 0.001$ , respectively), and scores for Copilot were also statistically higher than Bard scores ( $p = 0.004$ ). For FRE scores for ChatGPT were lower than Bard and website answers ( $p < 0.001$ ,  $p < 0.001$ , respectively). FRE scores differ from the others, with an increase indicating easier readability. For GFR scores for ChatGPT were higher than Bard and website answers ( $p < 0.001$ ,  $p < 0.001$ , respectively), while Copilot scores were also higher than Bard scores ( $p = 0.014$ ) (Figure 3).



**Figure 3.** Comparison of readability scores among Chat Tools

**Table 2.** Readability scores of the answers.

Questions	ChatGPT			Copilot			Bard			Websites		
	ARI	FRE	GFR	ARI	FRE	GFR	ARI	FRE	GFR	ARI	FRE	GFR
1	17,56	12	23,9	19,20	15	23,7	13,03	44	17,9	14,30	30	18,90
2	17,78	18	20,90	12,01	48	17,20	9,05	49	13,6	9,62	65	11,2
3	15,20	19	19,00	10,54	57	14,60	6,66	71	10,4	17,25	34	17,8
4	13,90	46	16,70	17,17	28	21,10	11,15	48	15,3	14,19	36	18,1
5	15,20	27	20,30	11,36	51	15,30	12,03	46	16	9,64	45	13,9
6	16,26	24	20,9	14,1	36	19,8	10,2	45	14,9	10,49	49	14,33
7	15,19	32	18,7	14,9	47	17	13,3	42	16,1	12,14	51	14,9
8	15,78	37	20,8	11,3	53	16,1	9,69	61	13,6	11,62	52	14
9	14,82	35	18,2	11,2	48	15,7	12,2	52	16,3	11,16	38	16,8
10	17,99	20	22,3	16,5	31	20,4	12	57	13,6	10,23	49	14,5
11	19,75	9	24	15,1	12	21,4	10,1	39	15,5	16,24	39	18,7
12	15,85	23	20,6	19,7	15	23,2	11,3	37	16	13,55	42	16,5
13	16,5	20	22,1	11,8	38	18,6	10,7	46	15,3	11,3	45	12,7
14	16,73	11	21,6	14,9	32	18,1	13,4	28	16,9	16,18	34	18
15	13,69	34	17,8	10,3	53	11,9	8,99	66	11,5	10,95	46	13,1
<b>Mean</b>	16,15	24,47	20,52	14,00	37,60	18,27	10,92	48,73	14,86	12,59	43,67	15,56

ARI: Automated Readability Index, FRE: Flesch Reading Ease, GFR: Gunning Fog Readability

*PEMAT understandability scores*

When evaluating the PEMAT scores for the answers, the average scores were calculated as 66.13 for the websites, 66.43 for ChatGPT, 68.53 for Copilot, and 79.53 for Bard. The PEMAT scores for each answer are summarized in Table 3. The Bard PEMAT score was statistically significantly higher than websites, ChatGPT, and Copilot ( $p=0.014$ ,  $p=0.014$ ,  $p=0.010$ , respectively).

**Table 3.** PEMAT understandability scores of the answers.

Questions	ChatGPT	Copilot	Bard	Websites
1	64	91	73	67
2	56	70	82	78
3	82	56	82	56
4	No Answer	70	64	56
5	58	78	82	67
6	44	67	67	40
7	78	67	78	78
8	67	80	89	56
9	67	70	78	67
10	82	70	82	67
11	60	56	83	67
12	56	56	87	85
13	78	60	73	92
14	82	70	82	60
15	56	67	91	56
<b>Mean</b>	66,43	68,53	79,53	66,13

## Discussion

In the study, when examining the accuracy of answers provided by chat tools to questions about the effects of radiation during pregnancy, it was found that the accuracy and quality of the answers were high, similar to findings in the literature.<sup>1,26,27</sup> Literature studies have generally been conducted using ChatGPT. For instance, in a study related to basal cell carcinoma, the answers were evaluated as appropriate and inappropriate, with an appropriate answer rate of 84%.<sup>1</sup> Similarly, in a study on breast cancer prevention, this rate was 88%,<sup>27</sup> and in a study on cardiovascular disease prevention, it was 84%.<sup>26</sup> In this study, 66.67% of ChatGPT answers were evaluated as completely accurate. When an unanswered question was excluded, the appropriate answer rate was calculated as 93.33%, similar to the literature. In a study related to lung cancer, ChatGPT answered 70.8% of the questions completely accurately, similar to our study.<sup>28</sup> In the same study, Copilot had an accuracy rate of 61.7%, and Bard had 51.7% accuracy. In our study, Copilot also similarly provided completely accurate answers to 73.33% of the questions. However, in this study, the accuracy rate for Bard was 93.33%, which was higher than the literature.<sup>28</sup> This could be attributed to the use of Bard's experimental version in the literature study. Overall, considering all these data, it can be concluded that chat tools generally provide appropriate answers to patient questions, and most of the answers are correct. However, in addition to these findings, a study using ChatGPT for clinical radiological information indicated that the majority of references could not be found, and only a small portion of references contained correct information to answer the questions.<sup>29</sup> This suggests that caution should be exercised, particularly as the difficulty level of questions increases when dealing with chat tool responses.

An important finding of this study is that the readability scores of the chat tool responses were significantly higher than the community average at school grade level eight. This adversely affects the comprehensibility of responses on chat tools and websites from the users' perspective. In a conducted study comparing ChatGPT and websites in terms of readability, ChatGPT was found to have statistically higher GFR scores. Additionally, the study stated that both websites and ChatGPT had readability scores above the average.<sup>15</sup> In an evaluation of patient-oriented information on abdominal aortic aneurysms obtained from websites, a study found an average FRE score of 39, considered difficult.<sup>30</sup> Various studies investigating readability scores have consistently found them to be high for the general population.<sup>11-13</sup> In this study, the average FRE scores range from 24.47 to 48.73, categorizing these values as difficult and very confusing. Another noteworthy finding in this study is that, despite high scores on all platforms, ChatGPT has more unfavorable scores in all three readability systems, especially when compared to websites and Bard. Considering that chat tools acquire information from the internet, these findings may not be surprising; however, it was observed that Bard presented information in a relatively more readable manner.

The answers provided to the questions are aimed at increasing the patient's level of knowledge. In this context, these responses can be considered as patient education materials. Accordingly, in the study, the PEMAT scores of the responses were calculated. A threshold of 70% has previously been suggested for the material to be considered suitable for patient education.<sup>21</sup> There are limited studies in the literature conducted from this perspective. In a study related to obstructive sleep apnea, ChatGPT and Bard were compared, and they were evaluated with PEMAT in terms of understandability. ChatGPT scores were found to be statistically higher than Bard's.<sup>14</sup> In another study, ChatGPT and website data were compared, and although the understandability scores were above 70%, they were found to be higher for websites.<sup>15</sup> In this study, PEMAT understandability scores for ChatGPT, Copilot, and websites were similar and remained below the 70% threshold. For Bard, the PEMAT score was calculated as 79.5%, which is statistically higher compared to the others. Although there are not many studies conducted on this topic in the literature, it is noteworthy that different results have been obtained in studies focusing on understandability.

This study has some limitations. Firstly, the accuracy of responses and PEMAT scores were evaluated by a single observer, even though experienced, which could introduce bias. Secondly, due to the nature of chat tools, they do not provide the same response each time. Therefore, repeated answers to the same questions may yield different results in some parameters. Lastly, ChatGPT, Bard, and Copilot have a constraint as they lack image processing capabilities for both inputs and outputs. As a result, all responses in this study received a score of zero on PEMAT questions assessing visual aids, limiting the highest achievable PEMAT understandability score to 92%.

The study evaluated data from websites and three commonly used chat tools. Similar to the literature, the responses from all platforms to the questions were largely appropriate, and most questions were answered completely accurately. Bard is identified as superior in terms of readability and understandability compared to other information sources. However, considering that many patients and their relatives perceive the internet as a source of information, our results indicate that responses from chat tools and websites are not suitable for patients in terms of readability and understandability. In this regard, chat tools and internet information sources should be developed, especially to ensure that the content is understandable to the majority of readers and to provide equal access to health information. While these platforms may have potential in terms of accuracy, it should be kept in mind that they may produce content that is deficient and difficult to understand in terms of patient education.

**Ethical Considerations:** The study was planned as a methodological study. This study does not require ethics committee approval as it does not involve human participants or sensitive personal data.

**Conflict of Interest:** The authors declare no conflict of interest.

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## Research Article

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# UNNECESSARY LABORATORY TEST REPETITION IN PRIMARY HEALTHCARE ORGANIZATIONS

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## Abstract

**Objectives:** Laboratory tests are an important tool in reaching the right medical diagnosis and have become an indispensable element for physicians. In this study, we aimed to determine the frequency of unnecessary laboratory test use in primary healthcare institutions, the effect of this situation on health expenditures, and the increase in laboratory test use.

**Materials and Methods:** In our study, the data of 25 specific tests studied between 2016 and 2019 in Konya Public Health Laboratory, which serves primary healthcare institutions, were examined. The compliance of these tests with the minimum test repetition interval was retrospectively screened, and the frequency of unnecessary test requests was determined.

**Results:** A total of 15,425,622 laboratory tests were evaluated in the study. Of these, 11,541,394 (74.8%) were performed on women, and 13,289,770 (86.1%) were conducted on patients under 65 years of age. It was determined that 956,112 (6.2%) of the evaluated tests were unnecessary repetitions. Unnecessary test repetitions were found to be significantly higher in females compared to males ( $p<0.001$ ) and in those above 65 years of age compared to those under 65 years of age ( $p<0.001$ ). The 4-year cost of unnecessary laboratory tests was determined to be ₺5,479,093.37. It was also found that the use of laboratory tests increased by 123.6% over the 4-year evaluation period.

**Conclusion:** The use of laboratory tests in primary care is increasing and unnecessary repeated tests harm the country's economy. To reduce costs and provide better health care, it is necessary to use laboratory tests wisely and to make effective interventions for this purpose.

**Keywords:** Primary healthcare services, unnecessary laboratory test repetition, health expenditures.

## Introduction

Today, the use of laboratory tests, which have become indispensable for physicians, is increasing rapidly.<sup>1</sup> There are great differences in the frequency of laboratory test requests by physicians, and these differences were not related to physicians' clinical competencies.<sup>2,3</sup> This unexplained difference in the frequency of laboratory test requests brings to mind the question of whether laboratory test orders are appropriate.

Unnecessary requests for laboratory tests will lead to a false-positive test result and an adventure of seeking treatment with a misdiagnosis of the patient. In addition, unnecessary requests are harmful not only to the patient but also to the country's economy due to the economic burden it creates on the health system.<sup>4</sup> Although laboratory test expenditures constitute a very small part of total health expenditures, it has been determined that laboratory tests affect 66% of the clinical decision-making process.<sup>5</sup> With these effects, laboratory tests indirectly affect a larger portion of health expenditures.

In the literature, different definitions have been used in many studies for the appropriateness of laboratory use, and the terms "unnecessary" and "inappropriate" are frequently used interchangeably. Unnecessary and inappropriate laboratory use is generally defined as a test request that falls outside of an approved guideline.<sup>5</sup>

Unnecessary repetition of laboratory tests is a subgroup of overuse of laboratory tests and is a subject that requires investigation in our country as well as in the rest of the world. Unnecessary laboratory test repetition can also be defined as tests that do not comply with the minimum test request time intervals given in approved guidelines.<sup>6</sup>

Due to the high number of them, it was seen that primary care physicians had more laboratory test requests than other specialties and 58% of laboratory test expenditures belonged to primary care physicians.<sup>7</sup> Diagnosing in primary care is a complex process. Situations such as the specific clinic have not yet been evident, the vagueness of the complaints, and the overlapping of non-dangerous and serious symptoms make it difficult to reach the diagnosis.<sup>8</sup> This difficult process in reaching the diagnosis may cause family physicians to prefer laboratory test orders more than normal.

Factors such as lack of experience, fear of lawsuits, unawareness of the cost of the tests, patient pressure (patients insistently demanding tests), lack of accessible guidelines, fear of making mistakes, development of modern diagnostic technologies, and rapid access to test results take place in the increase in unnecessary laboratory test requests.<sup>9</sup>

This study aims to determine the frequency of unnecessary laboratory test use in primary healthcare institutions and to assess the impact of this practice on healthcare expenditures and the overall increase in laboratory test utilization.

## Materials and Methods

In this study, 25 laboratory tests (alanine aminotransferase (ALT), aspartate aminotransferase (AST), high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglyceride, total cholesterol, hemoglobin A1c (HbA1c), uric acid, vitamin B12, vitamin D, iron, ferritin, folate, thyroid stimulating hormone (TSH), free triiodothyronine (fT3), free thyroxine (fT4), follicle-stimulating hormone (FSH), luteinizing hormone (LH), estradiol, total testosterone, progesterone, prolactin, total prostate-specific antigen (tPSA), rheumatoid factor (RF), antistreptolysin-O (ASO)) ordered in Konya Primary Healthcare Institutions and studied in Konya Public Health Laboratory during the 4 years between 01.01.2016-01.01.2020 were evaluated.

Out of a total of 15,486,427 laboratory test data obtained from the Konya Public Health Laboratory database, 60,805 (0.39%) with uncertain records in the system and incomplete or conflicting records of age and gender were excluded from this study.

In the obtained data, minimum test request time intervals specific to each test were used according to objective criteria to determine unnecessary laboratory test repetitions (Table 1).<sup>10,11</sup> Tests requested in a shorter time than the minimum test request time interval were considered unnecessary test repetitions. The total cost of unnecessary laboratory test repetitions was noted in TL (Turkish liras= ₺) using the number of unnecessary test repetitions of the determined tests and the current unit costs in the Health Implementation Communiqué (SUT) published in the Official Gazette No. 28597 dated March 24, 2013.<sup>12</sup>

### *Statistical Analysis of Study Data*

In the study, descriptive analyses of categorical data are shown with frequency and percentage values, and descriptive statistics of numerical data are shown with mean  $\pm$  standard deviation values. The normality assumption of the groups in the study was evaluated with the Shapiro-Wilk Test and the Kolmogorov-Smirnov Test. The Chi-squared test was used for the comparison of categorical data. 5% was accepted as the statistical significance limit in the study. All statistical analyses were performed using SPSS 22.0 (IBM Inc., Armonk, NY, USA) software.

## Results

The evaluated 15,425,622 laboratory tests belong to 756,544 different patients and contain 25 different parameters. Of the 15,425,622 laboratory tests studied, 11,541,394 (74.82%) were requested from women and 3,884,228 (25.18%) from men. 13,289,770 (86.15%) of the tests were studied in patients under 65 years of age, and 2,135,852 (13.85%) in patients over 65 years of age. Of the 15,425,622 laboratory tests examined, 956,112 (6.2%) were considered unnecessary test repetitions. Unnecessary retest orders were significantly higher in females (6.6%) than males (5.0%) ( $p < 0.001$ ), and in patients over 65 years of age (6.9%) than in patients younger than 65 years old (6.1%) ( $p < 0.001$ ) (Table 2). The test with the highest rate of unnecessary test repetitions was found to be vitamin B12 (32.5%), and the lowest test was the uric acid (0.1%) test.

**Table 1.** Minimum test request time intervals

Test	Minimum request time interval	Reference
ALT	30 days	(11)
AST	30 days	(11)
HDL cholesterol	90 days	(11)
LDL cholesterol	90 days	(11)
Triglyceride	90 days	(11)
Cholesterol	90 days	(11)
HbA1c	60 days	(10)
Uric acid	3 days	(10)
Vitamin B12	365 days	(10)
Vitamin D	90 days	(10)
Iron	14 days	(10)
Ferritin	28 days	(10)
Folate	365 days	(10)
TSH	13 days	(10)
ft3	13 days	(10)
ft4	13 days	(10)
FSH	13 days	(10)
LH	13 days	(10)
Estradiol	13 days	(10)
Total testosterone	13 days	(10)
Progesterone	28 days	(10)
Prolactin	13 days	(10)
tPSA	28 days	(10)
RF	30 days	(10)
ASO	14 days	(11)

**Table 2.** Association of unnecessary test repetitions with gender and age

		Unnecessary Test Repetition n (%)	Appropriate Test n (%)	p
Gender	Female	760,173 (6.6%)	10,781,221 (93.4%)	<0.001
	Male	195,939 (5.0%)	3,688,289 (95.0%)	
Age	Under 65 years old	808,933 (6.1%)	12,480,837 (93.9%)	<0.001
	Over 65 years old	147,179 (6.9%)	1,988,673 (93.1%)	

The total cost of unnecessary test repetitions in the 4 years was detected as ₺5,479,093.37. Based on the tests, the test with the highest unnecessary retest cost was vitamin B12 (₺2,117,731.60), while the lowest test was total testosterone (₺428.86). Among the evaluated laboratory tests, the number of requests for each test, the number of unnecessary test repetitions, the unnecessary test repetition rate, and the unnecessary test repetition costs are given in Table 3.

