SELÇUK TIP DERGİSİ
SELCUK MEDICAL JOURNAL

Araştırma Makalesi / Research Article

Selcuk Med J 2021;37(2): 137-145
DOI: 10.30733/std.2021.01505

Diabetes Unawareness in Patients Hospitalized Other Than Internal Medicine Services and Related Factors: A Cross-Sectional Multidisciplinary Study

Dahiliye Servisi Dışında Hastanede Yatan Hastalarda Bilinmeyen Diyabet ve İlişkili Faktörler: Multidisipliner Kesitsel bir Çalışma

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Geliş Tarihi/Received: *27 April 2021*
Kabul Tarihi/Accepted: *1 June 2021*

Öz

Amaç: Bu çalışmanın amacı dahiliye dışındaki servislerde yatan hastalarda tanı konulmamış diyabet prevalansının belirlenmesi ve diyabet farkındalığının olmaması ile ilişkili faktörlerin değerlendirilmesidir.
Hastalar ve Yöntem: Bu çok merkezli, tanımlayıcı, kesitsel çalışma dahili ve cerrahi kliniklerde yatmakta olan 630 katılımcı ile yapılmıştır. Katılımcıların antropometrik ölçümleri, glukoz ve HbA1c ölçümleri yapılmıştır. Bilinen diyabet tanısı olmayıp yatışı sırasında HbA1c değeri ≥ 6,5% olanlar diyabet farkındalığı olmayanlar olarak tanımlanmıştır.
Bulgular: Bilinen diyabeti olanların sayısı 190 iken (%30,2), 396 (%62,9) kişinin diyabeti yoktu, 44 (%7) hastada ise bilinmeyen diyabet saptandı. Diyabet farkındalığı olmayanlarda bilinen diyabet grubundakilere göre fazla oranda genç (<45 yaş) ve erkek hasta vardı (p<0.01, p<0.05). Diyabet farkındalığı olmayanlarda fazla kilolu olanların ve komorbiditesi olmayanların oranı bilinen diyabetlilerden daha yüksekti (p<0,01, p:0.01). Çok değişkenli lojistik regresyon analizi erkek cinsiyet, <45 yaş, aşırı kilolu olma ve komorbidite olmamasının diyabet ile ilişkili olduğunu gösterdi.
Sonuç: Hastanede iç hastalıkları servisi dışında yatmakta olan hastaların %7'sinde tanı konulmamış diyabet saptanmıştır. Tüm diyabetlilerin %18.8'i diyabet olduğunu bilmemektedir. Yatan hastalarda HbA1c ile diyabet taraması yapmak, <45 yaş, erkek , fazla kilolu ve komorbiditesi olmayan hastalara özellikle dikkat etmek, bilinmeyen diyabeti saptamaya yardımcı olabilir.

Anahtar Kelimeler: Diabetes mellitus, Hb A1c, yatan hastalar, teşhis tarama programları

Abstract

Aim: The aim of the study is to investigate the prevalence of diabetes unawareness in patients hospitalized in clinics other than internal medicine and evaluate the factors associated with them.
Patients and Methods: This multi-center, descriptive, cross-sectional study was conducted with 630 participants who were inpatients of internal and surgical clinics The participants' anthropometric measurements, glucose and HbA1c measurements were made. Those without a known diabetes diagnosis but with an HbA1c value of ≥ 6.5% were grouped as diabetes unaware.
Results: The number of the patients with known diabetes was 190 (30.2%), 396 (62.9%) did not have diabetes, and unknown diabetes was detected in 44 (7%). There were a higher rate of young (<45 years) and male patients in those with diabetes unawareness than those in the known diabetes group (p<0.01, p<0.05). The rate of overweight and absence of comorbidity were higher in the diabetes unaware group than known diabetics. (p<0.01, p:0.01). The multivariate logistic regression analysis showed that the male sex, age<45 years, being overweight and absence of a comorbidity were associated with diabetes unawareness.
Conclusion: Undiagnosed diabetes was detected in 7% of the patients. Among all diabetics, 18.8% had diabetes unawareness. Conducting diabetes screening with HbA1c in inpatients and paying special attention to those under 45, males, overweight patients and those without comorbidities may help detect unknown diabetes.

