



# Investigation of Eating Disorders and Hypoglycemia Awareness in People with Type 2 Diabetes

## Tip 2 Diyabetli Kişilerde Yeme Bozukluklarının ve Hipoglisemi Farkındalığının Araştırılması

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### ABSTRACT

**Aim:** This study aimed to investigate type 2 diabetics in terms of eating disorders (ED) and hypoglycemia awareness (HA).

**Materials and Methods:** This cross-sectional study was conducted with type 2 diabetics who applied to the Family Medicine Outpatient Clinic of a tertiary hospital between January and June 2022 and met the inclusion criteria. The Descriptive Information Form, Munich Eating and Feeding Disorder Questionnaire (Munich ED-quest), and The Gold Questionnaire (GQ) were used to obtain data. Measured fasting plasma glucose and HbA1c levels and anthropometric measurements were recorded.

**Results:** Of the 148 participants with an average age of  $53.56 \pm 7.61$  years (min: 28-max: 65), 62.8% (n=93) were female. Munich ED-(FPG) scores were  $22.49 \pm 19.68$  for overall condition. Subscale scores were  $5.12 \pm 11.50$  for "preoccupation with figure and weight",  $17.16 \pm 10.93$  for "bingeing and vomiting", and  $0.22 \pm 0.95$  for "inappropriate compensatory behavior". The average GQ score of participants who stated that they had previously experienced hypoglycemia (n=78; 52.7%) was  $1.50 \pm 1.03$  and impaired HA was detected in 7.7%. No significant correlation was found between GQ and Munich ED-quest scores. A significant relationship was observed between body mass index (BMI) and age and Munich ED-quest total score ( $r=0.215$ ,  $p=0.009$ ;  $r=-0.274$ ,  $p=0.001$ , respectively). A significant difference was found between gender and Munich ED-quest total score ( $p=0.007$ ).

**Conclusion:** The overall risk of ED was found to be low in people with type 2 diabetes. However, binge eating was the type of ED with the highest risk. Impaired HA was detected in 7.7% of those who stated that they had previously experienced hypoglycemia. Although no significant relationship was found between ED and HA in our study population, the possibility of ED development over time should be taken into consideration. Especially patients at risk for ED (young people, women and those with high BMI) should be followed more closely in this context.

**Keywords:** Diabetes mellitus, hypoglycemia, hypoglycemia awareness, eating disorders

### ÖZ

**Amaç:** Bu çalışmada tip 2 diyabetlilerin yeme bozukluğu (YB) ve hipoglisemi farkındalığı (HF) açısından incelenmesi amaçlandı.

**Gereç ve Yöntem:** Bu kesitsel çalışma üçüncü basamak bir hastanenin Aile Hekimliği Polikliniği'ne Ocak-Haziran 2022 tarihleri arasında başvuran ve çalışmaya dahil etme kriterlerini karşılayan tip 2 diyabetliler ile gerçekleştirildi. Verilerin elde edilmesinde Tanıtıcı Bilgi Formu, Münih Yeme ve Beslenme Bozuklukları Anketi (MYBBA) ve Gold Anketi (GA) kullanıldı. Ölçülmüş açlık plazma glukozu ve HbA1c düzeyleri ile antropometrik ölçümler kaydedildi.

**Bulgular:** Yaş ortalaması  $53,56 \pm 7,61$  (min: 28-maks: 65) yıl olan 148 katılımcının %62,8'i (n=93) (APG) idi. MYBBA'dan alınan toplam puan genel durum için  $22,49 \pm 19,68$  idi. Alt boyut puanları; "şekil ve kilo ile meşgul olma" için  $5,12 \pm 11,50$ , "tıkınırcasına yeme ve kusma" için  $17,16 \pm 10,93$  ve "uygunsuz telafi edici davranış" için  $0,22 \pm 0,95$  idi. Daha önce hipoglisemi yaşadığını belirten katılımcıların (n=78; %52,7) GA ortalama puanı  $1,50 \pm 1,03$  olup %7,7'sinde Bozulmuş HF saptandı. GA ile MYBBA skorları arasında istatistiksel olarak anlamlı ilişki bulunmadı. Vücut kitle indeksi (VKİ) ve yaş ile MYBBA toplam puanı arasında anlamlı ilişki vardı ( $r=0,215$   $p=0,009$ ;  $r=-0,274$   $p=0,001$ , sırasıyla). Cinsiyet ile MYBBA toplam puanı arasında anlamlı farklılık saptandı ( $p=0,007$ ).