**Table 3:** Numbers, frequency, and the cost of unnecessary test repetitions

Test	Total Number of Tests Evaluated	Number of Unnecessary Test Repetitions	Unnecessary Test Repetition Rate	Current Unit Cost (₺)	Total Cost (₺)	Estimated cost per year (₺)
ALT	1,098,458	17,812	1,6%	₺1.15	₺20,48	₺5120.95
AST	1,024,618	16,865	1,6%	₺1.05	₺17,70	₺4427.06
HDL	1,016,420	70,153	6,9%	₺1.67	₺117,1	₺29,288.88
LDL	990,773	66,689	6,7%	₺2.61	₺174,0	₺43,514.57
Triglyceride	1,032,509	71,663	6,9%	₺1.25	₺89,57	₺22,394.69
Cholesterol	1,039,734	72,310	6,9%	₺1.15	₺83,15	₺20,789.12
HbA1c	586,435	21,768	3,7%	₺17.77	₺386,8	₺96,704.34
Uric acid	608,352	577	0,1%	₺1.15	₺663.5	₺165.89
Vitamin B12	1,244,230	404,920	32,5%	₺5.23	₺2,117,	₺529,432.90
Vitamin D	1,013,723	77,230	7,6%	₺21.04	₺1,624,	₺406,229.80
Iron	832,381	3463	0,4%	₺1.15	₺3982.	₺995.61
Ferritin	938,748	9878	1,1%	₺5.23	₺51,66	₺12,915.48
Folate	421,983	104,584	24,8%	₺6.79	₺710,1	₺177,531.34
TSH	1,187,843	5086	0,4%	₺4.70	₺23,90	₺5976.05
ft3	661,651	2652	0,4%	₺4.70	₺12,46	₺3116.1
ft4	829,221	3211	0,4%	₺4.70	₺15,09	₺3772.92
FSH	51,101	297	0,6%	₺6.27	₺1862.	₺465.55
LH	43,385	255	0,6%	₺6.27	₺1598.	₺399.71
Estradiol	41,204	297	0,7%	₺6.27	₺1862.	₺465.55
Total	14,549	82	0,6%	₺5.23	₺428.8	₺107.21
Progesterone	30,699	648	2,1%	₺7.32	₺4743.	₺1185.84
Prolactin	44,776	328	0,7%	₺7.32	₺2400.	₺600.24
tPSA	72,888	657	0,9%	₺6.79	₺4461.	₺1115.26
RF	304,395	3319	1,1%	₺2.61	₺8662.	₺2165.65
ASO	295,546	1368	0,5%	₺2.61	₺3570.	₺892.62
<b>TOTAL</b>	<b>15,425,622</b>	<b>956,112</b>	<b>6,2%</b>		<b>₺5,479,</b>	<b>₺1,369,773.34</b>

It was determined that there was an increase in the use of laboratory tests every year (Figure 1). There was a significant increase of 123.6% in the use of 25 laboratory tests evaluated between 2016 and 2019. The test with the highest increase rate among laboratory tests was the vitamin D test and the rate of increase in 4 years was determined as 193.1%. The distribution of the evaluated tests by year and their 4-year increase rates are given in Table 4.



**Figure 1.** Number of requests for laboratory tests by years

**Table 4.** Annual request numbers and 4-year increase rates of laboratory tests

Test	2016	2017	2018	2019	4-year rate of increase
ALT	161,281	226,396	324,280	386,501	139.6%
AST	153,554	213,331	300,181	357,552	132.9%
HDL cholesterol	158,094	212,129	294,793	351,404	122.3%
LDL cholesterol	149,501	208,857	290,807	341,608	128.5%
Triglyceride	159,550	215,175	299,106	358,678	124.8%
Cholesterol	161,756	216,560	300,835	360,583	122.9%
HbA1c	87,858	123,750	181,419	193,408	120.1%
Uric acid	79,041	120,924	185,694	222,693	181.7%
Vitamin B12	197,275	262,721	365,185	419,049	112.4%
Vitamin D	124,873	207,910	314,968	365,972	193.1%
Iron	128,667	176,741	248,382	278,591	116.5%
Ferritin	142,606	195,074	277,236	323,832	127.1%
Folate	64,039	89,251	125,714	142,979	123.3%
TSH	181,540	246,581	347,807	411,915	126.9%
ft3	111,231	143,478	191,890	215,052	93.3%
ft4	133,427	177,247	241,023	277,524	107.9%
FSH	9030	12,093	14,597	15,381	70.3%
LH	7896	10,309	12,560	12,620	59.8%
Estradiol	7316	9610	11,794	12,484	70.6%
Total testosterone	2119	3248	4774	4408	108.0%
Progesterone	5664	7382	9218	8435	48.9%
Prolactin	7948	10,652	13,236	12,940	62.8%
tPSA	12,303	15,511	21,739	23,335	89.7%
RF	54,264	68,006	89,288	92,837	71.1%
ASO	55,976	71,651	86,895	81,024	44.7%



## Discussion

In the literature, studies are showing that unnecessary laboratory tests are between 5.0% - 95.0%.<sup>13-15</sup> In a Canadian study, it was shown that 16% of laboratory tests were requested more than necessary.<sup>14</sup> Similarly, in another study conducted in Turkey, the frequency of unnecessary laboratory test repetitions was found to be 16.2%.<sup>15</sup> In a 15-year meta-analysis study, which is the most comprehensive study on this subject, unnecessary test repetitions of laboratory tests were found to be 7.4%.<sup>16</sup> In our study, unnecessary laboratory test repetitions were found to be 6.2%. Although the result of our study is close to the result of the meta-analysis study, it was found to be lower than the literature data. This may be due to different conditions. While in many of the existing studies inpatients and outpatients were evaluated together or only inpatients were evaluated, the evaluation of only outpatients in our study may have contributed to the lower rate of unnecessary test repetitions. Two studies in the literature have shown that unnecessary test repetition is lower in outpatients.<sup>15,17</sup>

Studies investigating unnecessary test orders have used restrictive and tolerant criteria.<sup>16</sup> The tolerant criteria used in our study are more flexible in terms of unnecessary test requests. For example, the test is considered appropriate unless it is repeated unnecessarily. In studies where tolerant criteria are used, the rate of unnecessary test orders is expected to be lower.<sup>16</sup> Therefore, the use of tolerant criteria in our study may have resulted in a lower rate of unnecessary test repetitions. Studies using subjective criteria have shown that the rate of unnecessary testing is approximately 2 times higher than those using objective criteria.<sup>16</sup> It is estimated that the inability to disable the researcher's bias, especially in subjective criteria, increases this rate.<sup>16</sup> The fact that the rate of unnecessary test repetitions in our study was lower than in other studies in the literature may also be due to our use of objective criteria.

In our study, unnecessary retest orders were significantly higher in females than in males. Studies investigating the relationship between unnecessary test repetition and gender were limited in the literature. In another study conducted in Turkey, the risk of unnecessary test repetition was found to be higher in men than in women.<sup>15</sup> The fact that 74.82% of the tests were performed on women in our study may also have caused unnecessary test repetition to be high in women. In addition, since women's labor force participation rate in our country is lower than that of men, women's spending more time at home may also enable women to benefit more from primary healthcare services by providing more access to primary healthcare institutions that are close to households.<sup>18</sup> In a study investigating gender differences in health, it was found that although women had a longer life expectancy, they had more negative experiences in terms of health than men.<sup>19</sup> A Canadian study showed that women consult physicians more often than men.<sup>20</sup> The fact that women apply to physicians more frequently and feel unhealthy may have affected the higher frequency of unnecessary test repetitions in

women. However, this information alone is not sufficient to explain the higher frequency of laboratory test repetitions in women. More comprehensive studies are needed to explain this situation.

In our study, unnecessary retest orders were significantly higher in patients over 65 years of age than in patients younger than 65 years old. In a study conducted in Australia, a relationship was found between patients over 65 years of age and unnecessary test repetitions, and the result is in line with our study.<sup>21</sup> In another study conducted in Turkey, it was found that unnecessary test repetitions were more common over the age of 65.<sup>15</sup> Although these data in the literature were consistent with the results of our study, more studies investigating the relationship between age and unnecessary test repetition could not be found. In a study conducted in Canada, it was shown that laboratory tests and health expenditures increased in correlation with patient age.<sup>22</sup> The increase in comorbid diseases associated with aging may also cause the elderly population to benefit more from health services, and indirectly, to repeat laboratory tests more frequently.<sup>23</sup> In addition, due to the high risk of additional disease in the elderly, physicians may have shown a more defensive approach to older patients and repeated the tests more frequently.

In our study, the test with the highest rate of unnecessary repetition was vitamin B12 (32.5%). While the rate of unnecessary use of the vitamin B12 test was found to be 8.22% in a study conducted in Canada<sup>24</sup>, the unnecessary use rate of the vitamin B12 test was found to be 28.4% in another study conducted in the same country.<sup>14</sup> While this rate was 14.6% in a study conducted in our country<sup>15</sup>, it was found to be 18.2% in another study conducted in Italy.<sup>25</sup> The rates reached in the literature were relatively low compared to our result. The minimum repetition time intervals referenced in the studies in the literature varied. In some studies, the minimum repetition time intervals were determined to be lower than in our study, which may have resulted in lower unnecessary testing rates. However, this situation will not explain the lower rate of unnecessary requests for vitamin B12 in the study in which the same minimum repetition time interval was used as in our study. In addition, the follow-up and treatment of vitamin deficiencies by primary care physicians may have caused the unnecessary test repetition of vitamin values in primary care. The fact that vitamins (vitamin B12, folate, and vitamin D) formed the three tests with the highest rate of unnecessary repetition in our study strengthens this possibility. In addition, patients stated that they obtained information about vitamins from social media, other media outlets, other patients, and health professionals, and explained their symptoms with the information they obtained about the symptoms caused by vitamin deficiencies.<sup>26</sup> In the same study, physicians stated that if patients insist on their vitamin test requests despite adequate explanation, they accept vitamin test requests to maintain a good relationship with the patient and avoid conflicts.<sup>26</sup> All these situations may have increased the frequency of unnecessary vitamin test repetitions.

In our study, the 4-year total cost of unnecessary test repetitions was found to be £5,479,093.37. The total cost calculated was only obtained from the unit costs of the unnecessarily repeated tests, and the costs that the tests

lead to (other laboratory expenses, treatments, referral to hospital, hospitalization, etc.) were not taken into account. This may have caused the total cost to be lower than the actual total cost.

There was a significant increase of 123.6% in the use of 25 laboratory tests evaluated between 2016 and 2019. It was found that laboratory tests used in primary healthcare facilities in the United Kingdom increased by 24.2% between 2005 and 2009.<sup>27</sup> In a study conducted in a tertiary university hospital in Sweden, it was determined that the number of laboratory tests increased by 70% in 7 years.<sup>1</sup> In our study, the rate of increase in laboratory tests was higher than other studies in the literature. The reason for this may be that while all tests performed in the laboratory were included in other studies, a relatively limited number of tests were included in our study.

Various interventions have been developed for the appropriate use of laboratory tests. Considering the widespread use of laboratory tests by primary care physicians, these interventions will not provide a wide-ranging benefit without being implemented in primary care.<sup>8</sup> Studies have shown that education leads to a significant decrease in the number of laboratory test requests by physicians.<sup>28</sup> Publishing guidelines for family physicians on the use of laboratory tests and providing training to family physicians may also improve the use of laboratory tests in primary care. Hoffman and Kanzaria argued that to solve the problem of extremism in medicine, it is necessary to define and accept that there is an inevitable margin of miss in medicine, to break the demigod perception of society about physicians with education, and to reform the malpractice law for this purpose.<sup>29</sup> Aiming only at reducing costs while improving the use of laboratory tests may not provide long-term benefits. Aiming at both the cost and effectiveness of healthcare will ensure that the programs to be implemented will be more efficient.

As a result, in this study, it was found that unnecessary test repetitions were quite high among the laboratory tests requested by family physicians working in primary care. This situation brings a very high amount of unnecessary financial burden to the Social Security Institution of our country. Training family physicians on this issue and making adequate legal arrangements to protect physicians from malpractice can prevent unnecessary test repetitions.

The study had some limitations. No criteria other than the test request time interval were used to determine the tests as unnecessary. In the study, it was assumed that laboratory tests that fit the test request time interval were requested appropriately. In addition, tests considered unnecessary repetitions may have included tests requested to confirm the previous abnormal result. Another limitation is that we do not have information about the clinical status of the patients. Acute changes in the patient's clinical condition may have caused physicians to make frequent test requests. However, patients with sudden clinical changes are less likely to be followed up in primary care. Evaluation of a wide range of physicians and patients constitutes the strength of the study.

**Ethical Considerations:** This study was approved by the Necmettin Erbakan University, Faculty of Medicine Non-Pharmaceutical and Medical Device Ethics Committee (04.09.2020/115).

**Conflict of Interest:** The authors declare no conflict of interest.

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## Research Article

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# AN EXAMINATION OF PEDIATRIC PATIENTS PRESENTING TO THE EMERGENCY DEPARTMENT DUE TO DOMESTIC ACCIDENTS DURING THE PANDEMIC PERIOD

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## Abstract

**Objectives:** This study aims to examine pediatric emergency department visits due to domestic accidents during the COVID-19 pandemic. It focuses on analyzing the clinical features, underlying causes, and parental attitudes during increased home confinement.

**Materials and Methods:** This prospective observational study investigates the impact of pandemic-related lockdowns on children and parents, specifically their association with domestic accidents. Patients under 18 years old, who present with domestic accidents and with parental consent, were included. Data collected included demographics, trauma mechanisms, injury locations, and emergency department outcomes. After discharge, parents were surveyed about their educational and employment status, behavioral changes in their children, and perceptions of accident rates during the pandemic.

**Results:** The median age of patients was 5 years (1-11), with 34.5% (n=20) being female. Falls were the most common cause of trauma (79.3%, n=46), with head injuries occurring in 44.8% (n=26). The majority (91.4%, n=53) attributed the accidents to carelessness. Additionally, 60.3% (n=35) reported behavioral changes in their children due to staying at home, and 74.1% (n=15) believed domestic accidents increased during the pandemic. Behavioral changes were particularly notable among school-age children ( $p<0.001$ ). Families with sibling care, lower parental education levels, and higher hospital admission rates had increased behavioral changes ( $p=0.020$ ,  $p=0.008$ ,  $p<0.001$ ,  $p=0.011$ ).

**Conclusion:** The quarantine period during the pandemic significantly impacted both parents and children, increasing the risk of domestic accidents. The study highlights that caregiver awareness and education are crucial in preventing such incidents. Regular parental training at community health centers can reduce accident frequency and improve outcomes.

**Keywords:** Pandemics, COVID-19, quarantine, home accidents, pediatrics, behavior.

## Introduction

Trauma is one of the leading causes of death and disability among children. It is estimated that approximately 1 million children die each year due to accidents, and although the majority of these deaths occur in developing countries, accidents and trauma account for nearly half of child deaths even in developed countries. <sup>1</sup> While the causes of accidents vary between countries, domestic accidents rank high among them. <sup>2</sup> Most domestic accidents stem from preventable causes, often due to Carelessness in home safety. Parental attitudes and behaviors are also key factors in domestic accidents. <sup>3</sup>

On March 11, 2020, the World Health Organization declared the COVID-19 outbreak, which was first reported in Wuhan, China, a pandemic. <sup>4</sup> As a result of this pandemic, many countries implemented restrictions and lockdowns, and Turkey was one of these countries. Following the first reported case, a nationwide lockdown was enforced in Turkey starting on March 16. These quarantine measures not only changed parents' hospital visit habits but also led to more time being spent at home with their children. <sup>5</sup> Especially, the increased time children spend at home during school closures may contribute to a rise in domestic accidents. This process has impacted not only school-age children but all age groups equally. <sup>6</sup> As a result of trauma-related admissions, the amount of radiation exposure these children have experienced has also increased. <sup>7</sup>

In our study, we aimed to examine emergency department (ED) visits due to domestic accidents involving children who stayed at home during the pandemic period, and to highlight the clinical features of these accidents as well as parents' attitudes toward this issue.

## Materials and Methods

Our study is prospective and observational research conducted with the approval of the Ankara City Hospital No. 1 Clinical Research Ethics Committee (Ethics Committee Decision No: E1-21-1708). Trauma patients who presented to the ED between April 29, 2021, and May 17, 2021, were included in the study. During the indicated period, the longest closure period (complete quarantine) of the pandemic occurred, and pediatric patients who presented to the emergency department due to home accidents were assessed. Informed consent was obtained from the parents of all included cases.

These were our inclusion criteria:

- Patients under 18 years of age,
- The ED being the first point of care,

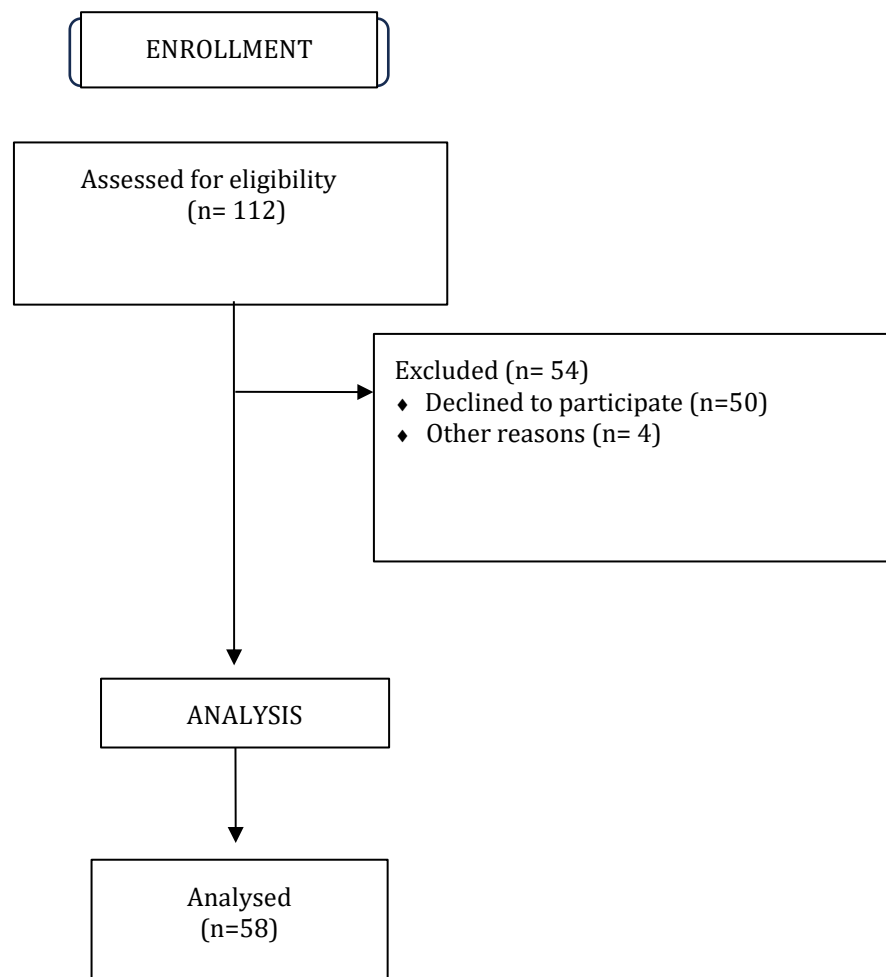
- Admission to the ED due to a domestic accident,

These were our exclusion criteria:

- Patients over 18 years of age,

- Those who did not provide consent to participate in the study,

- Those who did not respond to questions during the telephone interview after the ED visit. (Figure 1.)



**Figure 1.** Flow diagram

During the initial visit, data were recorded on age, gender, chronic diseases, trauma mechanisms, trauma locations (body regions such as head, maxillofacial, spinal, thoracic, abdominal, extremity, genitourinary), and the outcome in the ED (hospitalization, discharge, surgery). The researchers did not intervene in the treatment process of the cases in the ED.

