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TURKISH ADAPTATION OF THE DIABETES AWARENESS AND INSIGHT SCALE IN TYPE 2 DIABETICS: RELIABILITY AND VALIDITY STUDY

TİP 2 DİYABETLİLERDE DİYABET FARKINDALIĞI VE İÇGÖRÜ ÖLÇEĞİ'NİN TÜRKÇE UYARLAMASI: GÜVENİRLİK VE GEÇERLİK ÇALIŞMASI

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ABSTRACT

Objective: The aim of this study is to adapt the Diabetes Awareness and Insight Scale (DAS) into Turkish and to conduct its validity and reliability studies.

Methods: This study is a methodological study conducted to examine the validity and reliability of the Turkish version of the DAS. It was carried out with 351 diabetic patients in Istanbul between March 2022 and June 2023. Data were collected using the Patient Information Form, the DAS, the Brief Illness Perception Questionnaire, and the Positive and Negative Affect Schedule. Content Validity Index (CVI) and Confirmatory Factor Analysis (CFA) were used to evaluate the validity of the scale. Reliability was assessed through internal consistency, test–retest reliability, and item–total score correlation analyses. In addition, convergent and discriminant validity of the DAS were examined using the Brief Illness Perception Questionnaire and the Positive and Negative Affect Schedule, respectively.

Results: The one-factor CFA model demonstrated acceptable fit indices (χ^2/df = 2.977, RMSEA = 0.075, CFI = 0.901, TLI = 0.861, SRMR = 0.051), Content Validity Index: 1.0. The DAS demonstrated acceptable internal consistency (Cronbach's alpha = 0.70) and good test–retest reliability over a 25-day interval (r = 0.784). The item-total correlation values ranged between 0.304 and 0.572. The total mean score of DAS was 7.53±0.93. Diabetes awareness of the individuals was above average.

Conclusion: It was determined that the DAS is a valid and reliable measurement tool to evaluate the disease awareness of individuals with diabetes in Türkiye.

Keywords: Diabetes, Diabetes awareness, Validity, Reliability

ÖZ

Amaç: Bu çalışmanın amacı, Diyabet Farkındalık ve İçgörü Ölçeği'ni (DAS) Türkçe'ye uyarlamak ve geçerlik ve güvenirlik çalışmalarını yürütmektir.

Yöntem: Bu çalışma, DAS Türkçe versiyonunun geçerliliğini ve güvenilirliğini incelemek amacıyla yürütülen metodolojik bir çalışmadır. Mart 2022 ile Haziran 2023 tarihleri arasında İstanbul'da 351 diyabetli hasta ile yürütülmüştür. Veriler, Hasta Bilgi Formu, DAS, Kısa Hastalık Algılama Anketi ve Olumlu ve Olumsuz Duygulanım Ölçeği ile toplanmıştır. Ölçeğin geçerlik analizinde İçerik Geçerlik İndeksi ve Doğrulayıcı Faktör Analizi kullanılmıştır. Güvenirlik analizinde ise iç tutarlılık, test–tekrar test güvenirliği ve madde–toplam puan korelasyonu incelenmiştir. Ayrıca, DAS'ın yakınsak (convergent) ve ayırt edici (discriminant) geçerliği, sırasıyla Kısa Hastalık Algılama Anketi ve Olumlu ve Olumsuz Duygulanım Ölçeği ile değerlendirilmiştir.

Bulgular: Tek faktörlü CFA modeline ait uyum indeksleri kabul edilebilir düzeydedir (χ^2/df = 2,977; RMSEA = 0,075; CFI = 0,901; TLI = 0,861; SRMR = 0,051). İçerik Geçerlilik İndeksi: 1,0. DAS genel iç tutarlılık katsayısı (Cronbach alpha 0,70), 25 gün arayla test-tekrar test güvenilirliğini (0,784) göstermiştir. Madde-toplam korelasyon değerleri 0,304 ile 0,572 arasında değişti. DAS toplam puanı ortalaması 7,53 ± 0,93 olarak bulundu. Bireylerin diyabet farkındalığı ortalamanın üzerindeydi.

Sonuç: DAS'ın diyabetli bireylerin hastalık farkındalığını değerlendirmek için geçerli ve güvenilir bir ölçüm aracı olduğu belirlendi.

