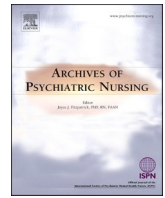




Contents lists available at ScienceDirect

Archives of Psychiatric Nursing

journal homepage: www.elsevier.com/locate/apnu

Development of the diabulimia knowledge level scale

Serap Çetinkaya Özdemir^{a,*}, Vahide Semerci^b, Ebru Sönmez Sari^b^a Faculty of Health Sciences, Department of Internal Medicine Nursing, Sakarya University, Sakarya 54050, Türkiye^b Faculty of Health Sciences, Department of Nursing, Bayburt University, Bayburt 69000, Türkiye

ARTICLE INFO

Keywords:
Diabulimia
Nurse
Reliability
Scale
Validity

ABSTRACT

The aim of this study was to develop the Diabulimia Knowledge Level Scale. The nurses voluntarily participated in the research ($n = 384$). The Diabulimia Knowledge Level Scale consists of 19 items and four factors. The four factors that make up the scale according to the results of Exploratory Factor Analysis explain 68.53 % of the total variance. The total Cronbach alpha coefficient of the scale was found to be 0.92. The Diabulimia Knowledge Level Scale is the first scale developed to determine the level of diabulimia knowledge among nurses. The scale is valid and reliable.

Introduction

Diabulimia is an eating disorder among individuals with type 1 diabetes that, according to the definition of the American National Eating Disorders Association, involves deliberately skipping insulin doses to reduce body weight or prevent weight gain (Hoffmann, 2019). Diabulimia can be life-threatening and may lead to serious problems in individuals with type 1 diabetes (Cleveland Clinic, 2022). In a study conducted in 2017, it was found that 25 % of individuals with type 1 diabetes were at risk of diabulimia, while in a study conducted in 2021, this rate was 31.8 % (Atik Altınok et al., 2017; Şahin-Bodur et al., 2021).

The etiology of diabulimia is not precisely known, but genetic, biological, and environmental factors are thought to be influential (Goebel-Fabbri, 2009; Hanlan et al., 2015). In a study conducted with individuals with diabulimia, it was stated that weight gain may disrupt self-image, create dissatisfaction with the body, and reduce self-esteem. For these reasons, individuals may reduce their insulin doses or stop using insulin in order to remain underweight (Braga Ribeiro et al., 2021).

Diabulimia has negative effects on health and can cause serious conditions, from simple to severe complications (Darbar & Mokha, 2008; Goddard & Oxlad, 2022a; Goddard & Oxlad, 2022b). Complications due to diabulimia increase the morbidity and mortality rates among these patients (Şahin et al., 2018). Individuals with diabulimia may have elevated blood glucose, increased HbA1c levels, headache, fatigue, weakness, glucosuria, and excessive weight loss (Diabetes UK, 2022; Goddard & Oxlad, 2022a; Goddard & Oxlad, 2022b; Ruth-Sahd et al., 2009; Schober et al., 2011). In addition, hypoglycemia, growth deficiency, osteoporosis, muscle atrophy, vomiting, deterioration of oral

health, and ketoacidosis may develop in these individuals (Darbar & Mokha, 2008; Diabetes UK, 2022; Şahin et al., 2018).

In the literature, it is recommended to use various valid and reliable screening tools to identify the presence of diabulimia (Markowitz et al., 2010; Zuijdwijk et al., 2014). The American Diabetes Association (ADA) has stated that the Diabetes Eating Problem Survey-Revised (DEPS-R) is a valid and reliable screening tool to determine eating behavior disorders in individuals with diabetes (American Diabetes Association, 2020). The Turkish validity and reliability study of that scale was conducted by Atik Altınok et al. in 2017 (Atik Altınok et al., 2017). The mSCOFF screening tool is also used for eating disorder screening in cases of type 1 diabetes mellitus. It has been stated that the mSCOFF, which is a very simple screening tool, can be applied to individuals at risk of diabulimia during routine clinical visits (Zuijdwijk et al., 2014). There appear to be a variety of scales and screening tools that can identify individuals with diabulimia or reveal the risk of diabulimia in individuals (Atik Altınok et al., 2017; Markowitz et al., 2010; Zuijdwijk et al., 2014).

Health professionals should treat individuals with type 1 diabetes for diabulimia risk factors and symptoms (Braga Ribeiro et al., 2021; Loretto et al., 2020; Zuijdwijk et al., 2014). In one study, individuals with diabulimia stated that health professionals should know more about diabulimia (Goddard & Oxlad, 2022a; Goddard & Oxlad, 2022b). In a different study, it was reported that it was important for health professionals to have more awareness about diabulimia (Poos et al., 2022). In light of this information, it can be concluded that nurses, among health professionals, need more information about diabulimia (Goddard & Oxlad, 2022a; Goddard & Oxlad, 2022b; Poos et al., 2022) because

* Corresponding author at: Sakarya University, Faculty of Health Sciences, Department of Internal Medicine Nursing, Sakarya 54050, Türkiye.
E-mail address: serapc@sakarya.edu.tr (S. Çetinkaya Özdemir).