**Sonuç:** Tip 2 diyabetlilerde genel YB riski düşük bulundu. Ancak tıkınırcasına yeme, en yüksek riskli YB tipi idi. Daha önce hipoglisemi yaşadığını ifade edenlerin de %7,7'sinde bozulmuş HF saptandı. Her ne kadar bizim çalışma popülasyonumuzda YB ile HF arasında anlamlı ilişki bulunmamış olsa da,

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zaman içerisinde YB gelişimi olabileceği göz önünde bulundurulmalıdır. Özellikle YB açısından riskli hastalar (genç yaştakiler, kadınlar ve VKİ yüksek olanlar) bu bağlamda daha sıkı takip edilmelidir.

**Anahtar Kelimeler:** Diabetes mellitus, hipoglisemi, hipoglisemi farkındalığı, yeme bozuklukları

## INTRODUCTION

Diabetes mellitus is a metabolic disorder characterized by hyperglycemia and the potential for acute and chronic complications to manifest during its progression<sup>1</sup>. Hypoglycemia, an acute complication of diabetes, is marked by a decrease in plasma glucose concentration and can arise from various factors such as glycemia-directed therapies, low-carbohydrate diets, and physical exertion<sup>2</sup>.

The symptoms and manifestations of hypoglycemia can vary depending on its severity and individual factors. Timely recognition of hypoglycemia symptoms empowers individuals to take corrective measures to restore their blood glucose levels. However, impaired ability to detect hypoglycemia symptoms at its onset is termed impaired awareness of hypoglycemia (IAH)<sup>3</sup>. IAH is a complication associated with glucose-lowering therapies in individuals with both type 1 and type 2 diabetes<sup>4</sup>. Various assessment methods exist for evaluating IAH in people with diabetes, and the prevalence may differ based on the chosen methodology<sup>5-7</sup>. Recurrent, untreated episodes of non-severe hypoglycemia can lead to IAH, predisposing individuals to severe hypoglycemic events<sup>8</sup>. Therefore, activities aiming at raising awareness about hypoglycemia recognition and prevention are crucial<sup>9</sup>.

Eating disorders (ED) are psychiatric disorders characterized by severe disturbances in eating behavior and body weight<sup>10</sup>. Diabetes has been previously linked to a heightened risk of ED<sup>11</sup>. Binge eating disorder (BED) is particularly prevalent among individuals diagnosed with type 2 diabetes<sup>12</sup>. Inappropriate caloric intake in these individuals may compromise insulin activity and secretion, leading to glycemic fluctuations consequently impacting diabetes management<sup>13</sup>. As a result, ED can exacerbate complications, mortality rates, and overall morbidity in individuals with diabetes<sup>14</sup>.

It is noteworthy that it is emphasized in the literature that hypoglycemia awareness (HA) is observed more frequently in type 1 diabetics and in diabetics who use long-term insulin. This study aimed to examine people with type 2 diabetes in terms of ED and HA.

## MATERIALS AND METHODS

### Study Design

This study employed a cross-sectional design. It was conducted between January 24, 2022 and June 5, 2022, with type 2

diabetic individuals aged 18 years and over, who applied to the family medicine outpatient clinic of a tertiary hospital for any reason and met the inclusion criteria for the study.

### Selection and Description of the Cases

The study comprised of 148 volunteers aged 18 years and above, having the diagnosis of type 2 diabetes for at least 1 year, with no known diagnosis of ED, no serious psychiatric illnesses, and not taking any medication. Exclusions were made for individuals under 18 years, those with less than 1 year of type 2 diabetes duration, gestational diabetes, type 1 diabetes, communication barriers (such as hearing and speech impairments, cognitive dysfunction, inability to cooperate), and for illiterate individuals.