On the seventh day following the ED visit, parents of the included cases were contacted by telephone, and a survey was conducted. The survey questions included whether the children attended school, the education and employment status of the parents, and whether these conditions changed during the pandemic. Additional questions were asked about who provided the child's care (mother, father, grandparent, sibling, nanny), whether staying at home led to behavioral changes in the child, and whether domestic accidents increased during the lockdown periods of the pandemic. All responses were recorded in the study form.

In this study, data from the parents of pediatric patients presenting to the emergency department due to domestic accident-related trauma were recorded after obtaining informed consent. The treatment and follow-up algorithm was not altered. Seven days after discharge, parents were contacted by phone and asked to complete a survey. Information from those who agreed to participate was recorded and included in the final analysis.

The data obtained from the study were analyzed using the Statistical Package for Social Sciences (SPSS) version 22.0. Descriptive analyses were presented as number (n) and percentage (%) for categorical data and as median (minimum and maximum) for numerical data. Pearson's Chi-Square test was used to compare categorical variables. The normality of the distribution of numerical data was evaluated with the Kolmogorov-Smirnov and Shapiro-Wilk tests. The Mann-Whitney U Test was used to assess the distribution of numerical data in two independent groups that did not show a normal distribution. Spearman correlation analysis was used to measure the levels of association. A p-value of less than 0.05 was considered statistically significant, with a 95% confidence interval applied in all tests.

## Results

The study was completed with a total of 58 patients, with a median age of 5 years (1-11). Of the patients, 34.5% (n=20) were female, and 12.1% (n=7) had chronic diseases. The most common cause of trauma was falls at a rate of 79.3% (n=46), and the most frequent trauma site was head trauma at 44.8% (n=26). The rate of patients discharged without hospital admission was 74.1% (n=43), and the rate of those attending school was 43.1% (n=33). The proportion of mothers with a university-level education was 17.2% (n=10), while the proportion of fathers with a university-level education was 34.5% (n=20). The employment rate of mothers was 13.8% (n=8), and that of fathers was 86.2% (n=50); during the pandemic, the maternal employment rate was 3.4%

(n=2), and the paternal employment rate was 6.9% (n=4). The rate of care provided by someone other than the mother was 15.5% (n=9) for fathers and 6.9% (n=4) for siblings. The proportion of those who believed the accident was due to carelessness was 91.4% (n=53). The rate of those who reported that staying at home changed their child's behavior was 60.3% (n=35). The proportion of those who believed that domestic accidents increased during the pandemic was 74.1% (n=15). The median number of siblings was found to be 1 (0-7) (Table 1).

Patients with extremity trauma had lower rates of head and maxillofacial trauma ( $p<0.001$ ,  $p=0.041$ ). The rate of hospital admissions was higher in patients with abdominal trauma ( $p=0.016$ ). Patients with head trauma had lower rates of school attendance ( $p=0.025$ ), while those with extremity trauma had higher rates of school attendance ( $p=0.015$ ). The educational level of fathers was lower in patients with abdominal trauma ( $p=0.016$ ). In patients with extremity trauma, the rate of those who reported that staying at home changed their child's behavior was higher ( $p=0.026$ ), while it was lower in patients with head trauma ( $p=0.011$ ) (Table 2).

In children attending school, the rates of those with spinal trauma, mothers who worked, and those who reported that staying at home changed their child's behavior were found to be higher ( $p=0.041$ ,  $p=0.049$ , and  $p<0.001$ , respectively).

In children cared for by their siblings, the rates of abdominal trauma, hospital admissions, mothers and fathers with an education level of middle school or below, unemployed fathers, and those who reported that staying at home changed their child's behavior were higher ( $p=0.007$ ,  $p=0.020$ ,  $p=0.008$ ,  $p<0.001$ ,  $p<0.001$ , and  $p=0.011$ , respectively) (Table 3).

The median age of patients with head trauma and those who experienced trauma due to falling was lower ( $p=0.025$ ,  $p=0.029$ ), while the median age of those with spinal and extremity trauma, school-going children, and those who reported that staying at home changed their child's behavior was higher ( $p=0.008$ ,  $p=0.014$ ,  $p<0.001$ , and  $p<0.001$ , respectively) (Table 4).

**Table 1.** Sociodemographic characteristics of the study

	%	n
<b>Age (years)</b>		
Median (min-max)		5 (1-11)
<b>Sex</b>		
Female	34.5	20
Male	65.5	38
<b>Chronic Disease</b>		
Yes	12.1	7
No	87.9	51
<b>Cause of Trauma</b>		
Fall	79.3	46
Sharp/penetrating instrument	6.9	4
Fall from height	6.9	4
Collision	5.1	3
Pulling	1.7	1
<b>Injury Location</b>		
Head trauma	44.8	26
Extremity trauma	34.5	20
Maxillofacial trauma	12.1	7
Abdomen trauma	10.3	6
Spine trauma	5.2	3
Thorax trauma	1.7	1
<b>Emergency Department Outcome Status</b>		
Discharged	74.1	43
Admitted to service	12.1	7
Discharged at their request	8.6	5
Admitted to intensive care unit	5.2	3
<b>Child School Attendance Status</b>		
Yes	43.1	33
No	56.9	25
<b>Mother's Education Level</b>		
Illiterate	19.0	11
Primary school	1.7	1
Middle school	17.2	10
High school	44.8	26
University	17.2	10
<b>Father's Education Level</b>		
Illiterate	15.5	9
Primary school	5.2	3
Middle school	5.2	3
High school	39.7	23
University	34.5	20
<b>Mother's Employment Status</b>		
Yes	13.8	8
No	86.2	50
<b>Father's Employment Status</b>		
Yes	13.8	8
No	86.2	50
<b>Mother's Employment During the Pandemic</b>		
Yes	3.4	2
No	96.4	56
<b>Father's Employment During the Pandemic</b>		
Yes	6.9	4
No	93.1	54
<b>Caregiver</b>		
Mother	100	58
Father	15.5	9
Grandmother	6.9	4
Sibling	6.9	4
<b>What do you think is the cause of the accident?</b>		
Carelessness	91.4	53
Non-Carelessness reasons	8.6	5

<b>Has staying at home changed your child's behavior?</b>		
Yes	60.3	35
No	39.7	23
<b>Do you think home accidents increased during the pandemic?</b>		
Yes	74.1	15
No	25.9	43

**Table 2.** Evaluation of Head. Abdominal. and Extremity Trauma with Study Parameters

	Head trauma		Abdominal trauma		Extremity Trauma	
	Yes	No	Yes	No	Yes	No
<b>Head trauma</b>						
Yes	-	-	16.7 (1)	48.1 (25)	0 (0)	68.4 (26)
No			83.3 (5)	51.9 (27)	100 (20)	31.6 (12)
p			0.143		<b>&lt;0.001</b>	
<b>Maxillofacial Trauma</b>						
Yes	3.8 (1)	18.8 (6)	0 (0)	13.5 (7)	0 (0)	18.4 (7)
No	96.2 (25)	81.3 (26)	100.0(6)	86.5 (45)	100 (20)	81.6 (31)
p	0.083		0.338		<b>0.041</b>	
<b>Outcome Status</b>						
Hospital Admission	23.1 (6)	28.1 (9)	66.7 (4)	21.2 (11)	75.0(15)	73.7 (38)
Discharge	76.9 (20)	71.9 (23)	33.3 (2)	78.8 (41)	25.0 (5)	26.3 (10)
p	0.662		<b>0.016</b>		0.913	
<b>School Attendance Status</b>						
Yes	26.9 (7)	56.3 (18)	50.0 (3)	42.3 (22)	65.0(13)	31.6 (12)
No	73.1 (19)	43.8 (14)	50.0 (3)	57.7 (30)	35.0 (7)	68.4 (26)
p	<b>0.025</b>		0.719		<b>0.015</b>	
<b>Mother's Education Level</b>						
Middle School and Below	65.4 (17)	59.4 (19)	50.0 (3)	63.5 (33)	45.0 (9)	34.2 (13)
High School and Above	34.6 (9)	40.6 (13)	50.0 (3)	36.5 (19)	55.0(11)	65.8 (25)
P	0.639		0.520		0.421	
<b>Father's Education Level</b>						
Middle School and Below	80.8 (21)	68.8 (22)	66.7 (4)	21.2 (11)	25.0 (5)	26.3 (10)
High School and Above	19.2 (5)	31.3 (10)	33.3 (2)	78.8 (41)	75.0(15)	73.7 (28)
p	0.299		<b>0.016</b>		0.913	
<b>Has staying at home changed your child's behavior?</b>						
Yes						
No	42.3 (11)	75.0 (24)	66.7 (4)	59.6 (31)	80.0(16)	50.0 (19)
	57.7 (15)	25.0 (8)	33.3 (2)	40.4 (21)	20.0 (4)	50.0 (19)
p	<b>0.011</b>		0.738		<b>0.026</b>	

(%): frequency, min: minimum, max: maximum, p-value was determined using the Chi-Square test.

**Table 3.** Evaluation of School Attendance Status and Caregiver Data in Relation To The Study Parameters

	School Attendance Status		Sibling Caregiver	
	Yes	No	Yes	No
<b>Spinal trauma</b>				
Yes	12.0 (3)	0 (0)	0 (0)	5.6 (3)
No	88.0 (22)	33 (100)	100 (4)	94.4 (51)
p	<b>0.041</b>		0.628	
<b>Abdominal trauma</b>				
Yes	12.0 (3)	9.1 (3)	50.0 (2)	7.4 (4)
No	88.0 (22)	90.9 (30)	50.0 (2)	92.6 (50)
p			<b>0.007</b>	
<b>Outcome Status</b>				
Hospital Admission	28.0 (7)	24.2 (8)	75.0 (3)	22.2 (12)
Discharged	72.0 (18)	75.8 (25)	25.0 (1)	77.8 (42)
p	0.746		<b>0.020</b>	
<b>School Attendance Status</b>	Yes			
No	-	-	0 (0)	46.3 (25)
			100 (4)	53.7 (29)
p			0.071	
<b>Mother's Education Level</b>				
Middle School and Below	24.0 (6)	48.5 (16)	100 (4)	33.3 (18)
High School and Above	76.0 (19)	51.5 (17)	0 (0)	66.7 (36)
p	0.057		<b>0.008</b>	
<b>Father's Education Level</b>				
Middle School and Below	16.0 (4)	33.3 (11)	100 (4)	20.4 (11)
High School and Above	84.0 (21)	66.7 (22)	0 (0)	79.6 (43)
p	0.135		<b>&lt;0.001</b>	
<b>Mother's Employment Status</b>				
Yes				
No	24.0 (6)	6.1 (2)	0 (0)	14.8 (8)
	76.0 (19)	93.9 (31)	100 (4)	85.2 (46)
p	<b>0.049</b>		0.407	
<b>Father's Employment Status</b>				
Yes				
No	92.0 (23)	81.8 (27)	0 (0)	3.7 (2)
	8.0 (2)	18.2 (6)	100 (4)	96.3 (52)
p	0.265		<b>&lt;0.001</b>	
<b>Did staying at home change your child's behavior?</b>				
Yes	96.0 (24)	33.3 (11)	0 (0)	64.8 (35)
No	4.0 (1)	66.7 (22)	100 (4)	35.2 (19)
p	<b>&lt;0.001</b>		<b>0.011</b>	

(%): frequency, min: minimum, max: maximum, p value has been determined by Chi-square test.



**Table 4.** Evaluation of study working parameters with head, abdominal and extremity trauma.

	<b>Age</b>	<b>Cost</b>
	<b>Median (min-max)</b>	<b>Median (min-max)</b>
<b>Head trauma</b>		
Yes	3 (1-11)	173 (17-510)
No	7 (1-11)	161 (17-1641)
p	<b>0.025</b>	0.569
<b>Abdominal trauma</b>		
Yes	5 (1-10)	595 (127-791)
No	5 (1-11)	148 (17-1641)
p	0.970	<b>0.006</b>
<b>Spine trauma</b>		
Yes	10 (10-10)	555 (189-695)
No	5 (1-11)	157 (17-1641)
p	<b>0.008</b>	0.112
<b>Extremity trauma</b>		
Yes	7 (1-11)	157 (20-1641)
No	3 (1-11)	188 (17-791)
p	<b>0.014</b>	0.998
<b>Outcome Status</b>		
Hospital Admission	6 (1-11)	564 (137-1641)
Discharged	5 (1-11)	126 (17-695)
p	0.886	<b>&lt;0.001</b>
<b>School Attendance Status</b>		
Yes	8 (5-11)	220 (57-1523)
No	3 (1-6)	138 (17-1641)
p	<b>&lt;0.001</b>	0.121
<b>Did staying at home change your child's behavior?</b>		
Yes	7 (1-11)	177 (20-1523)
No	2 (1-8)	147 (17-1641)
p	<b>&lt;0.001</b>	0.677
<b>Trauma causes</b>		
Fall	4 (1-10)	165 (17-1641)
Other causes	6 (3-11)	101 (20-791)
p	<b>0.029</b>	0.867
<b>Father's Education Level</b>		
Middle School and Below	5 (1-11)	472 (20-1641)
High School and Above	5 (1-11)	139 (17-1523)
p	0.907	<b>0.040</b>

(%): frequency, min: minimum, max: maximum, p value was determined using the Mann-Whitney U test.

## Discussion

Our study results show that male children experienced more frequent domestic accidents, with falls being the most common mechanism and head trauma being the most frequent trauma localization. Parents overwhelmingly believed that the domestic accident was due to their carelessness, and it was observed that a significant portion of children exhibited behavioral changes during the pandemic period. Additionally, there was an inverse relationship between parental education level and trauma severity and outcomes. Raising awareness of home accidents will also benefit preventive medicine and public health. The secondary aim of our study is to demonstrate the value of preventative medicine.

Although the pandemic altered hospital admission habits, with overall ED visits decreasing, the hospitalization rate increased.<sup>8-9</sup> With this shift in healthcare utilization, changes in the epidemiology of trauma were also observed. A similar study conducted in Morocco suggested that children around 7 years of age were more frequently exposed to domestic accidents.<sup>10</sup> In a study by Nabian and colleagues, which examined the epidemiological characteristics of pediatric trauma during the pandemic, children aged 9 were found to experience trauma more frequently, both during the pandemic and before it.<sup>11</sup> Likewise, a multicenter cohort study conducted in Italy found the average age of children exposed to domestic accidents to be 7 years, while in our study, it was 5 years.<sup>12</sup> As children grow older, they are more frequently exposed to trauma due to their sense of exploration and impulses.<sup>13</sup>

It is well established in the literature that male children are more frequently exposed to trauma, and our study findings were consistent with these data.<sup>12,14</sup> The higher rate of trauma exposure among male children is expected, given their naturally more active behavior.<sup>13</sup>

When examining the literature, it is evident that falls are the most common cause of domestic accidents, and our study findings are consistent with the existing literature.<sup>10,12</sup> No significant change in the mechanism of falls was observed between the pandemic and pre-pandemic periods. However, the increase in domestic accidents can be attributed to the fact that home environments were not adequately adjusted as parents adopted remote working arrangements.<sup>15</sup> The majority of parents in our study believed that the domestic accident was due to their carelessness, and about two-thirds thought their children experienced behavioral changes. The quarantine period significantly increased stress levels among individuals.<sup>16</sup> Elevated stress levels directly or indirectly affected children through their parents. The reduction in social stimuli and physical activity during quarantine resulted in more frequent behavioral changes in children, which also influenced parental attitudes on this matter.<sup>17-19</sup> Furthermore, most parents believed that domestic accidents increased during the quarantine period, a view supported by literature.<sup>9</sup>

When examining the association between trauma localizations in domestic accidents, children with head trauma were less likely to have extremity trauma. The median age of children with head trauma was lower, while those with abdominal trauma had higher hospitalization rates. The literature indicates that extremity trauma is generally the most common injury in domestic accidents.<sup>11,20</sup> The lower median age of our patients compared to the literature may explain the higher prevalence of head trauma in our study. The education level of parents of children with abdominal trauma was also found to be lower. Children cared for by someone other than a parent (e.g., a sibling) were more likely to experience abdominal trauma and had higher hospitalization rates. These findings suggest that the education and awareness levels of both children and parents are directly related to the severity and type of domestic accidents. In our study population, the mothers' education level was generally low, which may explain why the difference was observed in fathers' education levels. It is well known that lower education levels lead to a higher frequency of domestic accidents and are associated with lower first aid knowledge following accidents.<sup>21</sup> In unexpected stressful situations such as quarantine, regular parental training sessions provided at community health centers could help reduce the likelihood of potential adverse outcomes.<sup>22</sup>

Our study is limited by being a single-center experience with a relatively small sample size. However, this limitation arises from the fact that the study focuses solely on the quarantine period, restricting the number of eligible cases. Although the study was conducted at one of Turkey's largest hospitals, which generally manages more complex cases and receives fewer direct admissions, the findings still provide valuable insights into the impact of quarantine on domestic accidents. Nevertheless, the generalizability of the results remains limited.

Our study results, in line with the literature, demonstrate that caregivers' awareness, educational level, and sociocultural status are directly related to the frequency and severity of domestic accidents.<sup>23, 24</sup> Parents' awareness and personal experiences play a crucial role in the preventive measures they take against household accidents. Additionally, parents act as primary first aid providers in such incidents. As a preventive healthcare strategy, providing regular training to families with children on domestic accidents and first aid practices is essential for improving outcomes and reducing the incidence of such accidents.<sup>25</sup>

In conclusion, the negative effects of the quarantine period during the pandemic on both parents and children cannot be overlooked. Quarantine periods pose increased risks for individuals. Additionally, it has been shown that the awareness and education levels of caregivers are directly related to the severity and outcomes of domestic accidents. Therefore, parents must be more cautious and enhance safety measures at home to protect children from domestic accidents during the pandemic. When examining the relationship between caregivers' awareness levels and the outcomes of incidents, the importance of regular and routine training becomes more

evident. Regular parental training programs at community health centers can help reduce the frequency and improve the outcomes of adverse events.

**Ethical Considerations:** Ethical approval was obtained from the Ankara City Hospital No. 1 Clinical Research Ethics Committee (Date: 26/05/2021 - No: E1-21-1708).

**Conflict of Interest:** The authors declare no conflict of interest.

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## Research Article

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# THE IMPACT OF DIGITAL HEALTH LITERACY ON HEALTHY LIFESTYLE BEHAVIORS AMONG ADULTS: THE CASE OF ANKARA

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## Abstract

**Objectives:** This study examines the influence of digital health literacy on the adoption of healthy lifestyle behaviours among adults residing in the city of Ankara.