<https://doi.org/10.1016/j.apnu.2023.09.003>

Received 2 February 2023; Received in revised form 3 September 2023; Accepted 17 September 2023

Available online 18 September 2023

0883-9417/© 2023 Elsevier Inc. All rights reserved.

nurses spend more time with individuals with diabetes and have more opportunities to observe patients and manage their treatment and care processes. However, there is no measurement tool in the literature to determine the level of knowledge of nurses about diabulimia. The aim of this study was to develop the Diabulimia Knowledge Level Scale and to test the validity and reliability of this new scale in nurses. The newly developed scale measures the knowledge levels of nurses about diabulimia and will contribute to increasing their awareness and knowledge levels.

Methods

Design

This was a cross-sectional methodological study.

Settings and sample

The scope of the study consisted of nurses working in Türkiye. Sampling was performed by the snowball method. The sample size of this sort of studies is recommended to be 5 to 50 times higher than the total number of items in the literature (Karakoç & Dönmez, 2014). After expert opinion, there are 38 items in the item pool. For the sample of the present study, it was aimed to enroll participants numbering at least 10 times the number of scale items pool (38 items). Thus, the study included 384 nurses aged 18 and over who volunteered between October 2022 and December 2022.

Instruments

A personal information form and the Diabulimia Knowledge Level Scale item pool were used as data collection tools.

Personal Information Form: In this form prepared by the researchers, there were 8 questions addressing variables such as age, gender, education, marital status, and unit of employment.

Diabulimia Knowledge Level Scale Item Pool: A pool of 41 items was created by means of a literature review (Hoffmann, 2019; Markowitz et al., 2010; Ruth-Sahd et al., 2009). As the number of options increases in Likert-type scales, it can potentially enhance the validity and reliability of the scale. However, a high number of options in Likert scales can also introduce usability challenges. For this reason, the five-point Likert scale is often preferred in research (Preston & Colman, 2000). The scale was prepared in the format of a 5-point Likert-type scale, where 1 = Strongly disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, and 5 = Strongly agree. There are 8 reverse-scored items in the scale item pool (Items 4, 5, 8, 9, 15, 24, 35, 37).

Procedure

Permission was obtained from the ethics committee of the relevant university. The literature on developing Likert-type scales was examined (Tezbaşaran, 2008) and a 5-point Likert-type item pool referred to as “Diabulimia Knowledge Level Scale” was prepared. The prepared item pool was presented to a faculty member from the Department of Turkish Language and Literature in terms of compliance with Turkish language rules and its accuracy was checked. The created item pool was then sent to 10 experts on the subject for their opinions. These experts were asked to rate the items in terms of relationships, simplicity, and clarity. Experts scored each item according to the following 4-point scale: 1 = Incompatible, 2 = Needs significant corrections, 3 = Needs minor corrections, 4 = Very compatible. After obtaining the opinions of the experts, the content validity index (CVI) was calculated with the Davis technique. Items with CVI values below 0.80 were removed (Lindsey, 1992). The item pool, which was arranged in its final form after obtaining the expert opinions, was first applied online (via google form) to 30 nurses with characteristics similar to those of the sample. These 30 nurses were not

included in the study sample. Subsequently, it was applied online to the study sample of 384 nurses. In the next stage, the construct validity of the scale was evaluated. In repeated applications of the Diabulimia Knowledge Level Scale, the test-retest method was used to determine the likelihood of obtaining similar measurement values. This demonstrates the scale's invariance, indicating that similar responses are obtained when the measurement tool is administered to the same individuals at different times. The test-retest interval should be between 2 and 6 weeks, and the sample size should consist of at least 30 people (Büyükoztürk, 2017). The scale was applied twice for 30 nurses at an interval of 3 weeks.

Analysis

IBM SPSS Statistics 25 was used in the analysis of the data. Numbers and percentage ranges were calculated for the personal information of the sample. The CVI was evaluated with the Davis technique. Exploratory factor analysis (EFA) was applied with half of the sample ($n = 192$) to determine the construct validity of the Diabulimia Knowledge Level Scale. Kaiser-Meyer-Olkin (KMO) and Bartlett tests were applied for factor analysis. Confirmatory factor analysis (CFA) was performed for the other half of the sample ($n = 192$) with AMOS 21 to confirm the EFA results. To calculate the reliability of the scale, Cronbach alpha coefficients were calculated for internal consistency. Pearson correlations and paired samples *t*-tests were used to determine the test-retest reliability of the scale. Item-total correlations were calculated for item analysis. The Tukey test of additivity was applied to determine the total quality of the scale and the Hotelling T^2 test was applied to evaluate response bias.

Ethical consideration

Ethics committee approval (19.10.2022/Decision No: 220/11) was obtained before the study. The participants were informed about the study in accordance with the Declaration of Helsinki and their consent was obtained online via an informed consent form. All participants were included in the study on a voluntary basis.