### Data Collection Tools

For data collection, a Descriptive Information Form, the Turkish version of the Munich Eating and Feeding Disorders Questionnaire (Munich ED-quest), and the Gold Questionnaire were utilized.

### Descriptive Information Form

The form, developed based on existing literature, inquired about sociodemographic details (age, gender, educational status) and diabetes-related factors (type, duration, treatment, presence of complications, diet compliance, hypoglycemia, and frequency and timing of blood glucose monitoring). Height, weight measurements, and body mass index (BMI) calculations were recorded. Additionally, fasting plasma glucose (FPG) and HbA1c levels were measured and recorded.

### Turkish Version of the Munich Eating and Feeding Disorders Questionnaire

The Munich ED-quest was developed by Fichter et al.<sup>15</sup> in 2015 to assess ED symptoms in individuals aged 12-65 years. It was translated into Turkish by Öngün-Yılmaz<sup>16</sup> in 2020. The scale evaluates symptoms over two-time frames, as "current" (in the last three months) and "worst case in the past." The original version includes three subscales: "preoccupation with figure and weight," "bingeing and vomiting," and "inappropriate compensatory behavior." Total scores, derived from subscale items, indicate symptom severity, with a higher score indicating more severe symptoms. The scale demonstrated a Cronbach's alpha value of 0.940.

## The Gold Questionnaire

In our study, we utilized The Gold Questionnaire, developed by Gold et al.<sup>5</sup> in 1994, to assess the HA of participants who reported previous experiences with hypoglycemia. This questionnaire employs a visual analog measurement scoring system, consisting of a single question: "Do you notice when your blood glucose drops below 60 mg/dL?" Responses are rated on a 7-point Likert scale. Scores of four and above indicate the presence of IAH. Ethical permission to perform this study was approved by the University of Health Sciences Turkey, Gaziosmanpaşa Training and Research Hospital Local Ethics Committee (decision no: 14, date: 19.01.2022). The study adhered to the principles outlined in the Declaration of Helsinki. All participants provided informed consent before inclusion in the study, and necessary permissions were obtained.

## Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics 25.0. Descriptive statistics (frequency, mean, standard deviation) were utilized for data presentation. As the continuous data did not follow a normal distribution (Kolmogorov-Smirnov values  $p < 0.05$ ), Non-parametric tests including the Mann-Whitney U test and the Kruskal-Wallis H test were employed to assess significant differences between total and sub-dimension scores of the scale and sociodemographic variables. The Games-Howell Post-Hoc test was applied to identify significant differences between groups where applicable. Spearman correlation analysis was used to examine relationships between continuous variables, while the chi-square test was utilized for comparing categorical variables. A significance level of  $p < 0.05$  was considered statistically significant.

## RESULTS

This study involved 148 participants with a mean age of  $53.56 \pm 7.61$  years (range: 28-65). The average duration of diabetes was  $8.72 \pm 5.86$  years, with mean FPG levels at  $160.59 \pm 66.51$  mg/dL and mean HbA1c levels at  $7.77 \pm 1.97\%$ . Sociodemographic and diabetes-related characteristics of the participants are summarized in Table 1.

Participant responses regarding blood glucose monitoring and hypoglycemia are detailed in Table 2. Among the participants, 78 (52.7%) reported experiencing hypoglycemia at some point. The prevalence of self-reported mild and severe hypoglycemia within the past year was 3.4% and 1.4%, respectively.

Descriptive statistics of total and sub-dimension scores from the scales are presented in Table 3. Munich ED-quest total scores averaged  $22.49 \pm 19.68$  (range: 0-122), with "last three months" scores at  $12.14 \pm 8.68$  (range: 0-52) and "worst case in the past" scores at  $10.35 \pm 12.63$  (range: 0-77). Among those

who experienced hypoglycemia, the average Gold Questionnaire score was  $1.50 \pm 1.03$ , with 7.7% ( $n=6$ ) exhibiting IAH.