Key words: Diabetes mellitus, Hb A1c, inpatients, diagnostic screening programs

Cite this article as: Yildirim Ayaz E, Boyraz M, Keskinler MV, Erbakan AN, Oguz A. Diabetes Unawareness in Patients Hospitalized Other Than Internal Medicine Services and Related Factors: A Cross-Sectional Multidisciplinary Study. Selcuk Med J 2021;37(2): 137-145

Disclosure: *None of the authors has a financial interest in any of the products, devices, or drugs mentioned in this article. The research was not sponsored by an outside organization. All authors have agreed to allow full access to the primary data and to allow the journal to review the data if requested.*

INTRODUCTION

Diabetes is a significant cause of mortality and morbidity due to the macrovascular and microvascular complications it may cause, and its prevalence is increasing worldwide (1,2). In 2019, all throughout the world, about half of the diabetic patients between the ages of 20-79 years did not know that they had diabetes (3). While the prevalence of unknown diabetes among diabetic individuals in high-income countries is 38.3%, this rate reaches 66.8% in low-income countries (3). In the TURDEP-2 study conducted in Turkey in 2010, the prevalance of unknown diabetes in all diabetic patients was 55% (4). With the development of diagnosis and treatment methods throughout the years, the mortality of diabetic individuals in the United States decreased by 20% per decade (5). Although complications like end-stage renal failure, acute myocardial infarction, stroke, and lower extremity amputation are preventable with early diagnosis and treatment, the inadequacy of diagnosis leads diabetes to continue to be a significant public health problem and a global economic burden (6,7). A study conducted in Luxemburg found that 62% of patients without diabetes awareness had moderate-high risk of cardiovascular disease according to the Framingham risk scoring system (8). More screening is needed to increase awareness of diabetes. A significant accessible population for diabetes screening consists of patients staying at hospitals.

Determining those with diabetes unawareness and organizing diabetes care and treatment can shorten patients' hospitalization and reduce mortality (9). Previous studies have reported the undiagnosed diabetes rate in inpatients as 5-24% (10,11). While the diabetes prevalance is also high in the inpatients of units other than internal medicine services, diagnosis is frequently overlooked, and studies in this field are few. A study conducted on patients hospitalized for coronary heart disease or elective joint replacement surgery found the dysglycemia rate in those without a diagnosis of diabetes as 10-11% (12). A study conducted at an orthopedics clinic reported that 4% of patients did not know that they had diabetes (13). Assessment of inpatients concerning the presence of diabetes will not only reduce the number of undiagnosed diabetic patients in society but also allow these patients to receive higher-quality and appropriate healthcare services individually. To our knowledge, there is not any multidisciplinary study that has included patients from all units except for internal medicine and conducted screening on these patients in the literature.

Hyperglycemia may be associated with other factors than diabetes, such as stress hyperglycemia, in inpatients (14,15). Therefore it is not feasible to use glucose concentrations for the diagnosis of diabetes in inpatients. It will be more appropriate to use HbA1c in the diagnosis of diabetes for this specific population (14,15). Although several conditions may affect HbA1c, as it does not require fasting and is not affected by the sudden change in blood glucose, it provides a better advantageous alternative in inpatients (16).