Anahtar Kelimeler: Diyabet, Diyabet farkındalığı, Güvenirlik, Geçerlik

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Introduction

Diabetes Mellitus (DM) is a prevalent chronic metabolic disease marked by abnormalities in insulin secretion and/or action, resulting in disrupted metabolism of glucose, lipids, and proteins.[1] Before the 21st century, diabetes mellitus was a non-serious health problem in the world. However, it is one of the most important health problems threatening human health today.[2-3] In fact, diabetes is now reaching increasingly serious levels, whether alone or with the complications it causes. The modern lifestyle, which changed relatively with the economic development efforts of countries, the increase in urbanization and the parallel changes in lifestyle along with the conveniences of city life, the increase in the number of young adults with diabetes in recent years as a result of unhealthy diet and sedentary lifestyle, and increased lifespan are also responsible for diabetes reaching alarming levels.[2-3-4] Diabetes mellitus is a worldwide public health problem, regardless of socioeconomic level, and its prevalence is increasing.[5]

Diabetes is a long-term disease that causes many spiritual, emotional, social, and psychosexual problems and conflicts in the individual. It is already difficult for the patient to accept that he has a chronic disease. In addition to this, it is much more difficult to accept that he needs to make changes in his lifestyle. Emotional reactions of diabetic patients to events, their adaptation difficulties, impaired disease awareness, and disease denial are among the common but understudied issues that may contribute negatively to clinical outcomes.[6] In the study it was seen that the individuals still did not have sufficient awareness and knowledge about diabetes.[7] The fact that this situation reflects on the disease and patients do not receive the treatment they should receive, and consequently the majority of patients experience uncontrolled diabetes and complications of diabetes in the early stages, result in additional diseases. Therefore, there is an increasing need to investigate factors that prevent adherence to drug therapy in patients with type 2 diabetes.

Lack of therapeutic knowledge, complex diets, number of multiple injections, and the fact that it will last a lifetime are known as factors negatively affecting compliance to treatment. Patients' perception of the disease is also one of important psychological factors that contributes to their compliance to treatment. Although clinically important, more studies are needed to better understand the extent to which impaired disease awareness contributes to clinical outcomes. The patient with good awareness will also have good compliance. In the literature, there is no disease-specific scale developed to evaluate the disease awareness of individuals with type 2 diabetes. The aim of this study is to adapt the Diabetes Awareness and Insight Scale (DAS) developed by Gerretsen et al. into Turkish and Turkish culture and to its conduct validity and reliability studies.[8] The aim of this study is to adapt the DAS into Turkish and Turkish culture and to conduct its validity and reliability studies.

Methods

Study design and setting

The sample of this methodologically designed study consisted of individuals with type 2 diabetes who applied to the Endocrinology and Metabolism Diseases, Diabetes Polyclinic at a university hospital in Istanbul on Wednesdays and Fridays. The inclusion criteria comprised individuals aged 18–65 years with a diagnosis of type 2 diabetes for a minimum of six months, currently receiving follow-up care at the Endocrinology and Metabolic Diseases Diabetes Outpatient Clinic, who were literate, provided informed consent, and had no visual, auditory, or cognitive impairments that could hinder their ability to complete the study questionnaires.

Sample

Since the reliability and validity study of DAS would be conducted in the study, the sample size was planned by taking into account the number of items in the measurement tool. It is stated in the literature that in reliability and validity studies, it may be sufficient to reach 5 to 10 times more participants than the number of items in the scale.[9,10] The original scale was studied with 100 people, and it was suggested that the scale should be applied in studies with larger sample sizes. In this study, 351 individuals with diabetes who met the study inclusion criteria and participated voluntarily were included in study.[8]

Data Collection

The Patient Information Form consisting of 29 questions, including socio-demographic variables, metabolic and clinical parameters, information on existing complications, and descriptive information specific to the individual and the disease, The DAS, which was developed by Gerettsen et al. in 2019 specifically for the disease and measuring the disease awareness of individuals with diabetes, the 9-item Brief Illness Perception Questionnaire (BIPQ), which was developed by Broadbent et al. in 2006 and whose Turkish reliability and validity study was conducted by Kocaman et al. in 2007, and The Positive and Negative Affects Schedule (PANAS), which was developed by Watson in 1988 and whose Turkish validity and reliability study was conducted by Gençöz in 2000, measuring positive and negative emotions and consisting of 20 items were applied to the individuals included in the study.[8,11-14]

Measuring Instrument

In the study, first the language equivalence-cultural adaptation of DAS was made. First of all, permission was received via e-mail from Philip Gerretsen, who developed the DAS. The language equivalence of the scale was carried out in four stages: translation, back-translation, obtaining expert opinion, and conducting pilot studies. Although the scale had had a translated form into Turkish, the English form of the scale was translated

again into Turkish. First of all, the scale was translated into Turkish by a linguist and a nurse faculty member specialized in diabetes. The most appropriate translation for each item was determined by examining it together with three assistant professors who were experts in diabetes, four nurse faculty members, and three research assistants. In the back translation, a comparison was made with the original form of the scale, and since there was no difference in the expressions and the similarity was high, no changes were made. For the pilot study, the questionnaire was administered face to face to 30 individuals to assess clarity and feasibility; no item-level wording changes were required based on participant feedback. Participants were informed that their involvement in the study was entirely voluntary, and both written and verbal informed consent were obtained from those who agreed to participate. The identities of the participants were kept confidential.