Table 4 presents correlation analysis results examining relationships between scale scores and various variables. Positive, statistically significant correlations were observed between BMI and Munich ED-quest scores, both "last three months" and "worst case in the past" ( $r=0.215$ ,  $p=0.009$ ;  $r=0.295$ ,  $p<0.001$ , respectively). Additionally, a significant negative correlation was found between age and Munich ED-quest total scores, as well as "last three months" and "worst case in the past" scores ( $r=-0.274$ ,  $p=0.001$ ;  $r=-0.269$ ,  $p=0.001$ ;  $r=-0.255$ ,  $p=0.002$ , respectively).

Analysis results comparing scale scores across various variables are presented in Table 5. Significant differences were observed in

**Table 1. Baseline characteristics of the study participants (n=148)**

Variables	Groups	n	%
Gender	Female	93	62.8
	Male	55	37.2
Education level	Literate	22	14.9
	Primary school	89	60.1
	Middle school	10	6.8
	High school	20	13.5
	University	7	4.7
Groups according to body mass index	Weak (n=1) and normal (n=12)	13	8.8
	Overweight	54	36.5
	Obese	81	54.7
Diabetes treatment	Oral antidiabetic drug	99	66.9
	Insulin	7	4.7
	Combined treatment	42	28.4
Compliance with diet	Yes	49	33.1
	Partially	72	48.6
	No	27	18.2
Presence of complication	No	99	66.9
	Yes	49	33.1
	Median (min-max)	Mean $\pm$ SD	
Age (years)	55.0 (28.0-65.0)	53.56 $\pm$ 7.61	
Body mass index (kg/m <sup>2</sup> )	30.42 (17.30-54.82)	31.55 $\pm$ 5.57	
Fasting plasma glucose (mg/dL)	142.0 (68.0-404.0)	160.59 $\pm$ 66.51	
HbA1c (%)	7.10 (5.30-16.10)	7.77 $\pm$ 1.97	
Diabetes duration (years)	8.0 (1.0-26.0)	8.72 $\pm$ 5.86	
Number of insulin units	42.0 (1.0-110.0)	42.49 $\pm$ 27.04	
Number of oral antidiabetic drugs	1.0 (1.0-3.0)	1.58 $\pm$ 0.69	
Data are given as n (%), median, min-max, mean $\pm$ SD values. SD: Standard deviation, min-max: Minimum-maximum			

Variables	Groups	n	%
<b>Frequency of blood glucose monitoring</b>	1-2 times	48	32.4
	3 and above	10	6.8
	Never	27	18.2
	Irregular	63	42.6
<b>Blood glucose monitoring time*</b>	Random	66	22.5
	Before meal	79	27.0
	After meal	47	16.0
	Night	5	1.7
	When you feel bad	96	32.8
<b>Frequency of hypoglycemia</b>	None	70	47.3
	Rarely	42	28.4
	Sometimes	22	14.9
	Often/Always (n=2)	14	9.5
<b>HA status according to the Gold Questionnaire (n=78)</b>	Impaired HA	6	7.7
	Normal HA	72	92.3

Data are presented as n (%). HA: Hypoglycemia awareness. \*Since the answers contain multiple answers, the number (n) exceeds the sample size: Participants could choose more than one option for the relevant question since blood sugar monitoring could occur at different periods

	Median	Min-max	Mean $\pm$ SD
<b>Gold Questionnaire score (n=78)</b>	1.0	1.0-5.0	1.50 $\pm$ 1.03
<b>Munich ED-quest total score (n=148)</b>	18.00	0-122	22.49 $\pm$ 19.68
Preoccupation with figure and weight	0.00	0-77	5.12 $\pm$ 11.50
Bingeing and vomiting	16.00	0-53	17.16 $\pm$ 10.93
Inappropriate compensatory behavior	0.00	0-6	0.22 $\pm$ 0.95
<b>In the last three months (current)</b>	10.00	0-52	12.14 $\pm$ 8.68
Preoccupation with figure and weight	0.00	0-25	1.67 $\pm$ 3.95
Bingeing and vomiting	10.00	0-27	10.45 $\pm$ 6.11
Inappropriate compensatory behavior	0.00	0-3	0.02 $\pm$ 0.24
<b>The worst case in the past</b>	6.50	0-77	10.35 $\pm$ 12.63
Preoccupation with figure and weight	0.00	0-52	3.45 $\pm$ 8.56
Bingeing and vomiting	6.00	0-30	6.70 $\pm$ 6.11
Inappropriate compensatory behavior	0.00	0-6	0.20 $\pm$ 0.86