Defining the characteristics of individuals without diabetes awareness may help determine especially patients that need to be tested. In Turkey and many populations, women, the elderly and those with comorbidities are examined more frequently due to various diseases, and they become aware of their diseases. We think that being male and being young are a risk factor in terms of diabetes unawareness. Moreover, obese patients are frequently examined for diabetes, and diabetes is often overlooked in normal weight and overweight patients. A low education level is also a risk factor for diabetes unawareness (17). In a study conducted in Korea, diabetes awareness was higher in men and those over the age of 60 (18). Steven et al. (19) observed that diabetes awareness increased along with working hours, age and presence of family history. There is a need for comprehensive studies that are conducted to investigate whether or not there are differences between inpatients without diabetes awareness and those with known diabetes diagnosis in terms of age, sex, education status, presence of comorbidities and body mass index (BMI).

We aim to investigate the prevalence of undiagnosed diabetes in patients hospitalized at services other than internal medicine services by checking HbA1c and to assess whether or not there are differences between those without diabetes awareness and those with known diabetes diagnosis concerning age, sex, education status, presence of comorbidities and BMI. We hypothesize that diabetes unawareness is common in patients hospitalized other than internal medicine service, and those who do not know about their diabetes are more likely male, non-obese, younger, have a low education level and have no-comorbidity. We think defining the unknown diabetes prevalance and associated risk factors in inpatients will specifically determine patients who need to be screened, and this will improve healthcare.

PATIENTS AND METHODS

This multi-center, descriptive, cross-sectional study was conducted at Sultan Abdülhamid Han Training and Research Hospital and Göztepe Training and Research Hospital located in İstanbul, between April 20 and December 31, 2017.

Sample

Participants in the main cohort included those who were inpatients of internal and surgical clinics other than internal medicine and internal medicine sub-specialty services, at or over the age of 18, who volunteered to participate in the study, whose anthropometric measurements could be made, went through clustered random sampling method performed by a computer. The computer program enumerates the items in the sampling frame, determines its own random numbers, and presents the selected items to the researcher in writing or digitally (20). The internal clinics included neurology, dermatology, physiotherapy and rehabilitation, cardiology, infectious diseases, and pulmonology services, while the surgical clinics comprised of general surgery, cardiovascular surgery, pulmonary surgery, orthopedics and traumatology, brain surgery, ophthalmology, urology, gynecology, and plastic surgery services. Electronic medical records of the patients were examined. Also, anamnesis was taken from the patients and their doctor. Patients who had comorbidities that could affect their anthropometric measurements (e.g., heart failure, edema, liver cirrhosis, cancer, cachexia, and Cushing syndrome), those who had been using steroids for more than a month, those who were pregnant, those in the postoperative period, those with conditions altering the HbA1c (such as sickle cell disease, glucose-6-phosphate dehydrogenase deficiency, hemodyalysis, recent blood loss or transfusion, or erythropoietin therapy) were excluded from this study. Data of 3220 patients randomly selected from hospital records were obtained. 1105 patients who met the inclusion criteria were evaluated. After being evaluated for exclusion criteria, 802 patients remained eligible for the study. Of the 634 patients who gave consent to participate in the study, 4 patients could not complete the anthropometric measurements. The study was completed with 630 participants.

Participants wishing to participate in the study were informed about study objectives, procedures and data privacy, and were told that participation was voluntary, and they could withdraw from the study at any time. Approval was taken from the University of Medeniyet, Göztepe Training and Research Hospital Ethics Committee (approval number: 2017/038) before the study commenced. Also institution approval were obtained from the institution to which the health institutions where this study was conducted were affiliated. The participants were informed about the research topic in line with the “Declaration of Helsinki”, and their consent was obtained by stating that the data obtained from this study would be used only within the scope of this research; privacy and confidentiality would be provided. This study was registered at the Protocol Registration and Results System (Clinicaltrials.gov PRS) with the registration number NCT04694326. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist was used in the preparation of this article.