Results

The mean age of the nurses participating in the study was 33.05 ± 7.72 (range: 21–60) years, 89.1 % of the participants were women, 67.7 % were graduates of undergraduate programs, 66.1 % were married, 61.7 % had income equal to their expenses, 73.2 % lived in the city center, 35.7 % worked in a training and research hospital, and 42.2 % had worked in this field for >11 years. In addition, 79.2 % of the participants had cared for a patient with diabetes, 63.5 % had previously seen patients with eating disorders related to diabetes, and 7.3 % had previously worked as diabetes nurses.

Content validity

The Diabulimia Knowledge Level Scale item pool with a total of 41 items was sent to expert opinion. A total of 10 experts' opinions were obtained to evaluate the validity of the item pool. Based on the answers obtained from these experts, the CVI was calculated using the Davis technique for each item. The experts evaluated the scale items for content validity in terms of relationships, simplicity, and clarity. The 14th item, which had a CVI of <0.80, was removed, as were items 3, 40, and 41 in line with the obtained recommendations. Additionally, an item was added in line with the suggestions (item 13). In terms of relationships, the CVI was 0.97; in terms of simplicity, the CVI was 0.92; and in terms of clarity, the CVI was 0.95. According to these results, the validity of the revised item pool was sufficient.

Construct validity

Construct validity was tested using factor analysis. Before the factor construct of the scale was examined, KMO analysis was conducted to evaluate the adequacy of the sample for factor analysis and the Bartlett test was applied to evaluate its compatibility. The KMO score of the scale was 0.86 and the Bartlett test results were $\chi^2 = 3817.3$, $p = 0.000$.

In the EFA of the scale, a correlation matrix related to the factors was applied with the principal components method and the varimax conversion method was used. The eigenvalue was accepted as 1.00 and the factor load was 0.50. Factor loads, eigenvalues, and variances of the dimensions obtained in the factor analysis of the scale are given in Table 1.

The four factors that make up the scale as a result of EFA explain 68.53 % of the total variance. Items 6, 7, 13, 15, 16, 25, 35, 36, and 38 in the item pool were removed because they did not load on any factor, and items 8 and 24 loaded on more than one factor. In addition, items loading on possible factors with ≤ 2 items (items 4, 5, 9, 14, 26, 27, 28, and 37) were removed from the scale. As a result, the finalized scale consisted of 19 items and 4 factors (Table 1).

CFA analysis was conducted using AMOS. The maximum likelihood estimation method was selected. Model concordance values in CFA were $\chi^2 = 448.853$, $df = 146$, $p = 0.000$, $\chi^2/df = 3.074$, $NFI = 0.82$, $CFI = 0.87$, $RMSEA = 0.104$, $RMR = 0.07$, $GFI = 0.78$, $RFI = 0.79$, $IFI = 0.87$, and $TLI = 0.85$.

The factor loads of the scale items in relation to CFA were indicated with a path diagram. In the diagram shown in Fig. 1, factor loads are between 0.56 and 0.89 considering standardized parameter values. The factor loads for the dimension of general information are between 0.60 and 0.73. The factor loads for behaviors are between 0.56 and 0.85. The factor loads for psychological effects ranged from 0.62 to 0.89, and the factor loads for physiological effects ranged from 0.65 to 0.87 (Fig. 1).

Test-retest reliability

In repeated measurements of the Diabulimia Knowledge Level Scale, the test-retest method was used to determine the likelihood of obtaining similar measurement values. The scale was applied twice for 30 nurses at an interval of 3 weeks.

When the test-retest correlations for the total and factors scores of the Diabulimia Knowledge Level Scale were examined, it was found that they had values between 0.44 and 0.76 (Table 2). According to the results of the paired samples *t*-test, there was no difference between the first and second application ($p = 0.154$). According to the results of the analysis, the averages of the first (mean \pm SD: 76.83 \pm 10.50) and second (mean \pm SD: 78.70 \pm 9.66) applications were very close to each other, which shows that the scale is reliable.

Internal consistency and item analysis

The reliability of the scale was evaluated by internal consistency coefficients (Cronbach alpha coefficient) and item analyses. The total and factor Cronbach alpha coefficients and scale score averages are given in Table 3. The total Cronbach alpha coefficient (0.92) of the scale signified high reliability (Table 3).

In this study, item-total and item-distinctiveness indices were calculated in item analysis procedures. The item-total correlations of the items in the scale were found to be between 0.389 and 0.749 (Table 4).

A 27 % lower-upper group comparison was made to observe the distinctiveness of the items in the scale. The scores of the participants were ranked from highest to lowest, and 104 subgroups and 104 upper groups were created. Independent samples *t*-tests were applied between the lower and upper groups. The distinctiveness index of each item of the scale was calculated. Accordingly, a statistically significant difference was found between the mean of the lower and upper groups ($p < 0.05$). The *t*-values indicating the item distinctiveness coefficients

Table 1

Exploratory factor analysis of the diabulimia knowledge level scale.