Data are given as median, min-max, mean  $\pm$  SD values. Munich ED-quest: Munich Eating and Feeding Disorders Questionnaire, SD: Standard deviation, Min-max: Minimum-maximum

Munich ED-quest total scores and "last three months" and "worst case in the past" scores between genders, with higher scores reported in women ( $p=0.007$ ;  $p=0.003$ ;  $p=0.038$ , respectively).

However, no significant correlation was found between BMI, FPG, HbA1c, diabetes duration, insulin treatment regimens, and Gold Questionnaire scores.

## DISCUSSION

This study aimed to investigate ED and HA among individuals diagnosed with type 2 diabetes. While the risk of ED was found to be low based on the scale scores obtained, there was a heightened risk of binge eating. Among participants, 52.7% reported previous experiences with hypoglycemia, with IAH detected in 7.7% of these individuals. However, no significant relationship was found between HA and ED.

It is well-established that individuals with type 2 diabetes face an increased risk of developing ED, characterized by significant disruptions in eating behavior and body weight. The association between diabetes and the risk of BED is extensively documented in the literature<sup>17-21</sup>. In the development study of the Munich ED-quest, individuals with ED exhibited higher mean scores compared to community controls<sup>15</sup>. Similarly, in the adaptation of the Munich ED-quest into Turkish, the mean total scores were reported as 29.94 $\pm$ 23.40 (current) and 28.88 $\pm$ 23.72 (worst case in the past)<sup>16</sup>. In our study, the Munich ED-quest general total score was 22.49 $\pm$ 19.68. Notably, all scores obtained from the scale were lower than the literature average. However, "bingeing and vomiting" sub-dimension scores were higher than other sub-dimensions, consistent with previous literature findings. Disparities in sociodemographic and clinical characteristics among participants across studies, variations in exclusion criteria, and the use of different revisions for diagnosis may contribute to the wide range of prevalence reported in the literature.

Numerous factors contribute to the heightened risk of ED among individuals with diabetes. Research focusing on the ED status in people with type 2 diabetes indicates that age plays a significant role in disordered eating behaviors, with a higher prevalence observed among individuals under the age of 50 years<sup>21</sup>. Specifically, among type 2 diabetics, those reporting binge eating tend to be younger compared to those without an ED diagnosis<sup>17,18</sup>. Furthermore, evidence suggests that binge eating often precedes the onset of diabetes, with diabetes onset occurring earlier in individuals with this behavior pattern<sup>19</sup>. Consistent with existing literature, our study revealed a similar trend, wherein a decrease in participants' age correlated with an increased risk of both overall ED and binge eating. Given that young age is a notable risk factor for BED, particularly prevalent among individuals with type 2 diabetes, early screening for type 2 diabetes is warranted for this demographic.