**Materials and Methods:** A cross-sectional web-based survey was conducted among 414 adults aged 18–64 in Ankara, utilising validated scales for digital health literacy and healthy lifestyle behaviours. The data were analyzed for socio-demographic patterns, scale reliability, and regression to identify the relationships between digital health literacy and healthy lifestyle behaviours.

**Results:** The mean score for the Healthy Lifestyle Behaviour Scale was 85.17 ( $\pm 11.54$ ), with the highest scores observed for the 'Sleep' item and the lowest for the 'Personal Health Responsibility-II' item. The mean score for the Digital Health Literacy Scale was 2.86 ( $\pm 0.40$ ), with the highest score for "Privacy Protection" and the lowest for "Credibility." The regression analysis revealed a positive and statistically significant relationship between digital health literacy and healthy lifestyle behaviours. In particular, the subdimensions "Information Seeking" ( $\beta = 0.150$ ,  $p = 0.014$ ) and "Privacy Protection" ( $\beta = 0.123$ ,  $p = 0.019$ ) had a significant impact.

**Conclusion:** The results of this study indicate that individuals with higher levels of digital health literacy are more likely to adopt healthy lifestyle behaviours. Enhancing digital health literacy can empower individuals to adopt healthier habits, access reliable health information and effectively utilise digital health services, thereby improving public health outcomes.

**Keywords:** Digital health literacy, eHealth literacy, healthy lifestyle behaviors, health behaviors, health promotion, public health.



## Introduction

In the contemporary era, technology and the Internet have become pervasive influences in nearly every aspect of life, guiding and shaping the behaviours and decisions of individuals. These two factors, which drive the level of digitalisation, are also extensively utilised in the field of healthcare. However, the increasingly complex and strengthening relationship between healthcare, technology, and the internet yields both positive and negative outcomes. In this context, the widespread adoption of digital platforms in healthcare has significantly improved individuals' access to health services. Examples of conveniences enabled by digitalisation include telehealth applications that allow users to select doctors and hospitals online, book appointments, access remote health consultations, and retrieve test results remotely.<sup>1</sup> Nevertheless, the accessibility of vast quantities of information through digitalisation has also given rise to concerns regarding the reliability of such information.<sup>2</sup> The sheer volume of data makes it challenging for individuals to identify accurate and reliable information.<sup>3</sup> It is therefore essential to collaborate with stakeholders, including service providers, users, and developers, to address these challenges and evaluate the implications collectively. This approach is vital to ensure the delivery of effective, efficient, and sustainable healthcare services and to enhance the overall health status of the population.

The ability to access and utilise information is of paramount importance for the achievement of optimal health outcomes.<sup>4</sup> In light of the ongoing digital transformation, it is evident that access to health information necessitates not only the availability of technology but also the capacity to utilise it effectively. Furthermore, health literacy, which encompasses a range of abilities and resources about the processing of health-related information, represents a crucial prerequisite.<sup>5</sup> Digital platforms in healthcare can be utilised to access information that is designed to promote, maintain, or restore health through the encouragement of healthy lifestyle practices. Individuals have the option of accessing a wealth of information on exercise programs, nutrition guides, and other healthy living habits through both paid and free digital platforms.<sup>1</sup> The effective utilisation of this information is made possible through digital health literacy (DHL). DHL refers to individuals' ability to find, understand, evaluate, and use health-related information through digital platforms. It enables access to the accurate health information on the internet and facilitates the transformation of this information into healthy lifestyle behaviours.<sup>6</sup> In addition to the inequalities in access to and use of technology, often referred to as the digital divide,<sup>4</sup> disparities in DHL levels can lead to inequalities in health outcomes. In response, the World Health Organization has issued a call to action to improve DHL.<sup>7</sup>

The internet provides individuals with an accessible platform for accessing health-related information. However, low levels of DHL can have significant implications.<sup>8</sup> Prior research has demonstrated that individuals with diminished DHL are less inclined to utilise preventive health services<sup>9</sup> and exhibit reduced rates of medical adherence.<sup>10</sup> Conversely, research indicates that information-seeking behaviour on social

networks (e.g. Facebook) can influence stress levels, which in turn impact physical and psychological health.<sup>8</sup> Furthermore, another study indicated that access to digital systems or technological devices could enhance the health and well-being of breast cancer patients.<sup>11</sup> Indeed, individuals with higher DHL levels are more likely to engage in healthier lifestyle behaviours. In this regard, individuals with high DHL levels are more likely to engage in healthy behaviours, including the consumption of nutritious food, regular physical exercise<sup>12</sup> and the avoidance of harmful habits such as smoking and alcohol consumption.<sup>13</sup> Furthermore, both long-term illness and good health status are influenced by DHL levels.<sup>14</sup>

In conclusion, assessing the level of DHL within a population and understanding its potential influence on healthy lifestyle behaviors is critical for the development of targeted DHL interventions.

## Materials and Methods

### *Research Design*

The data were collected via a cross-sectional web-based questionnaire (Google Forms).

### *Population and Sample*

It aimed to reach the participants through the convenience sampling method, utilising a snowball approach. The online survey link was distributed through social media, email, and WhatsApp groups, and participation was voluntary. Data were collected between 20 October and 13 November 2024. The study population comprised adults aged 18 to 64 residing in Ankara. As the capital city of Türkiye and one of the country's most populous urban centers, Ankara is home to a diverse range of sociodemographic groups. According to recent statistics, 95.4% of the Turkish population has an active mobile phone subscription. This figure is consistent with the national average, indicating that internet and mobile phone usage rates in Ankara are also high.<sup>15</sup> In 2023, Türkiye exhibited a digital applications and internet penetration rate of 83.4 percent. Additionally, 73.1 percent of the population demonstrated active social media usage.<sup>15</sup> During the same period, it was determined that 95.5% of households had access to the internet. The internet usage rate for the age group of 16-74, which encompasses a significant portion of the population, was 87.1%,<sup>16</sup> with the average time spent on the internet daily being 7 hours.<sup>17</sup>

The latest data from the Türkiye Statistical Institute (2023) indicates that the adult population aged 18-64 in Ankara is 3,871,118.<sup>18</sup> The sample was designed to comprise 384 individuals, with a 5% margin of error and a 95% confidence interval. The data collection process was concluded when 414 participants, including 30 reserves, had been recruited.

The inclusion criteria for the sample were as follows: residence in Ankara, age between 18 and 64, possession of basic computer and internet knowledge, and voluntary consent to participate in the study.

#### *Data Collection Tools*

The data collection tools are comprised of three sections. The initial section comprises queries designed to ascertain the socio-demographic attributes of the participants. The second section comprises a scale developed by Sayılı et al. (2024) for the Turkish population. The Healthy Lifestyle Behaviour Scale is designed to assess healthy lifestyle behaviours using five-point Likert-type questions. It comprises 34 items and nine dimensions. The item scores are summed and then averaged (total score/34), and the scale score is obtained by multiplying the average by 25 (min:0, max:100).<sup>19</sup>

The third section comprises the DHL Scale, originally developed by Van Der Vaart and Drossaert (2017)<sup>20</sup> and subsequently adapted into Turkish by Çetin and Gümüş (2023).<sup>1</sup> The scale comprises 18 items distributed across six dimensions, employing a four-point Likert-type response format. The overall scale and each subdimension yield an average score between 1 and 4. A score below 2 indicates low DHL, scores between 2 and 3 represent moderate DHL and scores above 3 indicate high DHL.<sup>1</sup>

#### *Data Analysis*

The data were analysed using the SPSS 23 software. The demographic characteristics of the participants, the DHL and Healthy Lifestyle Behaviours Scale scores, and the reliability levels of the scales were calculated using descriptive statistics. The relationship between DHL and healthy lifestyle behaviours was tested using regression analysis.

#### *Ethical approval*

The study was granted ethical approval by the Ankara Yıldırım Beyazıt University (08/493) and was conducted following the Declaration of Helsinki. Before data collection, participants were informed about the research's purpose, the voluntary nature of their involvement, and the scientific use of the results. Informed consent was obtained from all participants.

## **Results**

Table 1 presents the findings regarding the socio-demographic characteristics of the participants. The socio-demographic characteristics of the participants indicate that the majority are aged between 18 and 44 years (75.4%) and predominantly female (75.8%). The majority of participants have completed a four-year college

degree (45.9%), and 58.0% are married. In terms of employment status, 57.5% of participants are employed on a full-time basis, 20.3% are students, and smaller proportions are classified as unemployed (12.3%), part-time workers (2.9%), self-employed individuals (2.2%), or retirees (4.8%). A significant proportion of monthly incomes are concentrated in the 50,000-100,000 TL range (36%), with the majority of participants perceiving their income level as medium (62.3%). About health insurance, 89.4% of participants are covered by Social Security (SGK), while a smaller proportion have private or international insurance. Nearly all participants reside in city or district centers (96.4%), and the most common daily internet use is 3-5 hours (45.9%).

**Table 1.** Sociodemographic characteristics of the participants

Variables	n	%	
<b>Age</b>	18-24	100	24.2
	25-34	101	24.4
	<b>34-44</b>	<b>111</b>	<b>26.8</b>
	45-54	89	21.5
	55-64	13	3.1
<b>Gender</b>	Female	314	75.8
	Male	100	24.2
<b>Education Level</b>	High School or Below	58	14.0
	Two-Year College	48	11.6
	Bachelor's Degree	<b>190</b>	<b>45.9</b>
	Master's/Doctorate	118	28.5
Marital Status	Married	<b>240</b>	<b>58.0</b>
	Single	159	38.4
	Divorced	15	3.6
Employment Status	Student	84	20.3
	Full-Time Employment	<b>238</b>	<b>57.5</b>
	Unemployed and Non-Working at Home	51	12.3
	Self-Employed and Business Owners	9	2.2
	Part-Time Employment	12	2.9
	Retirees	20	4.8
Monthly Income	≤ 11,000 TL	79	19.1
	11,000-18,000 TL	19	4.6
	18,000-50,000 TL	146	35.3
	50,000-100,000 TL	<b>149</b>	<b>36.0</b>
	≥ 100,000 TL	21	5.1
Perceived Income Level	Low	140	33.8
	Medium	<b>258</b>	<b>62.3</b>
	High	16	3.9
Health Insurance	Social Security (SGK)	<b>370</b>	<b>89.4</b>
	Private Insurance	10	2.4
	International Insurance	3	0.7
	Both SGK & Private	31	7.5
Residence	Village	8	1.9
	Town	7	1.7
	City/District Center	<b>399</b>	<b>96.4</b>
Daily Internet Use	< 3 Hours	137	33.1
	3-5 Hours	<b>190</b>	<b>45.9</b>
	6-8 Hours	65	15.7
	> 9 Hours	22	5.3
<b>Total</b>	<b>414</b>	<b>100.0</b>	

Table 2 presents the descriptive statistics and reliability analysis for the scales employed in the study and their constituent sub-dimensions. The data indicate that the mean score for the Healthy Lifestyle Behaviour Scale was 85.17 ( $\pm 11.54$ ). The highest score was observed in the 'Sleep' sub-dimension (96.89  $\pm 23.27$ ), while the lowest score was recorded in the 'Personal Health Responsibility-II' sub-dimension (66.50  $\pm 23.22$ ). The mean scores for the subdimensions are ranked from medium to high level; 'Social Support' (76.55  $\pm 18.87$ ), 'Nutrition' (84.67  $\pm 18.58$ ), and 'Exercise' (86.35  $\pm 16.67$ ). The overall mean for the DHL Scale is 2.86 ( $\pm 0.40$ ), with the highest scores observed in the "Privacy Protection" (3.25  $\pm 0.60$ ) and "Content Creation" (3.02  $\pm 0.61$ ) sub-dimensions. Conversely, the "Credibility" sub-dimension exhibits the lowest mean (2.45  $\pm 0.65$ ).

**Table 2.** Descriptive statistics and reliability for the scales and their subdimensions

Scales	Dimension& subdimension	Mean	SD	Items	Cronbach's Alpha
Healthy Lifestyle Behavior Scale (min:0, Max:4)	Exercise	86.3527	16.66814	5	0.798
	Personal Health Responsibility-1	90.0362	16.32533	4	0.834
	Personal Health Responsibility-2	<b>66.5006</b>	<b>23.22174</b>	4	0.697
	Sleep	<b>96.8901</b>	<b>23.27082</b>	2	0.610
	Social Support	76.5459	18.87326	5	0.658
	Stress Management	91.5862	18.90695	3	0.661
	Nutrition	84.6739	18.58694	5	0.745
	Smoking	88.9795	30.11216	4	0.856
	Alcohol	92.8442	15.79374	2	0.425
	Total	85.1749	11.54012	<b>34</b>	<b>0.715</b>
Digital Health Literacy Scale (min:1, Max:4)	Information Seeking	2.8349	0.62490	3	0.789
	Credibility	<b>2.4545</b>	<b>0.65397</b>	3	0.771
	Interest	2.6651	0.56439	3	0.670
	Navigation Skills	2.9302	0.58423	3	0.488
	Content Creation	3.0177	0.60640	3	0.818
	Privacy Protection	<b>3.2504</b>	<b>0.59668</b>	3	0.586
	Total	2.8587	0.40391	<b>18</b>	<b>0.750</b>

The results of the reliability analysis for the scales and subdimensions presented in Table 2 indicate that the Healthy Lifestyle Behavior Scale has an overall Cronbach's alpha of 0.715, which reflects a moderate level of internal consistency. Among its sub-dimensions, 'Smoking' (alpha = 0.856) exhibited the highest reliability, while 'Alcohol' (alpha = 0.425) demonstrated the lowest. Other sub-dimensions, including "Exercise" (alpha = 0.798), "Personal health responsibility-I" (alpha = 0.834), and "Stress management" (alpha = 0.661), demonstrated satisfactory reliability. The DHL Scale exhibited a Cronbach's alpha of 0.750, indicative of good internal consistency. The subdimensions of the DHL Scale also demonstrated variable reliability. The subdimensions of information seeking ( $\alpha = 0.789$ ) and content creation ( $\alpha = 0.818$ ) exhibited high reliability, whereas the subdimensions of navigation skills ( $\alpha = 0.488$ ) and privacy protection ( $\alpha = 0.586$ ) demonstrated relatively lower levels of consistency.

The influence of DHL on the adoption of healthy lifestyle behaviours was investigated through the application of two distinct regression models. As illustrated in Table 3, Model 1 evaluates the influence of DHL subdimensions on healthy lifestyle behaviours. The model was found to be statistically significant ( $p < 0.05$ ) with an explanatory power of 5.5% (Adj.  $R^2 = 0.055$ ). Among the subdimensions, information seeking ( $\beta = 0.150$ ,  $p = 0.014$ ) and privacy protection ( $\beta = 0.123$ ,  $p = 0.019$ ) demonstrated a positive and statistically significant effect on the dependent variable. The effects of Credibility Evaluation, Interest Level Determination, Navigation Skills, and Content Creation were found to be non-significant ( $p = 0.324$ ,  $p = 0.735$ ,  $p = 0.624$ , and  $p = 0.065$ , respectively).

In the second model, the overall effect of DHL was assessed, yielding an explanatory power of 4.2% (Adj.  $R^2 = 0.042$ ). The model was found to be statistically significant ( $p < 0.001$ ). The general effect of DHL (second model) and the subdimensions Information Seeking and Privacy Protection (first model) was found to have a statistically significant and positive impact on healthy lifestyle behaviours ( $p < 0.01$ ).

These results indicate that as DHL increases, the healthy lifestyle score also rises. Furthermore, the absence of multicollinearity and autocorrelation issues is corroborated by the Durbin-Watson and VIF values.

**Table 3.** Regression analysis results

Model	Independent Variable(s)	Adj. R <sup>2</sup>	Std. Beta	t	p	F	p(Model)	VIF	Durbin-Watson
1	Constant	0.055		15.957	0.000	5.002	0.001		1.704
	Information Seeking		0.150	2.468	<b>0.014</b>			1.609	
	Credibility		-0.063	-0.987	0.324			1.780	
	Interest		0.022	0.339	0.735			1.860	
	Navigation Skills		-0.025	-0.490	0.624			1.177	
	Content Creation		0.105	1.849	0.065			1.420	
	Privacy Protection		0.123	2.360	<b>0.019</b>			1.196	
	2		Constant					17.123	
	Digital Health Literacy	0.042	0.210	4.356	<b>0.001</b>		0.001	1.000	1.699

## Discussion

The objective of the study is to gain insight into the influence of individuals' abilities to access, comprehend, evaluate, and utilise health-related information through digital platforms on the adoption of healthy lifestyle practices. Moreover, the study aims to assess the correlation between DHL levels and healthy lifestyle behaviours, with a specific focus on the potential influence of DHL on health outcomes.

The responsibility for maintaining health, improving well-being, and promoting health lies with individuals and communities alike.<sup>21</sup> At the individual level, this responsibility was assessed in the study using the Healthy Lifestyle Behavior Scale, which revealed a total score of 85.17 ( $\pm 11.54$ ). Among the subdimensions, the lowest score was recorded in the "Personal Health Responsibility-II" subdimension, with a mean score of 66.50 ( $\pm 23.22$ ). The term "personal health responsibility" denotes the actions that individuals must undertake to sustain their physical, mental, and social well-being. This responsibility entails an obligation for individuals to seek information, social support, and all necessary resources from healthcare providers and other relevant stakeholders and to act following the advice provided.

The scale employed examined health responsibility under two factors: consultation responsibility (Personal Health Responsibility-I) and behavioural responsibility (Personal Health Responsibility-II). The Personal Health Responsibility-II subdimension evaluated participants' uptake of vaccinations outside routine

immunization programs but recommended by experts, completion of annual dental check-ups, undergoing recommended cancer screenings, and adoption of methods for sexual health and protection against sexually transmitted diseases.<sup>19</sup> In this context, while participants demonstrated a high level of fulfillment in consultation responsibilities ( $90.03 \pm 16.32$ ), they exhibited deficiencies in translating these responsibilities into behaviors.

The mean score for the participants' overall DHL was 2.86 ( $\pm 0.40$ ), indicating a moderate level of DHL. When considering the sub-dimensions, "Privacy Protection" ( $3.25 \pm 0.60$ ) and "Content Creation" ( $3.02 \pm 0.61$ ) show scores close to high, suggesting that participants are attentive to privacy and security issues when using digital health tools and have a higher level of knowledge regarding creating or contributing to digital health content. Nevertheless, the moderate DHL scores observed in other sub-dimensions indicate that participants may require additional education or skill development in areas such as accessing, using, and evaluating digital health information. This finding suggests that DHL is strong in certain areas but needs further development in others. Given the sample includes various groups based on age, education, income, and employment status, it may be beneficial to implement training and support programs to improve all aspects of DHL. Such programs could help participants utilize digital health information more effectively and make better use of digital health services.