Items	F1: General information	F2: Behaviors	F3: Psychological effects	F4: Physiological effects
1-Individuals with diabulimia intentionally skip insulin doses	0.776			
2-Diabulimia occurs among type 1 diabetics	0.852			
3-Diabulimia is more common during adolescence	0.592			
10-Individuals with diabulimia skip meals to lose weight		0.765		
11-Individuals with diabulimia may use laxatives (medications causing bowel movements) to lose weight		0.826		
12-Individuals with diabulimia may intentionally induce vomiting to lose weight		0.817		
17-Individuals with diabulimia are not satisfied with their bodies			0.571	
18-Individuals with diabulimia care very much about their appearances			0.664	
19-Individuals with diabulimia may display depressive behaviors			0.816	
20-The self-esteem of individuals with diabulimia is low			0.709	
21-Individuals with diabulimia may display obsessive behaviors			0.840	
22-Lack of concentration can be observed in individuals			0.776	

(continued on next page)

Table 1 (continued)

Items	F1: General information	F2: Behaviors	F3: Psychological effects	F4: Physiological effects
with diabulimia				
23-The moods of individuals with diabulimia change constantly			0.707	
29-Diabulimia can cause growth deficiency in adolescents				0.594
30-Individuals with diabulimia have weakness/fatigue				0.734
31-Urinary tract infections can be seen in individuals with diabulimia				0.736
32-Muscle loss can be seen in individuals with diabulimia				0.779
33-Individuals with diabulimia may have osteoporosis (bone resorption) in the long term				0.786
34-Menstrual irregularities can be seen in women with diabulimia				0.730
Eigenvalue	8.73	1.56	1.39	1.32
Variance explained (%)	23.36	20.72	13.74	10.70
Cumulative percentage (%)	23.36	44.08	57.82	68.53

ranged between 8.600 and 19.701 (Table 4).

As a result of the examination of the total quality of the scale with the Tukey test of additivity, which indicates whether we can take a scale's score into account as a single score by adding the scores of the factors of the scale, the score for non-additivity was $F = 0.049$, $p = 0.824$.

Finally, whether the reactions of participants to scale items were the same or not was evaluated by the Hotelling T^2 test. As a result, the Hotelling score for the Diabulimia Knowledge Level Scale was found to be $T^2 = 268.172$, $p = 0.000$. Thus, it was determined that the scale did not have the problem of reaction bias.

Diabulimia Knowledge Level Scale final version is given in Table 5.

Discussion

Previous studies have focused on the development of a variety of scales and screening tools that can identify individuals with diabulimia or reveal the risk of diabulimia among patients (Atik Altınok et al., 2017; Markowitz et al., 2010; Zuijdewijk et al., 2014). In the literature to date, however, there is no measurement tool for determining the level of knowledge of nurses about diabulimia. For this reason, the Diabulimia

Knowledge Level Scale was developed in the present study and it was found that this new scale is highly valid and reliable.

The Davis technique was used to determine content validity in this study. Using the Davis technique, a CVI value of >0.80 was obtained, which shows that content validity was achieved (Lindsey, 1992). According to this result, the scale's content validity was ensured in this study.

The fact that the KMO score was >0.80 for factor analysis showed that a very good fit was obtained. In the evaluation of the Barlett test, values of $p < 0.05$ indicate that the correlation matrix is significant, the dataset is appropriate, and the sample is sufficient (Kamiloğlu & Vural, 2022; Tavşancıl, 2006). In our study, according to the results of the KMO and Bartlett tests, the sample was sufficient and the dataset was suitable for factor analysis.

In EFA, which is used in scale development studies for construct validity, it is recommended to remove items with factor loads of <0.50 from the scale (Karagöz, 2020). It is also desirable to have at least three items per factor (Şencan, 2005). In our study, items with factor loads of <0.50 , items not loading on any factor or loading on more than one factor, and items loading on possible factors with ≤ 2 items were removed from the scale. In determining scale factors, it is generally accepted that factors with eigenvalues of >1.00 are significant, and the factor structure of a scale is stronger as the variance rate increases (Büyükoztürk, 2017; Gürbüz & Şahin, 2017). Variance rates between 40 % and 60 % are considered sufficient (Gürbüz & Şahin, 2017). In our study, it was seen that the current scale items explained 68.53 % of the total variance and all factor equivalents were above 1.00. Thus, it can be said that the construct validity of the newly developed Diabulimia Knowledge Level Scale is strong.

When CFA compliance indices are examined, the values obtained for CMIN/df, NFI, CFI, RMSEA, RMR, GFI, RFI, IFI, and TLI data should be at the desired levels (Hooper et al., 2008; Schermelleh-Engel et al., 2003; Simon et al., 2010). In our study, the whole scale showed acceptable compliance with these criteria.

Test-retest analysis is conducted to determine the reliability of a scale. Values of 0.00–0.25 are considered to be very weak while values of 0.26–0.49 reflect weak, 0.50–0.69 medium, 0.70–0.89 high, and 0.90–1.00 very high correlation (Büyükoztürk, 2017; Gözüm & Aksayan, 2003; Şencan, 2005; Tavşancıl, 2006). In our study, it was determined that the total and factor scores of the Diabulimia Knowledge Level Scale had values of 0.44–0.76 according to test-retest correlations. In addition, since there was no difference between the averages of the first and second applications as a result of the test-retest analysis, it was concluded that the scale is not affected by time and is reliable.