**Table 4. Correlation analysis of the relationships between scale scores and various variables**

		1	2	3	4	5	6	7	8	9	10	11
1) Gold Questionnaire (n=78)	r	1										
	p	.										
2) Munich ED-quest-total score (n=148)	r	0.016	1									
	p	0.893	.									
3) Munich ED-quest-in the last three months score	r	-0.046	0.929**	1								
	p	0.690	<0.001	.								
4) Munich ED-quest score-the worst case in the past score	r	0.027	0.897**	0.691**	1							
	p	0.813	<0.001	<0.001	.							
5) Age	r	0.006	-0.274**	-0.269**	-0.255**	1						
	p	0.957	<b>0.001</b>	<b>0.001</b>	<b>0.002</b>	.						
6) Fasting plasma glucose	r	-0.010	-0.067	-0.076	-0.064	0.012	1					
	p	0.928	0.422	0.356	0.438	0.889	.					
7) HbA1c	r	-0.010	-0.106	-0.151	-0.051	0.055	0.712**	1				
	p	0.929	0.199	0.067	0.535	0.505	<0.001	.				
8) Body mass index	r	0.026	0.215**	0.295**	0.095	-0.102	-0.095	-0.207*	1			
	p	0.819	<b>0.009</b>	<0.001	0.252	0.216	0.250	<b>0.011</b>	.			
9) Diabetes duration	r	0.059	-0.003	-0.069	0.056	0.235**	0.368**	0.473**	-0.150	1		
	p	0.605	0.970	0.405	0.497	<b>0.004</b>	<0.001	<0.001	0.070	.		
10) Numbers of oral antidiabetic drugs	r	-0.148	-0.051	-0.056	-0.041	0.118	0.192*	0.265**	-0.138	0.292**	1	
	p	0.209	0.549	0.512	0.63	0.162	<b>0.023</b>	<b>0.001</b>	0.102	<0.001	.	
11) Numbers of insulin units	r	0.383*	0.015	-0.055	0.119	0.016	0.128	0.037	0.134	0.204	0.131	1
		<b>0.034</b>	0.92	0.710	0.415	0.916	0.381	0.800	0.359	0.16	0.407	.

\*Correlation is significant at the level of 0.05 (Spearman correlation test), \*\*Correlation is significant at the level of 0.01, (Spearman correlation test), Munich ED-quest: Munich Eating and Feeding Disorders Questionnaire

Similar to the general population, females exhibit a higher prevalence of ED among individuals with type 2 diabetes<sup>17,21,22</sup>. However, contrasting findings have been reported by García-Mayor et al.<sup>20</sup>, highlighting a more significant association between BED and type 2 diabetes in men, while Nicolau et al.<sup>18</sup> found no significant gender-based difference in BED prevalence among individuals with type 2 diabetes. In alignment with existing literature, our study indicated that women had higher ED scores compared to men.

Research has indicated a relationship between longer years of education and binge eating behaviors in individuals with type 2 diabetes<sup>22,23</sup>. Consistently, our study revealed higher Munich ED-quest scores (worst case in the past) among university graduates compared to other educational groups. This association may stem from increased awareness and knowledge regarding dietary habits among individuals with higher education levels.

Certain types of ED are associated with an increase in BMI due to individuals' eating behaviors. Notably, individuals with type 2 diabetes and BED tend to have higher BMI compared to those without BED. Obesity, often linked to ED, poses a significant challenge in managing type 2 diabetes<sup>17,21,22,24</sup>. In line with existing literature, our study found that Munich ED-quest total scores (for the last 3 months) increased with higher BMI values.

The impact of ED on the metabolic control of type 2 diabetes remains unclear and most studies have failed to establish a significant relationship<sup>14,17,21,24,25</sup>. Similarly, a study investigating the clinical, biochemical, and psychological effects of ED on individuals with type 2 diabetes found no significant differences in glycemic parameters between those with and without BED<sup>18</sup>. Consistent with the literature, no significant relationship was found in our study between metabolic control (assessed by FBG and HbA1c levels) and Munich ED-quest scores. However, irrespective of HbA1c levels, behaviors such as consuming large quantities of food in a short timeframe and prolonged fasting may induce short-term glycemic variability in individuals with