Data Collection and Variables

The participants’ age, sex, education level, employment status, comorbidities (hypertension, cardiovascular disease, hyperlipidemia, heart failure, chronic kidney disease, hyperthyroidism, hypothyroidism, chronic obstructive pulmonary disease, asthma, cancer, other chronic disease) unit of hospitalization, and inpatient diagnosis were recorded. Their recorded diagnoses in the hospital system and the Ministry of Health’s system were accessed, International Classification of Disease-10 (ICD-10) codes were examined, the epicrisis was read in detail, anamnesis was taken including socio-demographic properties and medical history from the patient, and known diseases were also asked of their doctor. The prescription records in the Ministry of Health’s system were also examined, and whether they used antidiabetic drugs was checked. Height, weight, and waist circumference measurements were taken. Anthropometric measurements of patients were performed with light clothes and without shoes and headwear. Weight was evaluated in an upright position by a calibrated scale. The heights of the patients were measured with a standard-height ruler while standing with their back touching the height ruler. Waist circumference was measured with flexible tape, the midpoint between the lower rib margin and the iliac crest, after the patient exhaled. Fasting blood glucose and HbA1c values were assessed. The HbA1c test was conducted with the Boronate affinity HPLC method using a Trinity Biotech Premier Hb9210 device.

Waist circumference classified according to cutoff values for central obesity for European adults (21). It

was categorized as high if ≥80 cm in women and ≥94 cm in men, and it was considered normal otherwise. BMI (kg/m^2) was calculated based on height (kg) and weight (m^2).

BMI values of <25 kg/m² were recorded as underweight-normal, 25-29.99 kg/m² were categorized as overweight, and ≥30 kg/ m² were categorized as obese. American Diabetes Association (ADA) recommends that individuals without a known risk be screened beginning at the age of 45, but they may still have diabetes even if they are younger (16). Therefore patients who were younger than 45 years were also evaluated separately to see their diabetes risk and characteristics. Education level was categorised as illiterate, primary school, high scool and university.

History of previous diabetes diagnosis reported by the patient and/or doctor, the medications they used, and diagnoses recorded in the system were examined, and those with known diabetes were collected in the 'Known Diabetes' group. Among those with no previously known diagnosis of diabetes, those with an HbA1c value of ≥6.5% were categorized in the 'Diabetes Unaware' group, while those with an HbA1c value of <6.5% were categorized in the 'No Diabetes' group. As stress hyperglycemia could not be excluded in inpatients, glucose values were not used for diagnostic purposes. HbA1c measurement, which is not based on glucose measurement, which is one of the standard diagnostic criteria determined by the ADA, was used for detecting diabetes (16).

Outcomes

Outcomes of interest included determinig the prevalence of diabetes unawareness in hospital; defining whether or not there are differences between those without diabetes awareness and those with known diabetes diagnosis concerning age, sex, education status, presence of comorbidities and BMI; examining risk factors affecting diabetes unawareness.

Statistical analysis

To determine the sample size, a power analysis was conducted in the GPower 3.1 program by taking into consideration the values of the data obtained from a similar study in the literature. The required sample size [alpha] at an effect size of 0.5 and error level of .05 was determined as 630. The strength of

Table 1. Distribution of Sociodemographic Characteristics, and Anthropometric Measurements and Comorbidity Status

Variables		N (%)
Age (years)	Mean±SD (Min-Max)	58.04±18.56 (18- 94)
	<45 years	145 (%23.0)
	≥45 years	485 (%77.0)
Gender	Female	286 (45.4)
	Male	344 (54.6)
Weight (kg)	Mean±SD (Min-Max)	76.56±14.58 (40-134)
Body Mass Index (kg/m^2)	Underweight	18 (2.9)
	Normal weight	174 (27.6)
	Overweight	244 (38.7)
	Obesity Class 1	127 (20.2)
	Obesity Class 2	52 (8.3)
	Obesity Class 3	15 (2.4)
Waist Circumference (cm)	Mean±SD (Min-Max)	94.07±14.39 (60-149)
Female	Normal	38 (13.3)
	High	248 (86.7)
Waist Circumference (cm)	Mean±SD (Min-Max)	94.07±14.39 (60-149)
Male	Normal	170 (49.4)
	High	174 (50.6)
Education Level	İlleterate	81 (12.8)
	Primary School	350 (55.6)
	High School	114 (18.1)
	University	85 (13.5)
Employment Status	Working	239 (37.9)
	Not Working	8 (1.3)
	Retired	146 (23.2)
	Homemaker	229 (36.3)
	Student	8 (1.3)
Comorbidity	No	176 (27.9)
	Yes	54 (71.1)