The DAS consist of eight items. Although some items are conceptually grouped in the original study for descriptive purposes, the scale does not include psychometrically defined subscales. Both in the original scale development study and in the present Turkish adaptation study, the DAS was treated as a unidimensional instrument, and all validity and reliability analyses were conducted based on a single-factor structure.

Statistical Analysis

All statistical analyses, including descriptive statistics and tests of reliability and validity, were performed using SPSS Statistics version 26 (licensed) and AMOS version 21. Descriptive statistics for socio-demographic and clinical characteristics were calculated using frequencies, percentages, means, and minimum–maximum values.

Scale validity was evaluated through expert opinion and the Content Validity Index (CVI) to assess linguistic, cultural, and content validity, followed by construct validity analysis using factor analytic techniques. Confirmatory Factor Analysis (CFA) was conducted within the framework of structural equation modeling using a single latent factor model, consistent with the theoretical definition of the DAS as a unidimensional measure. Reliability of the scale was assessed using internal consistency analyses, including the split-half method, Cronbach's alpha coefficient, and item–total score correlations. Temporal stability was examined using test–retest reliability. The split-half method was employed to assess internal consistency by dividing the scale into two equivalent halves and examining the correlation between the two sets of scores.[15,16] A correlation coefficient greater than 0.70 was considered indicative of adequate reliability.[17]

Internal consistency was further evaluated using Cronbach's alpha coefficient, which ranges from 0 to 1, with values between 0.60 and 0.80 indicating acceptable reliability and values above 0.80 indicating high reliability.[16,17]

Item–total correlation analysis was conducted to evaluate the contribution of each item to the total scale score. Correlation coefficients of 0.30 or higher were considered acceptable, while lower values would suggest inadequate item performance.[9]

Test–retest reliability was used to assess the temporal invariance of the scale by re-administering the instrument to the same participants after a 25-day interval. A correlation coefficient greater than 0.70 was interpreted as evidence of satisfactory temporal stability.[18]

Convergent and discriminant validity were evaluated using correlation analyses. Spearman's rank-order correlation coefficient was calculated to examine the relationships between DAS scores and scores obtained from theoretically related and unrelated constructs. Convergent validity was supported by significant correlations with theoretically related measures, whereas discriminant validity was indicated by weak or non-significant correlations with theoretically distinct constructs.[9] In all analyses, p values <0.05 were considered statistically significant within a 95% confidence interval.

Ethical Considerations

For the study, approval was obtained from University Ethics Committee on January 28, 2022 (Session No:2022/01). Before the research, individuals with diabetes were informed about the purpose and process of the study and their consents were obtained with the Informed Volunteer Form. Participation in the study was based on volunteerism. The research was conducted in full compliance with the ethical standards set forth by the Declaration of Helsinki.

Results

351 individuals with type 2 diabetes were included in the study. It was observed that the average age of the individuals was 55.94±9.40 (min:22-max:81), 61% were women, 76.6% lived in a metropolitan city, 54.7% were primary school graduates, 78.3% were married, 61% had minimum income or above. The mean duration of diabetes diagnosis of the participants was observed to be 12.16±7.96 years (min:1-max:39) and 43% were receiving both oral anti-diabetic and insulin therapy. It was determined that 91.4% of the participants administered insulin themselves, 80.6% measured their blood sugar at home, and 58.7% of those who measured their blood sugar at home measured it less than twice. It was found that 46.2% of the participants engaged in physical activity and 43.2% of those who did so did it for 30-45 minutes three times a week. It was observed that, of the participants, 55% had three main meals, 29.6% had two snacks, 65.5% had regular mealtimes, 76.9% saw a diabetes dietician, and 44.4% mostly adapted. While 53.8% of the participants had chronic complications related to diabetes, the most common chronic complication was hypertension (74.6%). It was found that the mean duration of diabetes of the participants was 12.16±7.96 (min: 1-max: 39), the mean HbA1c value was 8.32±2.18 (min: 4.30-max: 21), the mean fasting blood

glucose was 160.44±61.86 mg/dl (min: 60-max: 550), and the mean BMI values was 29.12±6.35kg/m^2 (min: 17.01-max: 74.07) (Table 1).