**Table 5. Evaluation of the relationship between various variables and scale scores**

Variables		Munich ED–quest scores (n=148)			HA according to the GQ (n=78)	
		Total score	In the last three months	The worst case in the past	Impaired HA (n=6)	Normal HA (n=72)
<b>Gender</b>	n	Mean ± SD	Mean ± SD	Mean ± SD	n (%)	n (%)
Female	93	24.73±18.79	13.53±8.66	11.20±11.70	6 (12.2)	43 (87.8)
Male	55	18.70±20.72	9.80±8.27	8.91±14.08	0 (0)	29 (100)
	p	<sup>1</sup> 0.007	<sup>1</sup> 0.003	10.038	0.079 <sup>a</sup>	
<b>Education level</b>	n	Mean ± SD	Mean ± SD	Mean ± SD	n (%)	n (%)
1) Literate	22	21.22±19.79	11.82±7.19	9.41±13.33	2 (22.2)	7 (77.8)
2) Primary school	89	21.42±16.52	12.45±8.76	8.98±9.03	4 (8.9)	41 (91.1)
3) Middle school	10	16.20±9.56	9.50±6.28	6.70±5.79	0 (0)	5 (100)
4) High school	20	22.40±20.02	10.55±7.12	11.85±13.87	0 (0)	13 (100)
5) University	7	49.28±42.18	17.57±16.24	31.71±29.00	0 (0)	6 (100)
	p	<sup>2</sup> 0.005	20.754	<sup>2</sup> 0.026	0.353 <sup>a</sup>	
<b>Groups according to body mass index</b>	n	Mean ± SD	Mean ± SD	Mean ± SD	n (%)	n (%)
1) Weak/normal	13	14.46±12.85	8.00±6.73	6.46±6.84	0 (0)	7 (100)
2) Overweight	54	21.85±22.18	10.81±8.21	11.04±15.24	1 (3.2)	30 (96.8)
3) Obese	81	24.21±18.64	13.69±8.98	10.52±11.39	5 (12.5)	35 (87.5)
	p	<sup>2</sup> 0.104	<sup>2</sup> 0.020	<sup>2</sup> 0.385	0.345 <sup>a</sup>	
<b>Diabetes treatment</b>	n	Mean ± SD	Mean ± SD	Mean ± SD	n (%)	n (%)
1) Oral antidiabetic drugs	99	24.41±20.06	13.07±8.66	11.34±13.44	4 (8.3)	44 (91.7)
2) Insulin	7	24.86±15.08	13.00±8.19	11.86±7.03	0 (0)	4 (100)
3) Combined treatment	42	17.57±18.95	9.81±8.57	7.76±11.14	2 (7.7)	24 (92.3)
	p	<sup>2</sup> 0.062	<sup>2</sup> 0.054	<sup>2</sup> 0.103	1.000 <sup>a</sup>	
<b>Compliance with diet</b>	n	Mean ± SD	Mean ± SD	Mean ± SD	n (%)	n (%)
1) Yes	49	19.08±11.06	10.61±6.02	8.47±6.25	3 (10)	27 (90)
2) Partially	72	24.28±19.30	13.21±8.48	11.07±12.48	1 (2.7)	36 (97.3)
3) No	27	23.93±30.24	12.07±12.46	11.85±19.88	2 (18.2)	9 (81.8)
	p	<sup>2</sup> 0.137	<sup>2</sup> 0.121	<sup>2</sup> 0.236	0.143 <sup>a</sup>	
<b>Number of blood glucose monitoring</b>	n	Mean ± SD	Mean±SD	Mean ± SD	n (%)	n (%)
1) 1–2 times	48	20.69±19.22	10.38±7.15	10.31±13.93	1 (3.2)	30 (96.8)
2) 3 and above	10	19.00±25.52	11.2±14.47	7.80±11.20	1 (16.7)	5 (83.3)
3) Never	27	28.59±26.28	15.07±10.91	13.52±16.37	0 (0)	8 (100)
4) Irregular	63	21.81±15.27	12.38±7.30	9.43±9.74	4 (12.1)	29 (87.9)
	p	<sup>2</sup> 0.257	<sup>2</sup> 0.109	<sup>2</sup> 0.539	0.349 <sup>a</sup>	
<b>Frequency of hypoglycemia</b>	n	Mean ± SD	Mean ± SD	Mean ± SD	n (%)	n (%)
1) None	70	22.10±21.41	12.37±10.00	9.73±12.59	–	–
2) Rarely	42	25.00±18.92	12.21±7.14	12.79±14.09	3 (7.1)	39 (92.9)
3) Sometimes	22	17.73±10.1	11.05±6.43	6.68±5.52	2 (9.1)	20 (90.9)
4) Often/Always (n=2)	14	24.43±24.28	12.5±9.58	11.93±15.57	1 (7.1)	13 (92.9)
	p	<sup>2</sup> 0.549	<sup>2</sup> 0.936	<sup>2</sup> 0.286	1.000 <sup>a</sup>	