The maintenance of a healthy lifestyle is of paramount importance for overall well-being,<sup>19</sup> and DHL plays a pivotal role in influencing these behaviours. DHL has the potential to empower individuals to adopt and maintain healthier habits.<sup>22</sup> Individuals can learn fundamental skills such as reading, understanding, and locating health information.<sup>23</sup> These essential skills are directly linked to an individual's ability to navigate the healthcare system, understand diagnoses, adhere to recommended treatments, and interpret the validity of health information from various media sources.<sup>24</sup> In this context, the study found that DHL has a positive and statistically significant influence on healthy lifestyle behaviours in adults. This finding aligns with previous studies reporting that higher levels of DHL are associated with more favorable health behaviours and improved health outcomes. Although studies encompassing diverse age groups and generations exist,<sup>1,24,25</sup> research focusing specifically on adults remains limited.<sup>21</sup> Furthermore, it was established that the subdimensions of DHL, specifically credibility evaluation, interest level determination, navigation skills, and content creation, do not significantly influence healthy lifestyle behaviours. This emphasizes the necessity for caution regarding the concept of the "infodemic," which refers to the rapid dissemination of misinformation or fake news,<sup>26</sup> particularly in an era characterized by enhanced internet access and utilisation. Conversely, the study conducted by Aharony and Goldman (2017) revealed that DHL had no discernible impact on health or disease prevention behaviours.<sup>27</sup> Similarly, some research<sup>28,29</sup> has identified no significant correlation between eHL and certain health behaviours, particularly in specific populations or contexts. This evidence points to a need for the development of tailored interventions.



In conclusion, the findings of this study illustrate the beneficial influence of DHL, particularly in the areas of information seeking and privacy protection, on the uptake of healthy lifestyle behaviours. However, given the model's limited explanatory power, it is essential to consider additional factors to enhance its predictive capacity. In light of these findings, further investigation must be conducted into additional factors that may contribute to the adoption of healthy behaviours, as DHL alone does not fully explain the observed variation in healthy lifestyle scores. Future research should explore further mediators and moderators of this relationship, such as socio-economic status, access to healthcare resources, and the role of digital health tools in different cultural contexts.

#### *Study Limitations*

One of the limitations of this study is the use of convenience sampling, a non-probability sampling method. Although the sampling method offers advantages such as cost-effectiveness and reduced time commitment, the generalisability of the study is limited, and its ability to represent a large population is low. It is therefore recommended that future research employ probability sampling techniques to increase the representativeness and validity of the findings. Despite the widespread internet usage in Türkiye, data collection through electronic surveys resulted in a study conducted with a limited sample of participants who are literate and have internet access. This further restricts the external validity of the study. Additionally, it was assumed that participants provided accurate information.

**Ethical Considerations:** The study was granted ethical approval by the Ankara Yıldırım Beyazıt University (08/493) and was conducted following the Declaration of Helsinki. Before data collection, participants were informed about the research's purpose, the voluntary nature of their involvement, and the scientific use of the results. Informed consent was obtained from all participants.

**Conflict of Interest:** The authors declare no conflict of interest.

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## Research Article

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# ASSESSMENT OF THE RELATIONSHIP BETWEEN SEXUAL SATISFACTION AND DIABETES SELF-MANAGEMENT IN ADULTS WITH DIABETES AND THE FACTORS INFLUENCING THIS RELATIONSHIP

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## Abstract

**Objectives:** This study aimed to evaluate the relationship between sexual satisfaction and diabetes self-management among individuals diagnosed with diabetes mellitus (DM), as well as the factors influencing this relationship.

**Materials and Methods:** This descriptive and correlational study was conducted with 140 individuals with DM in a public hospital in Ankara, Turkey. Data were collected using the “Individual Information Form”, “New Sexual Satisfaction Scale (NSSS)”, and “Diabetes Self-Management Questionnaire (DSMQ)”.

**Results:** Participants' mean NSSS score was  $60.18 \pm 17.97$ , and their mean DSMQ score was  $5.65 \pm 1.71$ . Higher NSSS scores were observed in participants who were satisfied with their partner relationship, reported no changes in their sexual life compared to before their DM diagnosis, consumed alcohol, and whose partners had a university-level education or higher ( $p < 0.05$ ). A positive correlation was found between the total scores and subdimensions of NSSS and DSMQ ( $p < 0.05$ ). Regression analysis indicated that fasting blood glucose (FBG) (Beta= -0.22,  $p < 0.001$ ), alcohol consumption (Beta= -6.79,  $p = 0.022$ ), and satisfaction with the partner relationship (Not satisfied, Beta= -18.00) had significant effects on NSSS scores ( $p < 0.05$ ). Additionally, DSMQ had a positive effect on NSSS (Beta= 1.47;  $p = 0.05$ ).

**Conclusion:** Sexual satisfaction in individuals with DM is influenced by diabetes self-management. Partner relationship satisfaction and FBG are critical determinants of sexual satisfaction. Therefore, integrating sexual health and glycemic control into education and counseling services is essential for individuals with DM.

**Keywords:** Blood glucose, diabetes mellitus, self management, sexual satisfaction, sexuality.

## Introduction

Diabetes Mellitus (DM) is a chronic condition characterized by elevated blood glucose levels, arising when the body either does not produce insulin, produces insufficient amounts, or fails to use it effectively. Nowadays, DM has become a global health issue, affecting more than half a billion individuals worldwide.<sup>1</sup> According to the 2021 International Diabetes Federation Global Report, the prevalence of DM among adults is 10.5%, and it is projected to increase to 12.2% by 2045.<sup>2</sup> In Turkey, the prevalence of DM is 14.5%.<sup>3</sup> Factors such as the rising prevalence of DM, DM-attributable mortality, and health expenditures associated with DM continue to have significant social, financial, and systemic impacts globally.<sup>2</sup>

Uncontrolled, long-term DM not only leads to vascular and oxidative stress disorders that impair various physiological systems but also causes psychological symptoms.<sup>4</sup> In addition to these extensive effects, an important dimension directly affecting the quality of life of individuals with DM is its negative impact on sexual functioning. Sexuality is a significant aspect of an individual's life, influenced by numerous physical, psychological, and social factors.<sup>4-6</sup> Sexual dysfunctions are recognized as a common complication of DM in both men and women.<sup>4-7</sup> Therefore, the impact of DM on the sexual health and satisfaction of individuals is an area that should not be overlooked in the assessment of DM.

Sexual satisfaction, as defined by Hudson, refers to the degree of harmony and contentment experienced in sexual activities.<sup>8</sup> Suboptimal DM management not only leads to physiological complications but also contributes to sexual dysfunction through psychosocial effects.<sup>4,9,10</sup> Hyperglycemia observed in DM can cause damage to the vascular structures in the genital region and hormonal imbalances in women, leading to sexual dysfunction. In men, disruption of the balance between vasoconstrictive and vasorelaxant factors can restrict penile blood flow, resulting in erectile difficulties. Moreover, hyperglycemia-induced hormonal changes may decrease sexual desire and satisfaction in both women and men.<sup>11,12</sup> Additionally, the constant effort to maintain glycemic control and chronic exposure to hyperglycemia in individuals with DM can increase stress and anxiety,<sup>9,13</sup> fostering negative perceptions toward sexuality.<sup>13,14</sup> The literature highlights that when blood glucose levels cannot be stabilized, sexual satisfaction decreases in both genders.<sup>6,13</sup> In this context, the development of effective DM self-management strategies and the establishment of holistic approaches that integrate glycemic control and psychological support are essential for improving sexual satisfaction.

As highlighted by global DM guidelines, sexual dysfunction emerges as an under-discussed and often neglected complication of DM.<sup>15</sup> While the literature frequently examines sexual dysfunction in relation to type II DM and includes numerous studies focusing on female samples,<sup>6,9,11,14,16-19</sup> studies conducted on individuals with both type I and type II DM, as well as those including both male and female participants, remain limited.<sup>14,20</sup> However, no studies have been identified that assess sexual satisfaction in both genders among individuals

diagnosed with type I and type II DM. Within this scope, the aim of this study is to evaluate the relationship between sexual satisfaction and diabetes self-management in adult individuals diagnosed with type I and type II DM, as well as the factors influencing this relationship.

### ***Research Questions***

Do socio-demographic characteristics, health status, and changes in sexual life influence the levels of sexual satisfaction and diabetes self-management in adults diagnosed with DM?

Is there a relationship between sexual satisfaction and diabetes self-management levels in adults diagnosed with DM?

## **Materials and Methods**

### *Type of Study*

The study is descriptive and correlational in design.

### *Population and Sample*

The study was conducted in the internal medicine outpatient clinics of a Public Hospital in Ankara, Turkey. The exact number of individuals diagnosed with type I or type II DM attending the hospital is unknown. Therefore, the global DM prevalence of 10% for the 20–79 age group, as reported in 2021 data, was used for sample size calculation.<sup>1</sup> Using this prevalence, the sample size was determined with the formula for an unknown population ( $n = ((t_{(1-\alpha)})^2 * (p * q)) / d^2$ ) ( $t_{(1-\alpha)} = 1.96$ ,  $p = 0.10$ ,  $q = 0.90$ ,  $d = 0.05$ ). Based on this calculation, the sample size was determined to include at least 138 adult individuals with DM.<sup>21</sup> A non-probabilistic sampling method, specifically “convenience sampling”, was employed. The study included participants who met the following criteria: (i) Voluntary participation, (ii) Aged 20 years or older, (iii) Fluent in Turkish, (iv) At least a primary school graduate, (v) Sexually active prior to DM diagnosis, (vi) Diagnosed with type I or type II DM. Individuals with psychiatric/neurological health issues, neuropathy, postmenopausa, or communication barriers were excluded from the study. Of the 171 individuals invited to participate in the study, 5 were excluded due to the presence of neuropathy, and 8 women were excluded as they were in the postmenopausal period. Additionally, 18 individuals withdrew from the study during the data collection phase, as they did not wish to respond to questions related to sexuality. Consequently, the study was completed with 140 individuals.

### *Data Collection Tools*



### *The Individual Information Form*

In line with the literature,<sup>14,19,20</sup> the form was developed by the researchers. This form includes items related to the participants' socio-demographic characteristics, DM-related features, questions specific to their sexual lives, and metabolic parameters obtained during their routine check-ups.

### *The New Sexual Satisfaction Scale (NSSS)*

The validity and reliability of the NSSS were established by Štulhofer et al.,<sup>22</sup> and its Turkish adaptation was performed by Tuğut.<sup>23</sup> Developed to measure sexual satisfaction, the scale is a 5-point Likert-type instrument consisting of 20 items. The minimum and maximum possible scores on the scale are 20 and 100, respectively. The scale comprises two subdimensions: “Ego-centered” (Items 1–10) and “Partner- and sexual activity-centered” (Items 11–20). Higher scores on the scale indicate greater sexual satisfaction.<sup>22,23</sup> The Cronbach's alpha coefficient for NSSS was reported as 0.94 in the original study,<sup>22</sup> 0.94 for women and 0.95 for men in the Turkish adaptation,<sup>23</sup> and 0.96 in the current study.

### *The Diabetes Self-Management Questionnaire (DSMQ)*

The validity and reliability of the Diabetes Self-Management Questionnaire (DSMQ) were established by Schmitt et al.,<sup>24</sup> and its Turkish adaptation was conducted by Eroğlu and Sabuncu.<sup>25</sup> The DSMQ aims to examine the relationship between diabetes self-management and glycemic control by assessing the individual's situation over the past eight weeks. The scale provides scores ranging from 0 to 10, calculated using a specific formula. The DSMQ consists of 16 items and follows a 4-point Likert structure. It includes four subdimensions: “Glucose management”, “Diet control”, “Physical activity”, and “Healthcare use”. Nine items on the DSMQ are reverse-scored. Higher scores closer to 10 indicate better diabetes self-management.<sup>24,25</sup> The Cronbach's alpha coefficient for DSMQ was reported as 0.84 in the original study,<sup>24</sup> 0.85 in the Turkish adaptation,<sup>25</sup> and 0.79 in the current study.

### *Data Collection*

Data were collected by the researchers through face-to-face interviews using the “Individual Information Form” and the scales. The completion time for the data collection tools was approximately 15–20 minutes. To ensure the privacy of the participants, an appropriate interview environment was arranged. The researchers thoroughly explained the data collection forms to the individuals with DM, and clarifications were provided for any unclear expressions. The data collection process was completed between September 2023 and August 2024.

### *Ethical considerations*

Necessary permissions for the study were obtained from the Ankara Yıldırım Beyazıt University Ethics Committee for Health Sciences (Date: 14.06.2023, No: 06-309) and a Public Hospital affiliated with the Ankara Provincial Health Directorate of the Ministry of Health (Date: 31.08.2023, No: 223359448). Before the data collection process began, participants were informed about the purpose of the study. It was explained to them that their participation was voluntary and that they had the right to withdraw from the study at any stage. The study was conducted in accordance with the principles of the Helsinki Declaration.

### *Data Analysis*

The data were analyzed using IBM SPSS 27.0 and R-Project software packages. The Shapiro-Wilk normality test was employed to assess whether the variables followed a normal distribution, and parametric tests were used accordingly. The Levene test was utilized to evaluate the homogeneity of variances. Descriptive data were analyzed using frequency, percentage, mean, and standard deviation. Student t test and One Way ANOVA test were used in independent groups. Dunn Bonferroni Test was used to determine which group caused the difference in three or more groups. Pearson correlation analysis was used to evaluate the relationship between scale scores. To identify the factors influencing NSSS scores, certain independent variables that were statistically significant (fasting blood glucose (FBG), alcohol use, partner relationship satisfaction, and DSMQ) were included in the regression model (Figure 1). Based on Variance Inflation Factor (VIF) values ( $VIF < 10$ ), it was confirmed that there was no multicollinearity issue among the independent variables. This ensured that the regression model's assumptions were sufficiently met, allowing for reliable interpretations and conclusions. A significance level of  $p < 0.05$  was accepted for all statistical tests.

## **Results**

In this study, the mean age of individuals with DM was  $38.27 \pm 7.29$  years. 65.0% of individuals with DM had university-level education or higher. 20% of the individuals reported alcohol consumption. Additionally, 52.1% of the individuals had type II DM. The participants' mean FBG from the last three measurements was  $130.90 \pm 36.54$ . Furthermore, 61.4% of the individuals expressed satisfaction with their partner relationship. 41.4% of individuals with DM reported a decrease in their sexual satisfaction compared to before the diagnosis of diabetes (Table 1). In addition to diabetes, the presence of chronic diseases among participants was assessed. It was determined that 31 individuals had an additional chronic condition, including hypertension ( $n=16$ ), thyroid disorders ( $n=12$ ), epilepsy ( $n=2$ ), and asthma ( $n=1$ ). Additionally, 47.9% ( $n=67$ ) of the participants were smokers.

**Table 1.** Distribution of socio-demographic, health status, and sexual life characteristics of adults with diabetes (n=140)

<b>Variables</b>	<b>M±SD</b>	
<b>Age (Years)</b> (Min-Max = 20-55)	38.27±7.29	
<b>Duration of Diabetes Diagnosis (Years)</b>	11.01±8.85	
<b>HbA1c (%)</b> (n=76)	7.20±1.11	
<b>Fasting blood glucose level*</b> (n=140)	133.90±36.54	
<b>Postprandial blood glucose level*</b> (n=103)	180.26±46.07	
<b>Gender</b>	<b>n</b>	<b>%**</b>
Female	62	44.3
Male	78	55.7
<b>Educational Status</b>		
High school or below	49	35.0
University or above	91	65.0
<b>Perceived Income Status</b>		
Income equals expenses	75	53.6
Income exceeds expenses	20	14.3
Income is less than expenses	45	32.1
<b>Family Type</b>		
Nuclear family	112	80.0
Extended family	28	20.0
<b>Partner's Educational Status</b>		
High school or below	63	45.0
University or above	77	55.0
<b>Alcohol Consumption Status</b>		
Yes	28	20.0
No	112	80.0
<b>Type of Diabetes</b>		
Type I DM	67	47.9
Type II DM	73	52.1
<b>Medication Use Status</b>		
Yes	103	73.6
No	37	26.4
<b>Presence of Additional Chronic Disease</b>		
Yes	51	36.4
No	89	63.6
<b>Satisfaction with Partner Relationship</b>		
Satisfied	86	61.4
Partially satisfied	41	29.3
Not satisfied	13	9.3
<b>Sexual Desire Compared to Pre-Diabetes Diagnosis</b>		
Increased	7	5.0
Decreased	40	28.6
No change	93	66.4
<b>Sexual Satisfaction Compared to Pre-Diabetes Diagnosis</b>		
Increased	5	3.6
Decreased	58	41.4
No change	77	55.0
<b>Frequency of Sexual Intercourse Compared to Pre-Diabetes Diagnosis</b>		
Increased	10	7.1
Decreased	46	32.9
No change	84	60.0
<b>Effect of Sexual Intercourse on Blood Sugar</b>		
Hyperglycemia/Hypoglycemia	68	48.6
No effect	72	51.4

M: Mean, SD: Standard deviation. \* Mean of the Last Three FBG Measurements. %\*\*: Column percentage.

When the scale scores of individuals with DM were examined, the mean NSSS score was  $60.18 \pm 17.97$ , and the mean DSMQ score was  $5.65 \pm 1.71$  (Table 2).

**Table 2.** Distribution of scale scores (n=140)

Scales and Subdimensions	M±SD
<b>NSSS</b>	60.18±17.97
Ego-centered	30.76±9.38
Partner-and sexual activity-centered	29.43±10.17
<b>DSMQ</b>	5.65±1.71
Glucose Management	6.17±2.71
Diet Control	4.86±2.01
Physical Activity	5.07±2.80
Healthcare Use	6.15±2.40

NSSS: The New Sexual Satisfaction Scale, DSMQ: The Diabetes Self-Management Questionnaire. M: Mean, SD: Standard deviation.

The analysis revealed that individuals with DM whose partners had a university-level education or higher had significantly higher NSSS scores compared to those whose partners had a high school education or lower ( $p < 0.05$ ). Similarly, individuals with DM who consumed alcohol had significantly higher NSSS scores compared to non-drinkers ( $p < 0.05$ ). Additionally, in terms of partner relationship satisfaction, individuals who expressed satisfaction with their marriage had significantly higher NSSS scores compared to other groups ( $p < 0.05$ ). The differences in NSSS scores among groups based on changes in sexual life (sexual desire, sexual satisfaction, and frequency of sexual intercourse) were statistically significant ( $p < 0.05$ ) (Table 3).