In determining reliability, the Cronbach alpha coefficient should be above 0.70 (Ping et al., 2018). For the four factors of the Diabulimia Knowledge Level Scale, the Cronbach alpha reliability coefficients were >0.70 . The fact that the Cronbach alpha coefficients were in the range of $0.80 \leq \alpha < 1.00$ indicated that the reliability of the new scale is high (Özdamar, 2002). It can also be said that the reliability of the total Diabulimia Knowledge Level Scale is high as the Cronbach alpha coefficient for the total scale was 0.92.

Item analysis is one of the methods used to determine internal consistency. Item-total correlations describe the relationship between the scores of test items and the total score of the scale. When item-total correlations are positive and high, it can be concluded that the items reflect similar behaviors and the internal consistency of the scale is high (Büyükoztürk, 2017; Şencan, 2005; Tavşancıl, 2006). In the literature, it is recommended to remove items with item correlation coefficients of <0.30 from scales (Gözüm & Aksayan, 2003; Şencan, 2005). Item-total results are expected to be statistically significant ($p < 0.05$). In our study, since the item-total correlation was positive and high, it was concluded that the internal consistency of the scale was high. Item distinctiveness, on the other hand, is a comparison of the average score given to each item by lower and upper groups of 27 % when participants are ranked from the highest score to the lowest score according to the total scores

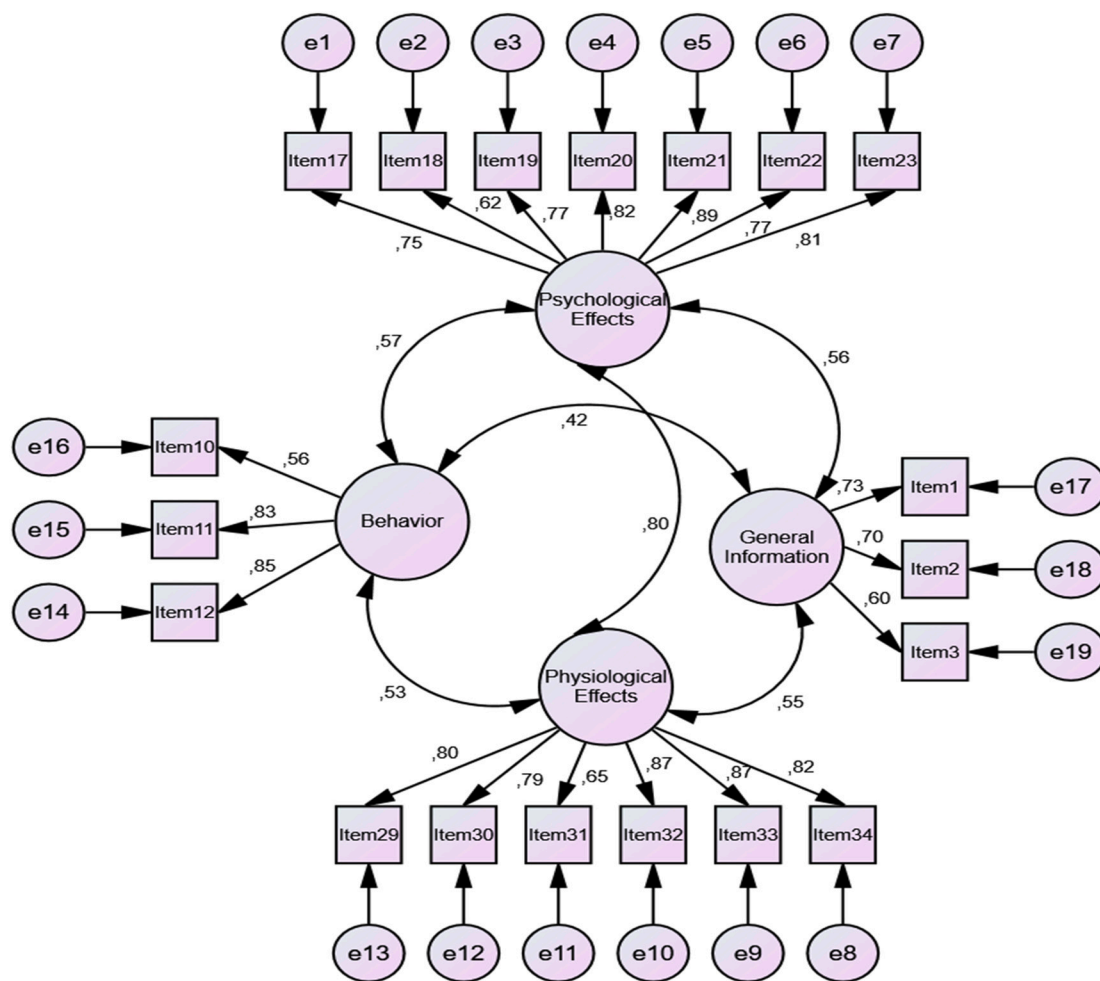


Fig. 1. Path diagram.