the analysis with this sample size was found to be 90.2%. The NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) software was used for the statistical analyses. While analyzing the data obtained in this study, in addition to descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum), one-way ANOVA was used to compare three or more groups showing normal distribution in the quantitative data. In contrast, the Bonferroni test and the Games-Howell test were used to determine the group causing the difference. In comparing three or more groups not showing normal distribution, the Kruskal Wallis test was used, whereas the Dunn-Bonferroni test was used to determine the group causing the difference. Pearson's chi-squared and Fisher Freeman Halton tests were used in comparing the qualitative data. Logistic regression analysis was used to determine risk factors affecting diabetes unawareness. $p<0.05$ was accepted as statistically significant.

RESULTS

The mean age of the 630 patients was 58.0±18.6 years, while 54.6% (n=344) were male. The patients' mean weight was 76.7±14.6 kg, and their mean BMI was 27.9±5.5 kg/ m2. This study included 274 (43.5%) patients were included from surgical units, and 356 (56.5%) patients from non-surgical units. Table 1 shows the distribution of the sociodemographic characteristics, anthropometric measurements and comorbidity status of the participants.

While the number of those with known diabetes was 190 (30.2%), 396 (62.9%) did not have diabetes, and 44 (7%) had undiagnosed diabetes. Of the 234 patients with diabetes, 18.8% (n:44) were not aware of their diabetes. Table 2 presents the assessment of sociodemographic characteristics, anthropometric measurements, comorbidity status and laboratory findings based on the presence of diabetes.

While there was no significant difference between the mean ages of those with known diabetes and the diabetes unaware group, the mean ages of both groups were higher than that of the no diabetes group (65.7±10.7, 65.3±13.9, 53.6±20.5, $p<0.01$, respectively). When 45 years of age was used as a cut-off point, the percentage of patients unaware of their diabetes were higher than the patients with known diabetes (11.4% vs. 3.7%) ($p<0.01$). When

Table 2. Assessment of Sociodemographic Characteristics, Anthropometric Measurements, Comorbidity Status and Laboratory Findings Based on the Presence of Diabetes