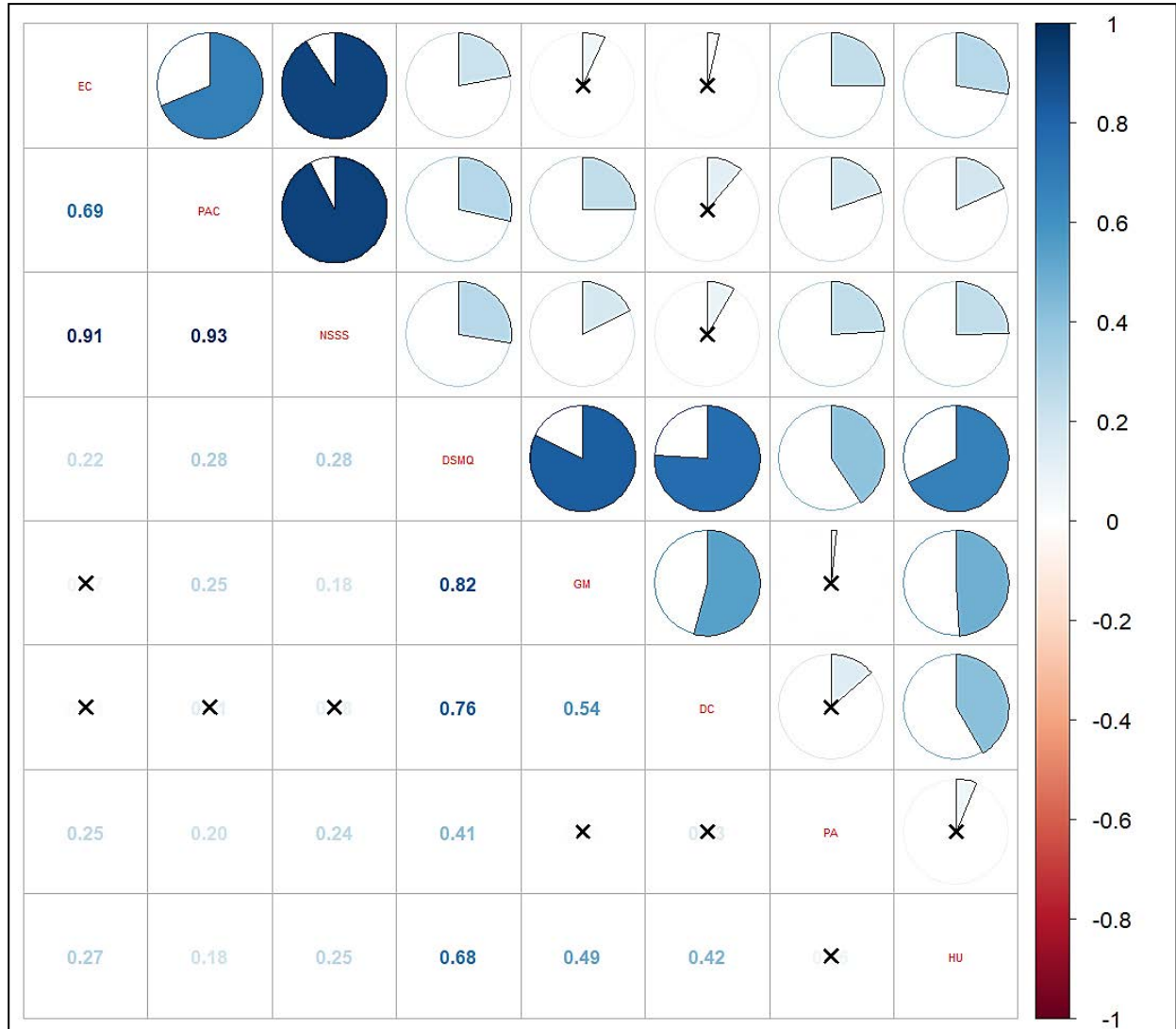
The DSMQ scores of individuals with DM were found to be significantly higher in women compared to men ( $p < 0.05$ ). Individuals diagnosed with type I DM had significantly higher DSMQ scores compared to those with type II DM ( $p < 0.05$ ). Additionally, individuals using medication had significantly higher DSMQ scores compared to those not using medication ( $p < 0.05$ ) (Table 3).

There was a weak positive correlation between NSSS and DSMQ total scores ( $r = 0.28$ ;  $p < 0.05$ ). Additionally, very weak but significant correlations were observed between NSSS and the DSMQ subdimensions of “glucose management”, “physical activity”, and “healthcare use” ( $r = 0.18$ ,  $r = 0.24$ , and  $r = 0.25$ , respectively;  $p < 0.05$ ) (Figure 1).

**Table 3.** Distribution of scale scores according to some characteristics of adults with diabetes (n=140)

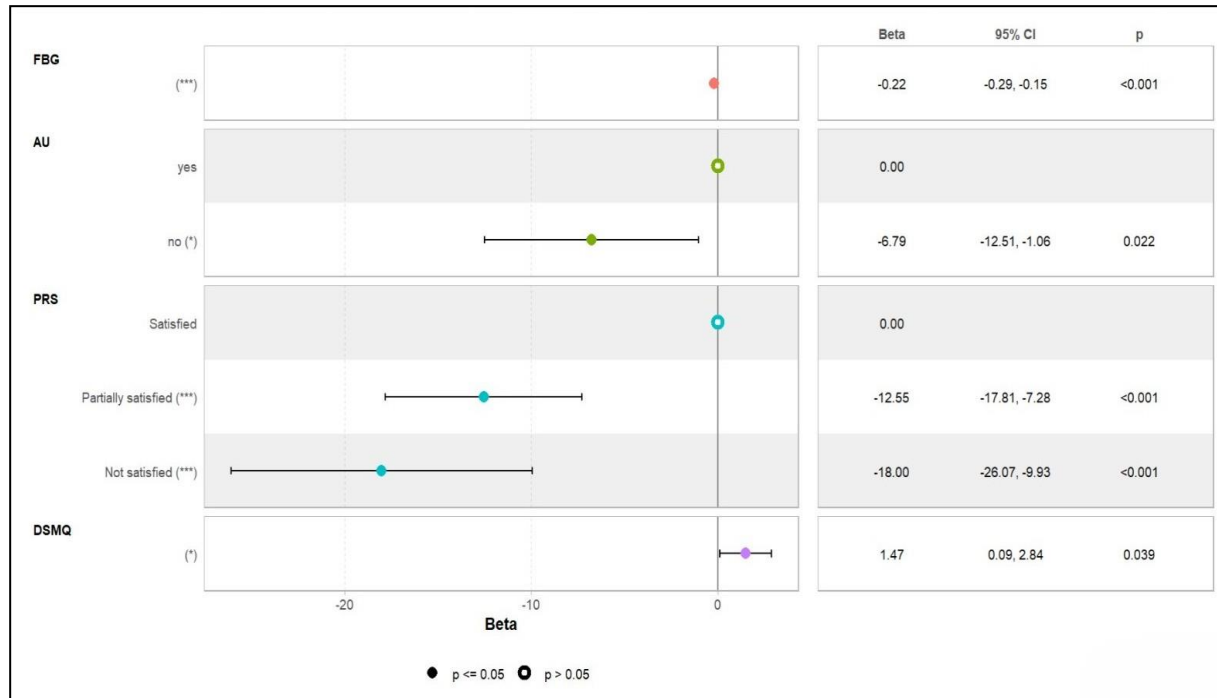
Variables	NSSS			DSMQ		
	M±SD	t/F	p	M±SD	t/F	p
<b>Gender</b>						
Female	61.19±18.27	t= 0.590	0.556	6.02±1.58	t= 2.359	<b>0.020</b>
Male	59.38±17.80			5.35±1.75		
<b>Educational Status</b>						
High school or below	56.38±15.36	t= 1.851	0.066	5.40±1.63	t= 0.395	0.205
University or above	62.23±18.99			5.78±1.74		
<b>Perceived Income Status</b>						
Income equals expenses	58.01±17.71	F=2.587	0.079	5.52±1.67	F=0.874	0.419
Income exceeds expenses	57.20±20.97			6.09±1.44		
Income is less than expenses	65.13±16.28			5.66±1.86		
<b>Family Type</b>						
Nuclear family	60.33±19.14	t= 0.259	0.797	5.75±1.69	t= 1.411	0.160
Extended family	59.57±12.43			5.24±1.75		
<b>Partner's Educational Status</b>						
High school or below	56.79±14.41	t= 2.110	<b>0.037</b>	5.43±1.53	t= 1.342	0.174
University or above	62.96±20.09			5.82±1.83		
<b>Alcohol Consumption Status</b>						
Yes	66.85±19.22	t= 2.227	<b>0.028</b>	5.91±2.08	t= 0.792	0.357
No	58.51±17.33			5.58±1.60		
<b>Type of Diabetes</b>						
Type I DM	62.52±20.67	t= 1.480	0.141	6.13±1.68	t= 3.293	<b>0.001</b>
Type II DM	58.04±14.89			5.21±1.68		
<b>Medication Use Status</b>						
Yes	59.63±18.51	t= 1.165	0.246	6.02±1.56	t= 4.567	<b>&lt;0.001</b>
No	63.13±16.22			4.62±1.70		
<b>Satisfaction with Partner Relationship</b>						
Satisfied	66.95±15.87 <sup>a</sup>	F=20.59 5	<b>&lt;0.001</b>	5.90±1.72	F=2.538	0.083
Partially satisfied	50.39±15.12 <sup>b</sup>			5.20±1.52		
Not satisfied	49.30±18.10 <sup>b</sup>			5.41±1.93		
<b>Sexual Desire Compared to Pre-Diabetes Diagnosis</b>						
Increased	59.57±14.29 <sup>ab</sup>	F=15.69 5	<b>&lt;0.001</b>	6.33±1.37	F=1.497	0.227
Decreased	48.12±16.22 <sup>a</sup>			5.31±1.62		
No change	65.41±16.49 <sup>b</sup>			5.74±1.75		
<b>Sexual Satisfaction Compared to Pre-Diabetes Diagnosis</b>						
Increased	62.60±17.27 <sup>ab</sup>	F=10.64 4	<b>&lt;0.001</b>	6.25±1.53	F=0.996	0.372
Decreased	52.52±16.55 <sup>a</sup>			5.43±1.57		
No change	65.97±17.03 <sup>b</sup>			5.78±1.81		
<b>Frequency of Sexual Intercourse Compared to Pre-Diabetes Diagnosis</b>						
Increased	60.30±12.32 <sup>ab</sup>	F=15.88 3	<b>&lt;0.001</b>	5.35±1.58	F=0.512	0.601
Decreased	49.28±16.31 <sup>a</sup>			5.50±1.59		
No change	66.14±16.68 <sup>b</sup>			5.76±1.79		
<b>Effect of Sexual Intercourse on Blood Sugar</b>						
Hyperglycemia/Hypoglycemia	60.16±17.76	t= 0.015	0.988	5.74±1.69	t= 0.653	0.515
No effect	60.20±18.28			5.56±1.72		

NSSS: The New Sexual Satisfaction Scale, DSMQ: The Diabetes Self-Management Questionnaire. <sup>a,b</sup>: The groups shown by different letters were different with respect to NSSS overall scores (Dunn Bonferroni Test). M: Mean, SD: Standard deviation.



**Figure 1.** Correlations between NSSS and DSMQ and its subdimensions (n=140)

EC: Ego-Centered, PAC: Partner- and Sexual Activity-centered, NSSS: New Sexual Satisfaction Scale, DSMQ: Diabetes Self-Management Questionnaire, GM: Glucose Management, DC: Diet Control PA: Physical Activity, HU: healthcare use



**Figure 2.** Regression model with NSSS as the dependent variables (n=140)

FBG: Fasting Blood Glucose, AU: Alcohol Use, PRS: Partner Relationship Satisfaction, DSMQ: The Diabetes Self-Management Questionnaire

According to the results of the regression analysis, FBG, alcohol consumption, and the level of satisfaction with the partner relationship were found to have significant effects on NSSS scores ( $p < 0.05$ ). A one-unit increase in FBG was associated with an average decrease of 0.22 units in NSSS scores (Beta = -0.22,  $p < 0.001$ ). Individuals who did not consume alcohol had NSSS scores that were, on average, 6.79 units lower compared to those who consumed alcohol (Beta = -6.79,  $p = 0.022$ ). The NSSS scores of individuals who were partially satisfied or dissatisfied with their partner relationships were significantly lower (Beta = -12.55 and Beta = -18.00, respectively;  $p < 0.001$ ). It was determined that as satisfaction with the partner relationship decreased, the negative impact on NSSS scores increased. In addition, DSMQ had a significant positive effect on NSSS scores; a one-unit increase in DSMQ scores resulted in an average increase of 1.47 units in NSSS scores (Beta = 1.47,  $p = 0.039$ ). This demonstrates that DSMQ has a meaningful and positive contribution to NSSS scores (Figure 2). These findings indicate that the dependent variable, NSSS, is significantly influenced by fasting blood glucose levels, alcohol consumption, and satisfaction with the partner relationship. Furthermore, DSMQ contributes significantly to improving NSSS scores.

## Discussion

DM is known to have a negative impact on sexual function in both women and men. It can affect sexual life in multiple ways, including orgasmic dysfunction, erectile dysfunction, decreased sexual desire, anxiety, and psychological issues.<sup>4,7,14,20</sup> Problems related to glycemic control in DM management can adversely affect individuals' quality of life.<sup>26</sup> In this context, sexual quality of life in DM is influenced by glycemic control and diabetes self-management.<sup>9</sup> This study identified a relationship between sexual satisfaction and diabetes self-management. Sexual satisfaction was found to be influenced not only by diabetes self-management but also by alcohol consumption, FBG levels, partner's education, and satisfaction with the partner relationship.

In this study, the NSSS ( $60.18 \pm 17.97$ ) and DSMQ ( $5.65 \pm 1.71$ ) scores of individuals with DM were found to be at a moderate level. The literature shows variability in the tools used to evaluate the sexual lives of individuals with DM, and it has been observed that sexual quality of life and sexual satisfaction scores in these individuals are relatively lower compared to the findings of this study.<sup>9,19</sup> The relatively higher NSSS scores in this study population, compared to the literature, may be explained by the younger age of the participants and the lower average age of the study group. Findings by Topaloğlu Ören et al. support this explanation, as sexual quality of life was reported to be higher in younger women with type I DM compared to those with type II DM.<sup>14</sup> In terms of diabetes self-management, the findings of this study align with the literature, showing moderate or above-moderate DSMQ scores.<sup>9,24,27</sup> Similarly, in the study by Schmitt et al. DSMQ scores for individuals with an HbA1c level of 9% or higher were consistent with the findings of this study.<sup>24</sup>

In this study, sexual satisfaction in individuals with DM was found to be associated with DSMQ and its subdimensions of "glucose management", "physical activity", and "healthcare use". This finding is further supported by the results of advanced analyses conducted in this study. As sexual satisfaction increases, diabetes self-management also improves. The findings of this study align with those of Eroğlu, who reported that as the sexual quality of life of individuals with DM improves, their perception of diabetes self-management also increases.<sup>9</sup>

One of the most significant findings related to diabetes self-management in this study is glycemic control management. Failure to maintain glycemic control in individuals with DM can lead to neurovascular changes, which in turn contribute to sexual dysfunction.<sup>5</sup> Schmitt et al. reported that individuals with DM who maintained HbA1c levels below 7.5% had higher DSMQ scores.<sup>24</sup> In the study, higher FBG levels and lower "glucose management" scores were found to be associated with reduced NSSS scores. These findings suggest that diabetes management and glycemic control have a multifaceted impact on sexual satisfaction. Additionally, factors such as gender, DM type, and medication use, which were found to be significant in this study, should be carefully considered in education and counseling programs aimed at enhancing diabetes self-management.



In this study, partner relationship satisfaction was found to be associated with higher NSSS scores. These findings, including regression analyses, suggest that individuals who are satisfied with their partner relationships have greater sexual satisfaction. Individuals who reported decreased sexual desire, satisfaction, and frequency of sexual intercourse after their DM diagnosis also had lower NSSS scores. Partner adaptation to DM, along with the need for partner support and empathy skills, significantly influences sexual life.<sup>16</sup> Mehdipour-Rabori et al. reported that sexual dysfunction in women with DM negatively affects life satisfaction and marital/partner harmony.<sup>18</sup> Kaplan Serin et al. highlighted that marital harmony enhances the quality of sexual life in women with DM and emphasized the importance of involving spouses in DM care.<sup>17</sup> The findings of this study are consistent with the literature. The inclusion of partners in care and the improvement of partner adaptation are essential to increasing partner awareness. This study also found that individuals with DM whose partners had a higher level of education reported higher sexual satisfaction, supporting the importance of partner involvement and education.

In this study, another notable finding related to sexual satisfaction was alcohol consumption. NSSS scores were lower in individuals with DM who did not consume alcohol compared to those who did, indicating that non-drinkers had lower levels of sexual satisfaction. Shettigar et al. emphasized that alcohol consumption is a factor associated with blood glucose levels.<sup>28</sup> Cui et al. suggested that occasional or light alcohol consumption might be acceptable for individuals with abnormal glucose metabolism, while excessive alcohol consumption should be avoided. However, it was also noted that DM guidelines provide limited information regarding alcohol consumption.<sup>29</sup> In this study, no data were collected regarding the daily or weekly alcohol consumption amounts of participants. Therefore, it remains unclear whether these individuals were light or heavy drinkers. Additionally, no studies were found that specifically examined the relationship between alcohol consumption and sexual life.

The study has four limitations. The first limitation is that the sample group consists of individuals with DM who attended the hospital where the study was conducted; thus, the results can only be generalized to individuals receiving services from these centers. The second limitation is that the responses provided in the data collection forms are based on participants' self-reports. Some individuals with DM had difficulty recalling their HbA1c, FBG, and postprandial blood glucose values. The third limitation is that, due to the inclusion of questions about sexual life, some individuals chose not to participate in the study. The fourth limitation was that the amount of alcohol consumption was not questioned.