Table 2
Test-retest correlation results for diabulimia knowledge level scale.

First application	Second application										
	General information		Behaviors		Psychological effects		Physiological effects		General		
	r	p	r	p	r	p	r	p	r	p	
General Information	0.49	0.00*									
Behaviors			0.44	0.01*							
Psychological Effects					0.49	0.00*					
Physiological Effects							0.73	0.00*			
General									0.76	0.00*	

r: pearson correlations.
* p < 0.05.

Table 3
Cronbach alpha coefficients of the diabulimia knowledge level scale (n = 384).

Factor label	No. of items	Cronbach alpha coefficient	Mean ± SD (Min-Max)
General information	3	0.70	10.44 ± 2.77 (3–15)
Behaviors	3	0.81	10.19 ± 3.01 (3–15)
Psychological effects	7	0.91	27.39 ± 5.33 (7–35)
Physiological effects	6	0.90	23.07 ± 4.61 (8–30)
Total	19	0.92	71.10 ± 12.85 (26–95)

obtained for the scale. The difference between the averages of the lower and upper groups is compared with the independent samples t-test, and there should be a significant difference between these two groups (Karagöz, 2020). Since there was a statistically significant difference between the averages of the lower and upper groups in our study, all items of the scale can be said to have distinctiveness. If the Cronbach alpha coefficient increases when an item is removed from the scale, the reliability of that item decreases and it needs to be removed from the scale (Çam & Baysan Arabacı, 2010; Çapık, 2015; Gözümlü & Aksayan, 2003). In the present study, when relevant items were removed and alpha coefficients were reexamined, no significant increases were seen and no items were removed.

In an examination of the total quality of the scale with the Tukey test

Table 4

Item analysis results of diabulimia knowledge level scale and internal consistency coefficients ($n = 384$).

Item no.	Item total	Item distinctiveness*	Cronbach alpha when item is removed
Item 1	0.506	12.863	0.929
Item 2	0.389	8.600	0.932
Item 3	0.478	11.836	0.929
Item 4	0.529	12.548	0.928
Item 5	0.559	13.028	0.927
Item 6	0.569	13.547	0.927
Item 7	0.687	17.530	0.924
Item 8	0.653	19.701	0.925
Item 9	0.677	17.616	0.925
Item 10	0.691	16.829	0.924
Item 11	0.749	19.305	0.923
Item 12	0.676	15.678	0.925
Item 13	0.720	17.377	0.924
Item 14	0.708	18.603	0.924
Item 15	0.734	18.991	0.924
Item 16	0.569	13.155	0.927
Item 17	0.707	18.616	0.924
Item 18	0.683	15.729	0.924
Item 19	0.677	18.074	0.925

* $p < 0.05$.

Table 5

Diabulimia knowledge level scale.

1	Individuals with diabulimia intentionally skip insulin doses
2	Diabulimia occurs among type 1 diabetics
3	Diabulimia is more common during adolescence
4	Individuals with diabulimia skip meals to lose weight
5	Individuals with diabulimia may use laxatives (medications causing bowel movements) to lose weight
6	Individuals with diabulimia may intentionally induce vomiting to lose weight
7	Individuals with diabulimia are not satisfied with their bodies
8	Individuals with diabulimia care very much about their appearances
9	Individuals with diabulimia may display depressive behaviors
10	The self-esteem of individuals with diabulimia is low
11	Individuals with diabulimia may display obsessive behaviors
12	Lack of concentration can be observed in individuals with diabulimia
13	The moods of individuals with diabulimia change constantly
14	Diabulimia can cause growth deficiency in adolescents
15	Individuals with diabulimia have weakness/fatigue
16	Urinary tract infections can be seen in individuals with diabulimia
17	Muscle loss can be seen in individuals with diabulimia
18	Individuals with diabulimia may have osteoporosis (bone resorption) in the long term
19	Menstrual irregularities can be seen in women with diabulimia

of additivity, which indicates whether we can consider the results of the scale as a single score by adding the scores of the items of the scale, it was determined that non-additivity was statistically insignificant ($p > 0.05$). In other words, the newly developed Diabulimia Knowledge Level Scale is additive.

The Hotelling T^2 test is used to determine response bias, which affects both the reliability and validity of a scale (Karagöz, 2020). The Hotelling T^2 test results for the Diabulimia Knowledge Level Scale showed that the scale is not affected by response bias.

Strengths and limitations of the study

In the literature to date, there is no measurement tool for evaluating the level of knowledge of nurses about diabulimia. The main strength of this study is that it offers the first measurement tool to determine the level of knowledge of nurses about diabulimia.

The study has several limitations. First, it was conducted only with Turkish nurses aged 18 and over, and second, the data were collected only through online forms.

Conclusions

The Diabulimia Knowledge Level Scale has sufficient validity and reliability. The scale consists of 19 items scored with a 5-point Likert-type system within four factors. The scale has no inverse items. As the total score increases, the level of knowledge of diabulimia increases. The minimum possible score is 19 and the maximum score is 95.