		Diabetes Presence			Test Value
		Known n (%)	Unaware n (%)	No Diabetes n (%)	p
Age (years)	Mean±SD	65.7±10.7$_a$	65.3±13.9$_a$	53.6±20.5$_b$	^{b}0.001**
	<45 years	7 (3.7)$_a$	5 (11.4)$_b$	133 (33.6)$_c$	
	≥45 years	183 (96.3)$_a$	39 (88.6)$_b$	263 (66.4)$_c$	^{b}0.001**
Sex	Female	99 (52.1)$_b$	14 (31.8)$_a$	173 (43.7)$_b$	^{a}0.027*
	Male	91 (47.9)$_b$	30 (68.2)$_a$	223 (56.3)$_b$	
Weight (kg)	Mean±SD	79.6±14.1$_a$	83.2±S12.7$_a$	74.4±14.6$_b$	^{b}0.001**
BMI (kg/m)	Underweight-Normal	36 (18.9)$_a$	3 (6.8)$_b$	153 (38.6)$_c$	^{d}0.001**
	Overweight	72 (37.9)$_a$	25 (56.8)$_b$	147 (37.1)$_c$	
	Obese	82 (43.2)$_a$	16 (36.4)$_b$	96 (24.2)$_c$	
Waist	Mean±SD	102.9±14.4$_a$	102.9±11.8$_a$	91.7±15.7$_b$	^{b}0.001**
Circumference	Normal	2 (2)$_a$	0 (0)$_a$	36 (20.8)$_b$	^{b}0.001**
Female	High	97 (98)$_a$	14 (100)$_a$	137 (79.2)$_b$	
Waist	Mean±SD	101.5±13.7$_a$	103.7±9.7$_a$	91.7±15.7$_b$	^{b}0.001**
Circumference	Normal	25 (27.5)$_a$	4 (13.3)$_a$	141 (63.2)$_b$	^{b}0.001**
Male	High	66 (72.5)$_a$	26 (86.7)$_a$	82 (36.8)$_b$	
Education Status	Illiterate	34 (17.9)	3 (6.8)	44 (11.1)	^{a}0.152
	Primary School	107 (56.3)	26 (59.1)	217 (54.8)	
	High School	30 (15.8)	8 (18.2)	76 (19.2)	
	University	19 (10)	7 (15.9)	59 (14.9)	
Comorbidity	No	20 (10.5)$_a$	11 (25)$_b$	145 (36.6)$_b$	^{a}0.001*
	Yes	170 (89.5)$_a$	33 (75)$_b$	251 (63.4)$_b$	
Glucose (mg/dL)	Mean±SD	159.8±73.2$_a$	137±54$_a$	91.6±18.4$_b$	^{c}0.001**
HbA1c (%)	Mean±SD	8.08±2.01$_a$	7.23±1.35$_b$	5.6±0.41$_c$	^{c}0.001**

Different letters next to the frequencies and Mean±SD indicate significantly different columns.
^{a}Pearson's Chi-Squared Test, ^{b}One-way ANOVA, ^{c}Kruskal Wallis Test, ^{d}Fisher-Freeman-Halton Test *p<0.05 **p<0.01

compared by gender, significantly more male patients were in the diabetes unaware group (68.2%) than the known diabetes group (47.9%) (p<0,05). There was no such difference between diabetes unaware and no diabetes (56.3%) groups (p:0.13).

There was a significant difference among the groups based on their distributions of BMI categories. The rate of the overweight individuals in the diabetes unaware group (56.8%) was significantly higher than those in the known diabetes (37.9%) and no diabetes (39.1%) groups (p<0.01 for both). The mean weight of the known diabetes group (79.6±14.1) was similar to that of the diabetes unaware group (83.2±12.7) and significantly higher than that of the no diabetes group (74.4±14.6) (p<0.01). Among both the men and the women, while the waist circumference was similar between known diabetes and diabetes unaware groups, it was higher in both of these groups than the no diabetes group (p<0.01 for both). The waist circumference was high among all women in the diabetes unaware group and 98% of the women in the known diabetes group. The percentages of high waist circumference were 86.7% and 72.5% for men, respectively. In the no diabetes group, the high waist circumference rates were 79.2% in the women and 36.8% in the men, and these rates were significantly lower compared to the other two groups (p<0.01 for both).

There was no significant difference among the three groups concerning their educational levels. While comorbidities were more frequently observed in the known diabetes group (89.5%) than the diabetes unaware group (75%), it was similar between those in the diabetes unaware group and the no diabetes group (63.4%) (p:0.01, p:0.13, respectively). There was no significant difference between the fasting glucose measurements of the known diabetes and diabetes unaware groups. The mean HbA1c value of the diabetes unaware group (7.2±1.4) was lower than that of the known diabetes group (8.1±2.0) (p:0.02).

Logistic regression analysis for diabetes unawareness and risk factors

The effect of gender, <45 years old, BMI, high waist circumference, and absence of comorbidity on diabetes unawareness among all diabetic patients was also evaluated by logistic regression analysis (Table 3). Male gender, <45 years, being overweight and absence of comorbidity were associated with diabetes unawareness.