Sexual life in individuals with DM is influenced by diabetes self-management. Factors such as glucose management, physical activity, healthcare utilization, and FBG levels, which are associated with diabetes self-management, are among the key determinants of sexual satisfaction in individuals with DM. Additionally, satisfaction with partner relationships is another significant determinant of sexual satisfaction in this

population. In this context, issues related to sexual life, as a critical determinant of health, should also be addressed in education and counseling services provided to individuals with DM. Healthcare professionals, particularly nurses, should contribute to raising awareness about the impact of DM on sexual health as part of DM management. Additionally, future research is needed to explore the impact of alcohol consumption levels and glycemic control on sexual life.

**Ethical Considerations:** : Approval for our study was obtained from the Ankara Yıldırım Beyazıt University Ethics Committee for Health Sciences (Date: 14.06.2023, No: 06-309). The study was conducted following the principles of the Declaration of Helsinki.

**Conflict of Interest:** The authors declare no conflict of interest.

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## Review

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# DIGITAL TRANSFORMATION OF CLINICAL EDUCATION THROUGH ARTIFICIAL INTELLIGENCE: A STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS (SWOT) ANALYSIS

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## Abstract

This review article examines the impact of Artificial Intelligence (AI) on the digital transformation of clinical education through a comprehensive SWOT (strengths, weaknesses, opportunities, and threats) analysis. AI offers several strengths, including innovative learning strategies through simulations and virtual patients, personalized learning paths, advanced clinical training, and enhanced communication skills. However, AI faces weaknesses such as a lack of transparency, potential for misinformation, limited curriculum integration, and access inequality. Opportunities include managing information overload, providing real-time feedback, supporting multiple languages, and generating clinical scenarios. Threats include misinformation and bias, overdependence on AI, privacy concerns, lack of human interaction, and access inequality. Addressing these challenges is critical to fully realize AI's potential in medical education.

**Keywords:** Artificial intelligence, medical education, digital health, clinical skills, patient simulation.

## Introduction

Traditional medical education often follows a teacher-centric approach, where content and learning pace are primarily determined by instructors, leading to passive student engagement and limited personalization. Integrating artificial intelligence (AI) in medical education revolutionizes traditional learning methods by offering innovative solutions that enable more personalized and efficient medical education.<sup>1</sup> (Table 1)

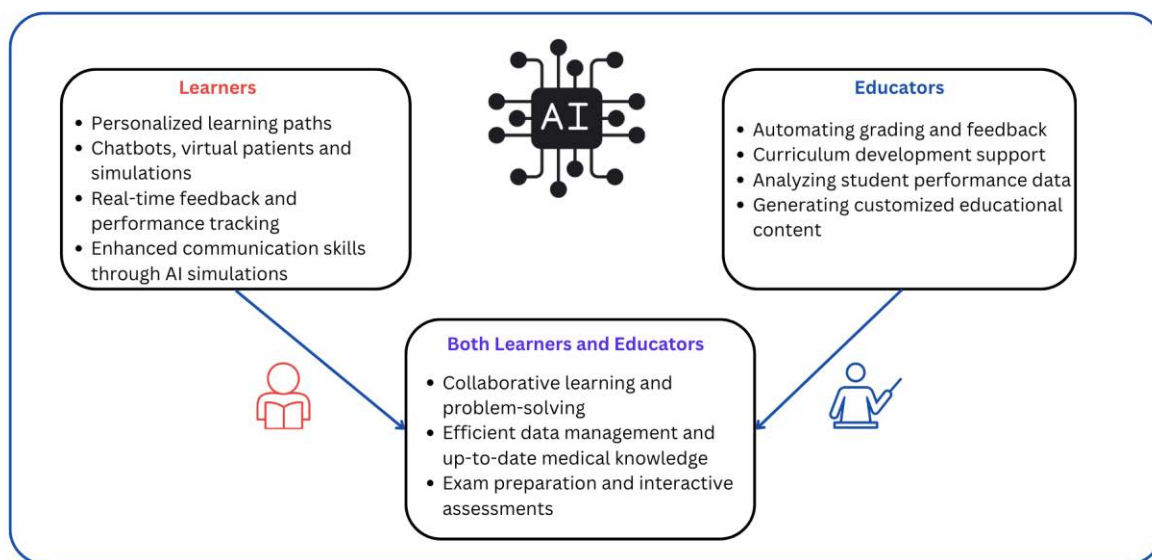
**Table 1.** Comparison of Traditional vs. AI-Driven Medical Education Methods

Aspect	Traditional Methods	AI-Driven Methods
<b>Scalability</b>	Limited to classroom size and instructor availability	Highly scalable across large groups with flexible access
<b>Personalization</b>	One-size-fits-all approach with limited customization	Tailored learning paths based on individual student needs
<b>Feedback</b>	Delayed and dependent on educator availability	Real-time, automated feedback through AI systems
<b>Access to Diverse Scenarios</b>	Limited exposure to rare cases due to resource constraints	Ability to simulate rare, complex, and diverse cases
<b>Accessibility by Students</b>	Restricted by location and time; in-person attendance required	Accessible anytime, anywhere with internet access, supporting flexible learning
<b>Interactivity and Engagement</b>	Primarily passive learning through lectures	Highly interactive, immersive learning experiences through simulations and virtual patients
<b>Availability of Resources</b>	Limited by faculty availability and physical resources	Vast digital resources accessible to students at their convenience

AI enhances knowledge acquisition, skill development, and understanding of complex medical concepts through personalized learning paths, real-time feedback, and immersive simulations of clinical scenarios for learners. AI tools streamline curriculum development, automate grading and assessments, and offer data-



driven insights into student performance, allowing for more targeted and effective teaching strategies for educators.<sup>2,3</sup> (Figure 1)



**Figure 1.** AI Applications in Medical Education for Learners and Educators

As conversational agents, chatbots have become increasingly prominent in medical education, offering students instant access to information, personalized guidance, and interactive learning experiences that complement traditional teaching methods. These chatbots can be designed to follow predetermined flows (rule-based) or be powered by AI.<sup>4</sup> Traditional rule-based chatbots have been used in medicine for several years, primarily offering scripted responses and limited interaction capabilities. However, the advent of AI and large language models (LLMs) marked a significant leap forward.<sup>5</sup> LLMs are advanced AI systems trained on extensive datasets, including vast amounts of online content, enabling them to generate natural, human-like text and other outputs. These models, with their sophisticated natural language processing (NLP) capabilities, are precious in medical education.<sup>6</sup> Widely known LLMs include ChatGPT (OpenAI), Palm (Google), and LLaMA (Meta).<sup>7</sup> These models have been increasingly integrated into healthcare to provide general information, support decision-making, aid in diagnostic processes, improve practical skills, and evaluate student performance; however, further research with rigorous validation is needed to identify the most effective AI tools for medical education.<sup>8</sup> Ai-driven educational chatbots, often deployed online, offer an innovative approach to delivering education by providing instant responses and engaging students in interactive learning activities.<sup>9</sup> This personalized interaction enhances the learning experience and allows educators to focus more on curriculum development and research, thus promoting a more efficient and effective educational process.<sup>10</sup>

Simulations and virtual patients (VPs) are critical components in modern medical training.<sup>11,12</sup> They provide a controlled, interactive environment where students can practice clinical skills. AI-driven technologies, such as NLP and machine learning, enable the creation of sophisticated virtual patients that can mimic real-life patient interactions. These tools are precious in enhancing diagnostic skills and improving patient communication.<sup>13</sup> In these simulations, learners act as healthcare providers, gathering information, suggesting diagnoses, and managing patient care. Virtual patients allow medical students to practice communication and clinical reasoning skills in an immersive, interactive environment that replicates real-life medical scenarios.<sup>3</sup>

This article aims to explore the impact of AI on the digital transformation of clinical education by conducting a comprehensive SWOT (strengths, weaknesses, opportunities, and threats) analysis, focusing on how AI-driven tools enhance personalized medical training, address current educational challenges, and shape the future of healthcare learning environments.

## Materials and Methods

To establish a comprehensive foundation for the SWOT analysis on the transformation of clinical education through artificial intelligence, an exhaustive literature review was conducted using PubMed. The search was performed in PubMed using the query [Title/Abstract]: (medical education) OR (medical training) AND (artificial intelligence). This search strategy yielded 737 relevant articles. The articles were screened based on relevance to the intersection of medical education and artificial intelligence. Articles that were outdated or did not contribute significantly to the focus of the study were excluded. Key information, including significant findings, theoretical frameworks, and pertinent factors for the SWOT analysis, was systematically extracted from the selected articles. The extracted data was critically analyzed and categorized into the SWOT themes strengths, weaknesses, opportunities, and threats. This synthesis facilitated the identification of primary factors influencing the integration of AI in clinical education.

## SWOT Analysis

The key points of the SWOT analysis for AI in medical education are presented in Table 2.

**Table 2.** The key points of SWOT analysis for AI in medical education

Strengths	Opportunities
<ul style="list-style-type: none"> <li>- New Education Strategies: AI Simulation and VPs</li> <li>- Personalized Medical Education</li> <li>- Advanced Clinical Training and Skill Development</li> <li>- Enhanced Communication Skills</li> <li>- Assisting Exam Preparation</li> <li>- Accessibility and Equality</li> </ul>	<ul style="list-style-type: none"> <li>- Management of Information Overload</li> <li>- Multidisciplinary Approach</li> <li>- Multi-Language Support</li> <li>- Clinical Scenario Generation</li> <li>- Real-Time Feedback</li> <li>- Retrieval-Augmented Generation (RAG)</li> </ul>
Weaknesses	Threats
<ul style="list-style-type: none"> <li>- Black Box Against Transparency</li> <li>- Artificial Hallucination and Inaccurate Citation</li> <li>- Limited Up-to-Date Information</li> <li>- Limited Integration in the Medical Curriculum</li> <li>- Limited Evaluation in Specific Areas</li> </ul>	<ul style="list-style-type: none"> <li>- Bias and Misinformation</li> <li>- Overdependence</li> <li>- Privacy and Ethical Concerns</li> <li>- Lack of Human Interaction and Emotions</li> <li>- Access Inequality</li> </ul>

### Strengths

#### *Novel Learning Strategies: AI-powered Simulation and Virtual Patients*

Integrating AI in simulation-based education offers innovative learning strategies that are transforming medical training. AI-driven simulations, including high-fidelity mannequins and virtual patients, have proven essential in enhancing safety and quality across various industries, especially healthcare.<sup>14</sup> These simulations can replicate real-life scenarios, including rare and complex cases, allowing students to practice repeatedly without posing risks to real patients. Immediate feedback these simulations provide further supports skill development and knowledge retention.<sup>15</sup>

For instance, a study utilizing a 'no-code' generative AI platform to create virtual patient avatars found that 87% of trainees rated the tool as intuitive and accurate, highlighting its potential for specialized medical training.<sup>16</sup> The ability to tailor these simulations to specific medical specialties provides realistic practice scenarios that enhance learning outcomes. In dental education, AI tools are increasingly used to refine procedural training and improve diagnostic accuracy, offering a controlled and safe environment for students to hone their skills.<sup>15</sup> In surgical training, AI-enhanced simulations, such as robot-assisted surgery training and virtual reality platforms, allow students to master complex techniques and decision-making skills, effectively preparing them for real-world surgical procedures.<sup>17</sup> Radiology education also benefits significantly from AI, with AI-powered systems assisting in image interpretation pattern recognition and providing automated feedback to trainees, thereby improving diagnostic skills and clinical readiness.<sup>18</sup> These advancements underscore the transformative potential of AI in medical education, offering personalized, immersive, and compelling learning experiences across diverse medical fields. The continued integration of AI-driven simulations will be critical in shaping the future of healthcare training.

AI-driven gamification is increasingly recognized as an effective tool in medical education, combining game elements like rewards and challenges with immersive learning. For example, a pilot study using virtual reality (VR) and gamification for training new nurses on responding to respiratory decline in infants showed promising results, with learners responding better to VR compared to traditional methods.<sup>19</sup>

#### *Personalised Medical Education*

AI tools are crucial in personalized medical education by adapting to each student's unique learning needs and pace, offering a more tailored and practical learning experience.<sup>20</sup> For instance, AI-driven platforms like ChatGPT can be utilized to create virtual tutors or assistants that provide personalized support by answering questions and helping with homework. This addresses the challenge teachers often face in designing study plans and learning resources that cater to students' diverse learning styles and abilities within a classroom environment.<sup>21</sup> The personalized approach AI offers can significantly enhance educational outcomes by providing more engaging learning experiences that are responsive to individual needs. A systematic review found that chatbots in education can effectively personalize learning activities, support educators, and gain deep insights into students' learning behaviours. Additionally, ChatGPT's ability to tailor content to individual learners facilitates a more interactive and practical learning environment, enabling students to understand complex medical concepts better and apply them in clinical practice.<sup>4,22</sup>

### *Advanced Clinical Training and Skill Development*

AI integration in medical education has improved diagnostic accuracy and procedural skills, with chatbots like ChatGPT demonstrating high levels of consistency and insightful explanations. These capabilities make them valuable resources for medical education and clinical decision-making.<sup>4,23</sup>

While effective, traditional standardized patient (SP) encounters are often costly and time-intensive. The rise of telemedicine and virtual SP encounters presents a more accessible and efficient alternative, enabling residents to practice clinical skills in a controlled and simulated environment. AI-driven simulations further enhance these opportunities by providing scalable, cost-effective training tailored to meet individual learning needs, ultimately improving the quality and accessibility of medical education.<sup>24</sup>

Moreover, AI simulations are instrumental in training students to manage patients with undifferentiated symptoms where the diagnosis is not immediately clear. This capability is crucial for developing the skills to conduct thorough assessments and consider multiple potential diagnoses.<sup>13,25</sup>

Additionally, recent research, such as a 2023 protocol focused on AI in wound care education, underscores the importance of leveraging AI to optimize patient outcomes through enhanced educational strategies.<sup>26</sup> Exposure to various clinical conditions through AI-powered simulations can help bridge training gaps and improve students' diagnostic skills, better preparing them for real-world medical challenges.

### *Enhancing Communication Skills*

The importance of diverse communication strategies in medical education cannot be overstated, particularly when training involves interactions with varied patient personalities. Research consistently shows that communication skills are a core physician competency that directly influences patient outcomes, including recall, adherence to therapy, and overall patient satisfaction.<sup>27</sup> AI simulations provide diverse and realistic case scenarios, offering students opportunities to improve their communication skills while practicing clinical decision-making.<sup>28</sup> Through AI-simulated patients, learners can engage in authentic clinical interactions, allowing them to effectively develop their bedside manner and patient engagement strategies. Research has shown that VPs are particularly useful in enhancing communication skills, including nonverbal communication, by responding dynamically to users' emotional states and promoting deeper engagement.<sup>29</sup>

A recent study explored the innovative use of AI chatbots, specifically ChatGPT, in training physicians to deliver bad news—a critical skill in fields like emergency medicine. By offering detailed prompts to the AI chatbot, educators were able to create realistic clinical scenarios, facilitate active roleplay, and provide real-time feedback to trainees. The results demonstrated that ChatGPT could successfully simulate a training

environment using the SPIKES framework for delivering bad news and offering clear and structured feedback. This proof-of-concept study highlights the significant potential of AI chatbot technology to contribute to graduate medical education by offering new opportunities for skill development and interactive learning.<sup>30</sup>

#### *Accessibility and Equality in Medical Education*

AI-driven technologies have the potential to bridge gaps in accessibility and promote educational equality in medical training. The rise of telemedicine encounters provides a more accessible and efficient alternative to traditional clinical training, allowing residents to practice clinical skills in a controlled, simulated environment. This approach is particularly beneficial when access to physical training resources is limited. A comprehensive review of 80 articles highlights that educational chatbots have been successfully applied in diverse fields such as health advocacy, language learning, and self-advocacy.<sup>31</sup> Studies indicate that chatbots enhance student engagement and motivation and provide immediate, personalized assistance, making education more inclusive and accessible. Their applications extend beyond basic interactions, offering features like answering frequently asked questions, conducting short quizzes, providing scaffolding, and recommending targeted learning activities.<sup>4</sup> Furthermore, AI tools can be instrumental in patient education by creating customized, easy-to-understand materials tailored to different literacy levels and languages. By improving both clinical training and patient education, these advancements offer a pathway to more efficient and effective healthcare delivery.<sup>32</sup> By offering these capabilities, AI tools ensure that learners from various backgrounds can access high-quality educational resources, contributing to a more equitable learning environment.

#### *Assisting Exam Preparation*

AI-driven tools like chatbots and language models have shown the potential to support medical students' exam preparation and performance. Although current chatbots are still limited in consistently generating reliable board-style questions and clinical assessments, future developments could focus on creating customizable clinical vignettes that mimic USMLE or specialty exam formats. These tools would provide interactive, real-time feedback, helping students identify areas of strength and weakness.<sup>32</sup> For instance, studies have demonstrated that ChatGPT can perform at or near the passing threshold for the USMLE, indicating its utility in preparing for high-stakes exams.<sup>23</sup> Additionally, ChatGPT has been tested on advanced specialty exams and performed successfully, showing its capability in postgraduate education as well.<sup>33</sup> The tool has also proven useful for undergraduate medical education, particularly in addressing higher-order reasoning questions in subjects like biochemistry.<sup>34</sup> (4). Beyond traditional exams, ChatGPT supports continuous medical education for practicing clinicians by offering up-to-date, evidence-based information to enhance decision-making and patient care.<sup>35</sup> Furthermore, the platform facilitates self-directed learning by adapting to students' needs, guiding them through complex scenarios, and reinforcing understanding through conversations.<sup>36,37</sup>

## Weaknesses

### *Blackbox Against Transparency*

One of the primary concerns with AI in education is the "black box" nature of these technologies, particularly with deep learning models.<sup>38</sup> These systems often lack transparency in their decision-making processes, making it difficult for users to understand how specific conclusions are reached. This lack of clarity can lead to frustration and discomfort, as students and educators cannot verify the reasoning behind specific outputs or decisions. In educational contexts, where transparency and trust are crucial for creating a positive learning environment, without insight into why an AI system arrived at a particular conclusion, students may struggle to trust the feedback, which can diminish the educational value and overall effectiveness of these technologies.<sup>17,39</sup> (2, 3). For AI to be fully integrated into education, especially in fields like medicine, it is essential to prioritize transparency, ensuring that users can understand and validate the underlying processes that inform AI-generated outcomes.