This newly developed scale measures the knowledge levels of nurses about diabulimia and it will contribute to increasing their awareness and knowledge levels. This will positively affect the quality of care and service provided to individuals with diabulimia.

The Diabulimia Knowledge Level Scale is recommended for use by health professionals and students in medical fields who will provide care and services to individuals with diabulimia.

Funding information

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRedit authorship contribution statement

Serap Çetinkaya Özdemir: Conceptualization, Methodology, Investigation, Writing - Original Draft, Writing - Review; Analysis, Editing, Visualization, Project administration. **Vahide Semerci:** Conceptualization, Methodology, Investigation, Writing - Original Draft, Writing - Review, Analysis, Editing, Visualization. **Ebru Sönmez Sarı:** Conceptualization, Methodology, Investigation, Writing - Original Draft, Writing - Review, Analysis, Editing, Visualization.

Declaration of competing interest

The authors are in agreement with the manuscript and there is no conflict of interests regarding publication. This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Data availability

All relevant data are within the paper and its supporting information files.

Acknowledgment

The authors are grateful to the nurses who participated in study.

References

- American Diabetes Association. (2020). 13. Children and adolescents: Standards of medical care in diabetes—2020. *Diabetes Care*, 43(Supplement 1), 163–182. <https://doi.org/10.2337/dc20-S013>
- Atik Altunok, Y., Özgür, S., Meseri, R., Özen, S., Darcan, Ş., & Gökşen, D. (2017). Reliability and validity of the diabetes eating problem survey in Turkish children and adolescents with type 1 diabetes mellitus. *Journal of Clinical Research in Pediatric Endocrinology*, 9(4), 323–328. <https://doi.org/10.4274/jcrpe.4219>
- Braga Ribeiro, L., Maurício Pieper, C., Andrade Frederico, G., Antar Gamba, M., & da Silva Rosa, A. (2021). The relationship between women with diabetes and their body: The risk of diabulimia. *Escola Anna Nery Revista de Enfermagem*, 25(4), 1–8. <https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=149825312&site=ehost-live>
- Büyükoztürk, Ş. (2017). *Sosyal bilimler için veri analizi el kitabı*. Pegem Akademi.
- Çam, M. O., & Baysan Arabacı, L. (2010). Qualitative and quantitative steps on attitude scale construction. *Journal of Education and Research in Nursing*, 59–71.
- Çapık, C. (2015). Use of confirmatory factor analysis in validity and reliability studies. *Journal of Anatolia Nursing and Health Sciences*, 17(3), 196–203.
- Cleveland Clinic. (2022). Diabulimia. Retrieved from <https://my.clevelandclinic.org/health/diseases/22658-diabulimia> [Accessed December 12, 2022].
- Darbar, N., & Mokha, M. (2008). Diabulimia: A body-image disorder in patients with type 1 diabetes mellitus. *Athletic Therapy Today*, 13(4), 31–33. <https://doi.org/10.1123/att.13.4.31>