DISCUSSION

In this study, where we investigated new diabetes detection frequency in inpatients hospitalized in clinics other than internal medicine services by checking HbA1c, the diabetes unawareness prevalence was 7%. Approximately one-fifth of the diabetic patients were unaware of their diabetes. The male sex, age<45 years, being overweight and absence of a comorbidity were associated with diabetes unawareness, while education level had no significant relationship to diabetes unawareness.

A study conducted in the United States in 2017 among the general public found the undiagnosed diabetes frequency as 3% (22). In their analysis, the findings showed that the diagnosed diabetics led to an economic burden of 327 billion dollars per year, while undiagnosed diabetics created a financial burden of 43 billion dollars per year (22). Detection and treatment of undiagnosed diabetic individuals in society will reduce this economic burden by preventing complications that will be created by diabetes in the future and allow individuals to have a higher-quality of life. Furthermore, applying current treatment will reduce cardiovascular diseases and mortality (23,24). Finding the diabetes unawareness prevalence as 7% in the entire inpatient population and 18.8% in the diabetic population in our study suggest that undiagnosed patients are still a real obstacle for

Table 3. Logistic regression analysis for diabetes unawareness and risk factors

	B	p	ODDS	95% C.I.for ODDS	
				Lower	Upper
Sex (Male)	0,85	<0,05*	2,33	1,16	4,67
Age (<45 years)	1,21	<0,05*	3,35	1,01	11,1
BMI (overweight)	0,77	<0,05*	2,16	1,11	4,19
High WC (female)	19,27	0,999	233161326,7	0,00	
High WC (male)	0,90	0,12	2,46	0,78	7,77
Comorbidity (no)	1,04	0,013	2,83	1,24	6,46

WC: Waist Circumference, BMI: Body Mass Index *p<0,05

diabetes treatment, and public health screenings are inadequate.

Not only public screenings but also in-hospital screenings are in need of improvement. In a study where the records of patients hospitalized who had hyperglycemia were investigated, it was observed that only 62% of those without a diagnosis of diabetes but had hyperglycemia were tested for HbA1c, and undiagnosed diabetes was detected in 58% of those whose HbA1c values were checked (25). As stress hyperglycemia may lead to high glucose levels in inpatients, glucose measurement is inadequate for the diagnosis of diabetes. In a study where HbA1c measurement, glucose measurement, and oral glucose tolerance test (OGTT) were conducted among those with high risk concerning diabetes in patients admitted to the hospital by emergency services, the findings showed that HbA1c was more sensitive in identifying undiagnosed diabetes in comparison to the other tests (26).

Detection of undiagnosed diabetic individuals by HbA1c screening may shorten hospital stays and reduce mortality by guiding treatment arrangements. It should be kept in mind to screen for diabetes by HbA1c testing in inpatients. Sentell et al. (27) determined known diabetes in 30.5% and undiagnosed diabetes in 3.4% of inpatients at a major medical center in Hawaii, and they found that those with undiagnosed diabetes had more hospitalizations, prolonged hospital stay, and in-hospital mortality than those with known diabetes.

According to the National Health and Nutrition Examination Survey (NHANES), the male gender ratio is higher in undiagnosed diabetic individuals than in those who are diagnosed (28). Furthermore, in a study conducted for screening by HbA1c measurement in pneumonia patients in the general public, the male gender was associated with undiagnosed diabetes to a 2.5-fold higher extent (29). In our study, the rate of men in the diabetes unaware group was higher than twice the number of women, and the percentage of male patients was significantly higher than those of the known diabetes and no diabetes groups. Our findings supported the data from previous studies. A study conducted in Germany also found the ratio of the male gender in undiagnosed diabetes patients higher than the known diabetes group, and the patients in the undiagnosed group were also younger (30). Similarly, in our study, patients under the age of 45 were more likely to be unaware of their diabetes than the known diabetes group.