### *Artificial Hallucination and Inaccurate Citation*

One of the key weaknesses of AI in medical education is the occurrence of "artificial hallucination," where AI systems generate responses that are either factually incorrect or entirely fabricated while delivering them with a high degree of confidence.<sup>40</sup> These misleading outputs can be particularly problematic because they are often presented convincingly, making it difficult for users to distinguish between correct and erroneous content. This risk becomes significant when students rely heavily on AI-generated information, potentially leading to the spread of inaccuracies in their learning. Additionally, AI-powered chatbots face challenges in providing reliable citations. The tendency of some AI systems to produce fabricated references or incomplete sources undermines academic integrity and poses risks to students who may unknowingly incorporate false information into their work.<sup>32</sup> For AI to be more effective in educational settings, it must be equipped to reference credible, evidence-based sources consistently. To mitigate these risks, AI tools should be designed to adhere to ethical and scientific standards, ensuring the accuracy of their outputs.

### *Lack of up-to-date information*

A significant weakness of current AI technologies, including chatbots and large language models like GPT-4, is their reliance on static datasets. These models are trained on data that is current only up to a specific cutoff date, meaning they do not have access to the latest research or developments that occur after their last update. This limitation generates outdated or scientifically inaccurate information, which can be problematic in fields like medicine, where staying up-to-date is critical. Therefore, AI-generated content must be carefully reviewed and verified before use to avoid disseminating obsolete or incorrect information.<sup>41</sup>

### *Limited Integration of AI in Medical Curriculum*

Despite the growing relevance of AI in healthcare, it remains underrepresented in the medical curriculum, giving students limited opportunities to deeply engage with the subject and develop essential expertise.<sup>42</sup> Dartmouth Medical School has introduced an AI patient app to help students practice interviewing skills, demonstrating how AI can enhance traditional medical education methods.<sup>43</sup> A multi-center study conducted in Turkey revealed that while most medical students perceive AI as a tool that could improve access to healthcare and reduce errors, only 6% felt competent to inform patients about AI applications, highlighting significant educational gaps. The study emphasized the urgent need to restructure medical curricula to equip future physicians with the knowledge and skills necessary for effectively using AI while addressing ethical concerns and preserving professional values.<sup>44</sup> While some institutions have made strides in incorporating AI into their programs, such initiatives are still not widespread. A recent study outlined key competencies that medical graduates need to be prepared for the implications of AI, further emphasizing the importance of integrating AI education into medical curricula.<sup>45</sup> To fully prepare the next generation of healthcare professionals, medical education must evolve to include comprehensive AI training, ensuring that students are equipped with the knowledge and skills necessary to navigate an increasingly technology-driven healthcare environment.

### *Limited Evaluation in Specific Areas*

While AI is promising to transform medical education, its evaluation and effectiveness in certain areas remain limited. For instance, Project TOUCH integrates advanced technologies like virtual reality and AI to enhance problem-based learning in medical education.<sup>46</sup> However, the study primarily focused on an ongoing project. It lacked empirical data comparing the effectiveness of AI-enhanced virtual patient simulations to traditional paper-based case tutorials, revealing a significant research gap.<sup>47</sup> Moreover, despite advancements in AI simulations in specialized fields such as surgery and dentistry, primary care has yet to see widespread adoption of these technologies. Expanding AI simulations into primary care could provide substantial benefits, such as improving training for common conditions and enhancing diagnostic accuracy. By simulating complex and undifferentiated patient scenarios, AI can help students develop well-rounded clinical skills and better prepare for real-world practice.<sup>48</sup> Addressing these evaluation gaps is crucial for the broader implementation and optimization of AI tools across various medical disciplines.



## Opportunities

### *Management of Information Overload*

In today's rapidly evolving medical landscape, the sheer volume of medical information is expanding at an unprecedented rate, making it increasingly difficult for healthcare professionals to stay updated. AI has the potential to alleviate these challenges by efficiently processing large amounts of data and supporting physicians in making informed decisions.<sup>8</sup> Integrating LLMs into medical education offers real-time, interactive access to vast reservoirs of medical knowledge tailored to the learner's level. These tools assist in answering clinical questions, suggesting differential diagnoses, generating educational materials, and enhancing the understanding of complex medical concepts.<sup>49</sup> Given the challenge of staying current with rapidly advancing medical literature, LLM tools like ChatGPT can integrate AI text classifiers to help students and educators quickly identify relevant research, categorize extensive scientific data, and generate concise summaries. These features support continuous learning and ignite interest in specific research areas. Furthermore, chatbots offer personalized assistance by acting as interactive tutors, guiding students through challenging concepts, automating the creation of study materials such as flashcards, and developing memory aids like mnemonics. This personalized support enhances active recall and retention of key information, making AI a powerful tool in modern medical education.<sup>32</sup>

### *Realtime Feedback*

AI-powered educational platforms are revolutionizing how feedback is delivered in medical training by providing real-time, automated insights crucial for skill development. One such example is the Virtual Operative Assistant, an educational tool designed to offer automated feedback on surgical performance by aligning with expert proficiency benchmarks. This system has shown high accuracy, specificity, and sensitivity in distinguishing between skilled and novice participants during neurosurgical tasks, making it an effective formative tool in surgical education.<sup>17</sup> Combining expertise classification, objective feedback, and instructor input creates a comprehensive learning environment that supports the integration of AI and virtual reality simulations in medical education. Future advancements in this area will likely refine these feedback systems and broaden their application across various levels of medical expertise.

Additionally, AI-driven intelligent tutoring systems (ITSs) are increasingly used in medical education to mimic the benefits of one-on-one human tutoring. These systems analyze extensive data related to a student's performance, learning style, and progress, allowing them to identify gaps in knowledge and provide personalized learning experiences. ITSs can adapt their teaching strategies in real-time, offering customized feedback, diagnosing strengths and weaknesses, curating relevant learning materials, and facilitating collaborative learning among students.<sup>3</sup> By emulating the behaviour of skilled human tutors, AI-based ITSs

enhance the learning process, making medical education more responsive and tailored to individual needs. The continued integration of real-time AI-driven feedback systems in medical education promises to create more personalized, effective, and adaptive learning experiences that can significantly improve both knowledge acquisition and skill mastery.

#### *Multi-language support*

One of the key strengths of generative AI tools is their ability to support multiple languages, significantly improving accessibility for non-native English speakers. These tools can communicate in several languages beyond English, offering a more inclusive learning environment compared to earlier chatbots. However, the effectiveness of this multi-language capability varies depending on the quality and quantity of training data available for each language.<sup>50</sup> By facilitating translation and correction of scholarly work, AI tools help reduce language barriers, allowing research from non-native English-speaking countries to be evaluated more equitably alongside work from native speakers.<sup>51</sup> This enhanced accessibility contributes to a more diverse and inclusive academic environment, ensuring that language differences do not hinder global collaboration and knowledge-sharing in medical education.<sup>52</sup>

#### *Clinical Scenario Generation*

AI-generated clinical case vignettes present a promising opportunity to streamline the creation of diverse and inclusive medical training scenarios. Traditionally, developing clinical vignettes has been resource-intensive and time-consuming, requiring significant expertise. However, with the advent of AI tools like ChatGPT and image generators, educators can now automate the production of a wide variety of clinical scenarios that are both realistic and customizable, significantly reducing costs and time.<sup>53</sup> This capability allows for the rapid generation of large volumes of clinical vignettes that better represent varied patient populations, addressing common biases and enhancing the realism of medical education.<sup>21</sup> Moreover, research has demonstrated the effectiveness of AI in creating realistic virtual standardized patient dialogues. For example, studies focusing on scenarios like prenatal counseling have shown that AI can expand virtual patient programs by generating diverse and engaging patient interactions that improve the quality of medical training.<sup>54</sup> By leveraging AI in clinical scenario generation, educators can provide students with broader clinical experiences, better preparing them for real-world decision-making and patient care.

#### *Citation-Based Response Generation*

While current AI-driven chatbots still face limitations due to their reliance on diverse internet sources, they hold significant potential for future refinement in clinical applications. AI-powered tools could be enhanced to deliver evidence-based, scenario-specific information in a conversational format, making complex medical

concepts more accessible and supporting better clinical decision-making.<sup>32</sup> These tools can also serve as quick references for medication guidelines, drug interactions, and treatment protocols, streamlining the learning process for students. As chatbots become more integrated with electronic medical records, they could assist in generating consistent medical documentation while still encouraging critical thinking and decision-making skills among students. The development of citation-based response generation within AI tools can lead to more accurate, reliable, and educationally beneficial resources for both students and educators.

#### *Retrieval-augmented generation (RAG)*

The integration of advanced AI techniques like retrieval-augmented generation (RAG) offers significant benefits in medical education by improving both the accuracy and relevance of AI-generated content. Unlike traditional models that rely solely on pre-existing training data, RAG retrieves information from external databases before generating responses, grounding its output in the most up-to-date and verified sources. This reduces the risk of AI hallucinations, ensuring students receive accurate and reliable information.<sup>55</sup> By incorporating RAG, educators can enhance learning experiences with detailed, real-world case studies that are directly relevant to complex medical topics like electrolyte imbalances in chronic kidney disease (CKD). Accessing current case reports and clinical scenarios enriches the curriculum, making it more interactive, evidence-based, and aligned with current medical practices.<sup>56</sup> As a result, students are better equipped to apply theoretical knowledge in real-world contexts, thereby enhancing their preparedness for medical careers.

#### *Multidisciplinary Approach*

In medical education, fostering a multidisciplinary perspective is crucial for preparing healthcare professionals to navigate complex, real-world scenarios. RAG's ability to draw insights from various medical disciplines makes it a valuable tool for this purpose. For example, when teaching conditions like chronic obstructive pulmonary disease (COPD) complicated by heart failure, RAG can integrate knowledge from pulmonology, cardiology, and pharmacology, providing a comprehensive understanding of how different body systems interact. This holistic approach helps students appreciate the importance of interdisciplinary collaboration in patient care, enhancing their critical thinking and decision-making skills. By incorporating multiple perspectives into case-based learning, educators can prepare students to manage complex cases effectively and develop the collaborative mindset necessary in modern healthcare.<sup>56</sup>

## Threats

### *Misinformation and Bias*

One of the significant threats associated with AI models in medical education is the potential for misinformation and algorithmic bias. AI models, including LLMs like GPT-4, are often trained on datasets that may inherently contain biases, reinforcing stereotypes and social biases. These biases can have serious implications for medical education, affecting the quality and fairness of student training.<sup>21</sup> Ensuring that AI models are trained on diverse and accurate datasets and incorporating rigorous validation mechanisms are crucial to mitigating these risks. Addressing misinformation and bias is essential to fully realize the benefits of AI in medical education while minimizing potential harm.<sup>50,57</sup>

### *Overdependence*

Overreliance on AI models in medical education presents a significant threat, especially when misinformation is convincingly delivered. Despite ongoing advancements, models like GPT-4 can still generate incorrect or misleading information, which poses a risk if students and educators accept these outputs without proper verification.<sup>16</sup> This dependence on AI tools can undermine the development of essential skills in medical students, such as critical thinking, problem-solving, and effective communication. The convenience of AI-provided answers might reduce students' motivation to engage in independent research and draw their conclusions. As a result, students could miss opportunities to cultivate analytical skills that are crucial in medical practice.<sup>50</sup>

### *Privacy and Ethical Concerns*

The development of AI algorithms typically requires vast amounts of data, raising ethical issues related to patient consent, data privacy, and security. In particular, handling sensitive patient data in educational contexts introduces complex challenges that demand strict adherence to regulatory and ethical guidelines. Privacy concerns extend to the risks associated with AI's ability to manage sensitive student and patient data, which could lead to significant data breaches or misuse if not properly managed.<sup>8</sup> Safeguarding patient privacy requires robust data protection measures and strict regulatory compliance. Additionally, the potential for AI to generate errors or biases in data presents a unique challenge, as these mistakes could impact both educational content and clinical decision-making.<sup>58</sup>

Another key ethical issue is the balance between AI-driven efficiency and human oversight. While AI offers substantial benefits in automating educational processes, there remains a critical need for human verification and the ability to identify and correct errors generated by AI systems. Ensuring transparency, accountability, and the ethical use of AI tools necessitates establishing clear guidelines and regulatory frameworks. This includes addressing the risks of algorithmic bias, ensuring data accuracy, and maintaining the ethical standards that underpin medical education.<sup>1</sup> Addressing these privacy and ethical challenges is crucial to ensuring the responsible use of AI in medical education while maintaining trust and safeguarding data integrity.<sup>50</sup>

#### *Lack of Human Interaction and Emotions*

AI applications often lack the human element essential in healthcare, particularly in understanding and responding to emotional reasoning, which is crucial in medical education and patient interactions. Current LLMs, while advanced, are limited to textual interfaces and are unable to recognize physical gestures or movements, nor can they convey emotions.<sup>50</sup> This absence of human interaction can harm students who value personal connections with educators. Studies, such as one conducted by D'Mello and colleagues, have shown that students who engaged with virtual tutors that mimicked human-like emotional behaviour achieved better learning outcomes than those who interacted with emotionless virtual tutors. The challenge of humanizing generative AI tools—to provide accurate responses and exhibit emotions and a distinctive personality—remains significant.<sup>59</sup>

#### *Access Inequality*

Despite the potential benefits of AI in education, access to these tools is not universally equitable. Students from disadvantaged backgrounds, those with disabilities, or those who are not proficient in English often face significant barriers to benefiting from AI-enhanced education. These disparities risk widening the educational gap, particularly as AI tools become more integrated into learning environments.<sup>57</sup> LLMs offer multilingual support, but their effectiveness varies depending on the language and the availability of high-quality training data. This variation makes these tools less accessible to non-English speakers, limiting their usefulness for a global audience. Additionally, limited internet access, high subscription costs, and a lack of familiarity with technology can disproportionately affect students from lower-income backgrounds or underfunded institutions.<sup>50</sup> A recently developed scale, the Medical Artificial Intelligence Readiness Scale for Medical Students (MAIRS-MS), could serve as a valuable tool to assess and address these gaps, providing a foundation for more equitable AI integration in education.<sup>60</sup>

### *Limitations*

This review article primarily draws on existing literature and case studies to analyze the integration of AI in medical education. However, the rapidly evolving nature of AI technologies presents a challenge, as newer tools and updates may quickly outdated some of the findings and discussions. Additionally, while the article covers a broad range of AI applications, it does not delve deeply into the long-term effects of AI integration on student outcomes, as comprehensive longitudinal studies are still limited.

In conclusion, the findings of this study align with prior reviews in highlighting the transformative potential of AI in medical education, particularly in areas such as personalized learning, enhanced accessibility, and real-time feedback. Similar to previous studies, our analysis underscores the significance of AI-driven simulations and VPs in bridging gaps in traditional educational methods. However, this study diverges in its emphasis on the challenges specific to integrating AI in medical curricula, particularly the limited adoption in low-resource settings and primary care training, which were less explored in previous reviews. Incorporating a SWOT framework offers a structured lens to compare strengths and limitations, providing unique insights into balancing AI's benefits and risks in educational contexts. These findings extend prior research by contextualizing AI's impact within the evolving needs of multidisciplinary healthcare education, particularly emphasizing equitable access and curriculum integration.

In conclusion, integrating AI into medical education offers transformative potential by addressing longstanding challenges, enhancing learning experiences, and providing personalized educational pathways for learners and educators. Students can use AI-powered simulations, real-time feedback systems, and advanced data management to engage in more interactive and effective learning environments. However, successfully implementing these tools requires overcoming significant challenges, including issues related to transparency, misinformation, equity, and ethical considerations. As AI technologies continue to evolve, a balanced approach that leverages their strengths while addressing their limitations is essential for shaping the future of medical education. Ongoing research, collaboration, and strategic regulation will ensure that AI-driven education delivers its full potential while maintaining the core values of medical training and patient care.

**Ethical Considerations:** As this is a review article based on existing literature, ethical considerations related to human or animal research do not apply.

**Conflict of Interest:** The authors declare no conflict of interest.

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## Letter to Editor

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# WHAT CAN RESEARCH ON EARTHQUAKE SURVIVORS STAYING IN REMOTE AREAS TEACH US? THE IMPACT OF RELOCATION AFTER THE EARTHQUAKE ON MENTAL HEALTH

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Dear Editor,

I would like to contribute to the discussion of the article titled “Analysis of Sociodemographic and Clinical Features of Earthquake Survivors Seeking Treatment at the Psychiatry Outpatient Clinic Following the Kahramanmaraş Earthquakes on February 6, 2023” which was recently published in Ankara Medical Journal.<sup>1</sup> I congratulate the authors for presenting their data on a subject that should always be well-researched in our country for providing beneficial health policies. This cross-sectional study examines the characteristics of 309 earthquake survivors who sought treatment at a psychiatry outpatient clinic in Ankara, a city far from the epicenter, within one month of the Kahramanmaraş earthquake. The study found that acute stress symptoms were prevalent in this group.<sup>1</sup>

The findings of Kamis et al.'s study revealed that all survivors exhibited symptoms of traumatic stress within one month, consistent with previous research.<sup>1-2</sup> Since earthquakes are known to cause serious and long-lasting mental disorders, identifying individuals at risk of developing such disorders is crucial for determining who requires follow-up care and for making evidence-based recommendations. Some of the well-established risk factors such as the severity of the trauma, injury, having been trapped under rubble, loss of close ones, female gender, and lower education were mentioned by the authors.<sup>1-4</sup>

Since Kamis et al.'s study was conducted in Ankara, a city far from the epicenter, I want to highlight relocation as another potential risk factor for prolonged traumatic stress symptoms after disasters. This factor was not addressed in their study. I believe it should be discussed as it may provide a better understanding and accurate interventions in the acute period after disasters leading to protection from the prolongation of traumatic stress. Although limited studies have examined relocation as a predictor of mental disorders, staying in temporary housing has been found to have a more positive impact on mental well-being than staying in container accommodations.<sup>4-5</sup> One study examining the effect of post-earthquake relocation in Ankara after the 1999 Marmara earthquake showed that those who had migrated had higher traumatic stress levels than others who had been temporarily in the earthquake area for a visit.<sup>4</sup> Moreover, temporary housing was found to be protective for depression compared to relocation for older adults.<sup>5</sup> As a result, whether the earthquake survivors migrated to Ankara or stayed temporarily may be one of the determinants of future symptoms, and questioning it may have provided significant information on predicting whether their psychological symptoms tend to continue.

Given that acute stress symptoms often subside spontaneously over time, the resilience of human mental health should not be overlooked.<sup>2</sup> Nevertheless, scientific health policies are critical for protecting mental health after earthquakes. In conclusion, the impact of strategies, such as relocation, should be better understood to prevent mental disorders after earthquakes. In this context, psychiatrists should not only provide pharmacotherapies

for psychiatric disorders but also participate in teams that prepare interventions to enhance living conditions following earthquakes.



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