Data are given as n (%) and mean ± SD values. <sup>1</sup>Mann-Whitney U test, <sup>2</sup>KV: Kruskal-Wallis, <sup>a</sup>Fisher's exact test, p<0.05, Munich ED–quest: Munich Eating and Feeding Disorders Questionnaire, HA: Hypoglycemia awareness, GQ: Gold Questionnaire, SD: Standard deviation

BED. Hence, further exploration of the relationship between BED and glycemic variability is warranted.

Several methods have been developed to assess IAH<sup>5,6,7</sup>. IAH prevalence may vary depending on the diabetes-related variables of the patients as well as the methodology used. A

meta-analysis of 62 studies encompassing type 1 and type 2 diabetes reported a prevalence of 26.2% using the Gold score<sup>4</sup>. Additionally, multinational studies have documented prevalence rates ranging from 20.2% to 27.9% in type 2 diabetes<sup>26,27</sup>. Among type 2 diabetics treated with insulin, prevalence rates of up to 10% have been reported<sup>28</sup>. Studies conducted in our country have reported IAH prevalence rates among type 2 diabetics ranging from 10.7% to 38.5%<sup>29,30</sup>. In our study, 52.7% (n=78) of participants reported experiencing hypoglycemia at any frequency and severity, with IAH observed in 7.7% of these individuals. Although HA has been predominantly emphasized in type 1 diabetics and long-term insulin users, it is acknowledged that the incidence of hypoglycemia may rise in type 2 diabetics due to glycemia-directed therapies. Our study concluded that the rate of IAH was lower than reported in the literature, likely due to the relatively small number of individuals using insulin alone or in combination with oral antidiabetic drugs.

### Study Limitations

Our study has two primary limitations. Firstly, the single-center and cross-sectional design, along with the relatively small sample size, may restrict the generalizability of the findings to the broader population. Secondly, the lack of participant follow-up poses a limitation. Although our initial evaluation found no relationship between ED and HA in our study population, the potential development of ED during follow-up should be considered. Future contributions to the literature should aim for larger sample sizes and multicenter studies with patient follow-up to address these limitations. The strength of our study lies in being the first in our country to explore the relationship between ED and HA in individuals with type 2 diabetes.

### CONCLUSION

Our findings suggest that while the overall risk of ED was low, the risk of binge eating was elevated among individuals with type 2 diabetes. 7.7% of those reporting hypoglycemia experienced impaired awareness but no significant relationship was observed between HA and ED. However, the possibility of developing ED over time should still be considered. Clinicians should consider psychiatric consultation for patients with type 2 diabetes displaying disordered eating attitudes. Raising patient awareness about hypoglycemia may help deter disordered eating behaviors.

### Ethics

**Ethics Committee Approval:** Ethical permission to perform this study was approved by the University of Health Sciences Turkey, Gaziosmanpaşa Training and Research Hospital Local Ethics Committee (decision no: 14, date: 19.01.2022).

**Informed Consent:** All participants provided informed consent before inclusion in the study, and necessary permissions were obtained.

### Footnotes

### Authorship Contributions

Surgical and Medical Practices: L.K., S.T.K., O.B., Concept: L.K., S.T.K., O.B., Design: L.K., S.T.K., O.B., Data Collection or Processing: L.K., S.T.K., O.B., Analysis or Interpretation: L.K., S.T.K., Literature Search: L.K., S.T.K., Writing: L.K., S.T.K., O.B.

**Conflict of Interest:** One author of this article, (Okcan BASAT) is a member of the Editorial Board of the Namık Kemal Medical Journal. However, he did not take part in any stage of the editorial decision of the manuscript. The editors who evaluated this manuscript are from different institutions. The other authors declared no conflict of interest.

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