A high waist circumference is one of the most significant risk factors for diabetes (31). In our study, there was no significant difference between the known diabetes group and the diabetes unaware group regarding their waist circumference values. In the diabetes unaware group, 86.7% of the male and all females had high waist circumference values. A meta-analysis that included epidemiological studies in the last 15 years reported that even the average waist circumference values in Turkey were higher than the limit values (32). Therefore, a high waist circumference value becomes no longer a distinctive characteristic in the Turkish population.

In the Hispanic Community Health Study, being overweight was determined to be associated with undiagnosed diabetes (33). Similarly, Bantie et al. (34) found a relationship between undiagnosed diabetes and being overweight. However, in our study, the frequency rate of being overweight in the undiagnosed diabetes group was higher than that in the known diabetes group. This finding can be explained by that overweight patients are frequently overlooked while obese patients are commonly screened for diabetes.

In a study investigating the relationship between social inequalities and unknown diabetes, the findings showed that those with a higher education level had a 1.5 times higher risk of undiagnosed diabetes than those with a low education level (35). A study conducted in Bangladesh found that patients with undiagnosed diabetes had lower education levels (17). A cross-sectional study in the United States determined a higher rate of unknown diabetes among individuals without access to health insurance and health services (36). In our study, the education levels were not different between the known diabetic and undiagnosed diabetic individuals. While individuals from every socioeconomic class can directly and freely access even tertiary health institutions, and everyone frequently gets tested in Turkey might affect this result, having obtained the data only from two hospitals' patient populations limits this inference.

The finding in our study that diabetes unawareness is higher among those without comorbidities can be attributed to those individuals who visit hospitals due to any disease are also tested for other diseases, including diabetes. While the fasting glucose levels were similar between known diabetes and diabetes unaware groups in this study, the HbA1c levels were higher in the known diabetes group. HbA1c is one of the most significant biomarkers of diabetes complications (37). Those with higher HbA1c levels

visit hospitals with diabetes complications more frequently might affect this result.

Limitations and Strengths

Our study had many limitations. First of all, this study was conducted at only two different tertiary hospitals in Istanbul. Including other hospitals from different regions of Turkey might give a better understanding of the situation. However, this is still an exemplary study where HbA1c screening has been performed by including patients from several clinics units at the included hospitals. Our study did not assess the risk factors for diabetes development, such as social isolation, physical inactivity, and dietary habits. Additionally, HbA1c measurement is influenced by situations like anemia, blood transfusion, massive blood loss, and hemolysis, which would only lead to underdiagnosing of diabetes (16). Patients with these medical situations were excluded from the study but were still not examined for these conditions.

One of the strengths of our study was that this study involved data from several different clinics. In our research, by excluding internal medicine services and internal medicine subspecialities services, we included patients from all other surgical and internal services at the hospitals. To our knowledge, there is no study in the literature that has conducted HbA1c screening by including patients from all surgical and internal units except for internal medicine services. We believe our research will raise awareness of the necessity for non-internist physicians to take part in the diagnosis of diabetes. Additionally, we think that all procedures that have been used in this study are easily accessible and applicable and will provide an advantage in reflecting the results on practice.

CONCLUSION

In conclusion, HbA1c was checked in the inpatients of clinics other than internal medicine services, and undiagnosed diabetes was determined in 7% of the patients. This study showed that 18.8% of all diabetic patients had diabetes unawareness. The undiagnosed diabetic patients were more likely to be younger than 45 years of age, male, overweight and have no comorbidities. Conducting diabetes screening with HbA1c in inpatients and paying particular attention to those under 45, males, overweight patients, and those without comorbidities may help detect unknown diabetes. Further studies are needed on the prevalence of diabetes unawareness and related factors.

Conflict of interest: *Authors declare that there is no conflict of interest between the authors of the article.*

Financial conflict of interest: *Authors declare that they did not receive any financial support in this study.*

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