- Diabetes UK. (2022). Eating disorders and diabetes. Retrieved from <https://www.diabetes.org.uk/guide-to-diabetes/emotions/eating-disorders-and-diabetes> Accessed December 12, 2022.
- Goddard, G., & Oxlad, M. (2022a). Caring for individuals with type 1 diabetes mellitus who restrict and omit insulin for weight control: Evidence-based guidance for healthcare professionals. *Diabetes Research and Clinical Practice*, 185(February), Article 109783. <https://doi.org/10.1016/j.diabres.2022.109783>
- Goddard, G., & Oxlad, M. (2022b). Insulin restriction or omission in type 1 diabetes mellitus: A meta-synthesis of individuals' experiences of diabulimia. *Health Psychology Review*, 1–20. <https://doi.org/10.1080/17437199.2021.2025133>
- Goebel-Fabrizi, A. E. (2009). Disturbed eating behaviors and eating disorders in type 1 diabetes: Clinical significance and treatment recommendations. *Current Diabetes Reports*, 9(2), 133–139. <https://doi.org/10.1007/s11892-009-0023-8>
- Gözüm, S., & Aksayan, S. (2003). A guide for transcultural adaptation of the scale II: Psychometric characteristics and cross-cultural comparison. *Journal of Research and Development in Nursing*, 1, 3–14.
- Gürbüz, S., & Şahin, F. (2017). *Sosyal bilimlerde araştırma yöntemleri felsefe- yöntem-analiz. Seçkin Yayıncılık*.
- Hanlan, M. E., Griffith, J., Patel, N., & Jaser, S. S. (2015). Eating disorders and disordered eating in type 1 diabetes: Prevalence, screening, and treatment options compliance with ethics guidelines conflict of interest. *Current Diabetes Reports*, 1(1), 1–14. <https://doi.org/10.1007/s11892-013-0418-4>
- Hoffmann, B. (2019). Diabulimia - cultural determinants of eating disorders. *Trakia Journal of Sciences*, 17(2), 187–195. <https://doi.org/10.15547/tjs.2019.02.013>
- Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, 6(1), 53–60.
- Kamiloğlu, N., & Vural, P. I. (2022). The Turkish validity and reliability study of fertility desire scale. *YÖBU Faculty of Health Sciences Journal*, 3(1), 1–13.
- Karagöz, Y. S. B. (2020). *Bilimsel araştırmalarda kullanılan ölçme ve araçları ve ölçek geliştirme*. Nobel Yayınları.
- Karakoç, F. Y., & Dönmez, L. (2014). Basic principles of scale development. *Tıp Eğitimi Diniyat*, 13(40), 39–49. <https://doi.org/10.25282/ted.228738>
- Lindsey, D. L. (1992). Instrument review: Getting the most from a panel of experts. *Applied Nursing Research*, 5(4), 194–197. [https://doi.org/10.1016/S0897-1897\(05\)80008-4](https://doi.org/10.1016/S0897-1897(05)80008-4)
- Loretto, L., Pes, G. M., Dore, M. P., Milia, P., & Nivoli, A. (2020). Eating disorders and diabetes: Behavioural patterns and psychopathology. Two case reports. *Rivista di Psichiatria*, 55(4), 240–244. <https://doi.org/10.1708/3417.34001>
- Markowitz, J. T., Butler, D. A., Volkening, L. K., Antisdell, J. E., Anderson, B. J., & Laffel, L. M. B. (2010). Brief screening tool for disordered eating in diabetes: Internal consistency and external validity in a contemporary sample of pediatric patients with type 1 diabetes. *Diabetes Care*, 33(3), 495–500. <https://doi.org/10.2337/dc09-1890>
- Özdamar, K. (2002). *Güvenirlilik ve soru analizi paket programlar ile istatistiksel veri analizi*. Etam.
- Ping, W., Cao, W., Tan, H., Guo, C., Dou, Z., & Yang, J. (2018). Health protective behavior scale: Development and psychometric evaluation. *PLoS One*, 13(1), 1–12. <https://doi.org/10.1371/journal.pone.0190390>
- Poos, S., McGowan, K. R., & Martin, A. (2022). A case of diabulimia in a 23-year-old woman with extensive comorbidities. *Journal of the Academy of Consultation-Liaison Psychiatry*, 63, S164. <https://doi.org/10.1016/j.jaclp.2022.10.108>
- Preston, C. C., & Colman, A. M. (2000). Optimal number of response categories in rating scales: Reliability, validity, discriminating power, and respondent preferences. *Acta Psychologica*, 104(1), 1–15. [https://doi.org/10.1016/S0001-6918\(99\)00050-5](https://doi.org/10.1016/S0001-6918(99)00050-5)
- Ruth-Sahd, L. A., Schneider, M., & Haagen, B. (2009). Diabulimia: What it is and how to recognize it in critical care. *Dimensions of Critical Care Nursing*, 28(4), 147–153. <https://doi.org/10.1097/DCC.0B013E3181A473FE>
- Şahin, G., Altınok, Y. A., & Keser, A. (2018). Eating behavior disorder in individuals with type 1 diabetes mellitus: Diabulimia. *Mersin University Journal of Health Sciences*, 11(3), 366–375.
- Şahin-Bodur, G., Keser, A., Şıklar, Z., & Berberoğlu, M. (2021). Determining the risk of diabulimia and its relationship with diet quality and nutritional status of adolescents with type 1 diabetes. *Nutrition Clinique et Metabolisme*, 35(4), 281–287. <https://doi.org/10.1016/j.nupar.2021.05.002>
- Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *MPR-Online*, 8(May 2003), 23–74.
- Schober, E., Wagner, G., Berger, G., Gerber, D., Mengl, M., Sonnenstatter, S., Barrientos, I., Rami, B., Karwautz, A., & Fritsch, M. (2011). Prevalence of intentional under- and overdosing of insulin in children and adolescents with type 1 diabetes. *Pediatric Diabetes*, 12(7), 627–631. <https://doi.org/10.1111/j.1399-5448.2011.00759.x>
- Şencan, H. (2005). In H. Şencan (Ed.), *Sosyal ve davranışsal ölçümlerde güvenirlik geçerlilik*. Seçkin Yayıncılık.
- Simon, D., Kriston, L., Loh, A., Spies, C., Scheibler, F., Wills, C., & Härter, M. (2010). Confirmatory factor analysis and recommendations for improvement of the autonomy-preference-index (API). *Health Expectations*, 13(3), 234–243. <https://doi.org/10.1111/j.1369-7625.2009.00584.x>
- Tavşancıl, E. (2006). *Tutumların ölçülmesi ve spss ile veri analizi*. Nobel Yayınları.
- Tezbaşaran, A. (2008). In A. A. Tezbaşaran (Ed.), *Likert tipi ölçek hazırlama kılavuzu*.
- Zuidwijk, C. S., Pardy, S. A., Dowden, J. J., Dominic, A. M., Bridger, T., & Newhook, A. (2014). The mscoff for screening disordered eating in pediatric type 1 diabetes. *Diabetes Care*, 37(2), 26–27. <https://doi.org/10.2337/dc13-1637>