Table 1. Socio-demographic characteristics (n=351)

Socio-Demographic and Occupational Characteristics of Patients		**n (%)**
Age Mean ± SD (min–max)	55.94 ± 9.40 (22–81)	
Gender	Female Male	214 (61.0) 137 (39.0)
Educational status	Primary school High school University and above	192 (54.7) 81 (23.1) 78 (22.2)
Marital status	Single Married Divorced/widow	21 (6.0) 275 (78.3) 55 (15.7)
Working status	Yes No	116 (33.0) 235 (67.0)

A minimum of 76.6% of the participants (n = 269) experienced at least one diabetes-related health problem (Table 2).

Table 2. Health experiences of individuals with diabetes (n=351)

		n (%)
Do you regularly feel thirsty? Do you drink excessive amounts of water?	Yes No	244 (69.5) 107 (30.5)
Do you urinate very often? Or is your urine excessive?	Yes No	256 (72.9) 95 (27.1)
Do you regularly wake up to urinate during the night?	Yes No	269 (76.6) 82 (23.4)
Do you complain of blurred vision?	Yes No	182 (51.9) 169 (48.1)
Have you lost a significant amount of weight recently?	Yes No	103 (29.3) 248 (70.7)
Do you generally feel tired-exhausted?	Yes No	251 (71.5) 100 (28.5)
Do you have numbness, tingling, burning, or loss of sensation in your feet or hands?	Yes No	193 (55.0) 158 (45.0)

Linguistic and Content Validity Findings of the Scale

For linguistic validity, the scale was independently translated into Turkish by two bilingual experts and subsequently back-translated into English by two different bilingual experts. Content validity was evaluated by an expert panel consisting of four endocrinology specialists and six academic nurses with expertise in diabetes care. Data was collected using the Davis technique (1992). Experts were asked to rate each item on a four-point scale: (a) appropriate, (b) requires minor revision, (c) requires major revision, and (d) not appropriate. In accordance with the Davis method, the Item-Level Content Validity Index (I-CVI) was calculated by dividing the number of experts who rated each item as (a) or (b) by the total number of experts. The analysis showed that all items achieved an I-CVI value of 1.00, indicating excellent item-level content validity. The Scale-Level Content Validity Index (S-CVI/Ave) was calculated as the average of the I-CVI values across all items and was also found to be 1.00, demonstrating excellent overall content validity of the scale.

Construct Validity Analysis

To examine the factor structure of the scale, Exploratory Factor Analysis (EFA) was first conducted using Principal Component Analysis. The communalities of the items ranged from 0.305 to 0.619. The highest communalality values were observed for items S5 (0.619) and S8 (0.614), whereas the lowest value was found for item S1 (0.305). Nevertheless, all items exceeded the commonly accepted threshold of 0.30 in social sciences. Furthermore, the factor loadings of the DAS items ranged between 0.402 and 0.709 (Table 3).

Following the EFA, CFA was performed within the framework of structural equation modeling to verify the theoretically proposed unidimensional structure of the scale. The CFA results demonstrated that the scale consists of eight items loading onto a single latent factor. The model was statistically significant ($p<0.001$). No error covariances were specified in the single-factor model, yet the overall model fit was found to be acceptable.

Evaluation of the model fit indices indicated an acceptable model–data fit ($\chi^2/df = 2.977$, RMSEA = 0.075, CFI = 0.901, TLI = 0.861, SRMR = 0.051). These findings indicate an acceptable level of model–data fit and confirm the unidimensional factor structure of the scale. Overall, the results provide evidence supporting the construct validity of the scale.[21-22]

Scale Reliability

Internal consistency analysis

The internal consistency of the scale was assessed using Cronbach's alpha coefficient, which was found to be 0.70, indicating acceptable internal consistency. Item-deletion analyses revealed that removal of any item did not result in a meaningful increase in the overall alpha coefficient; therefore, no items were excluded from the scale. Item–total correlation coefficients and Cronbach's alpha values if item deleted were calculated for each item. The alpha coefficients ranged from 0.623 to 0.706, supporting the contribution of all items to the overall internal consistency of the scale.

Invariance Analysis

To evaluate the temporal stability of the scale, test–retest reliability was assessed using an interval-based approach. The scale was re-administered via telephone to the first 30 participants from the study sample after a 25-day interval. For the overall DAS scores,

Table 3. Item means, ıtem–total correlations, and factor loadings of the Turkish version of the DAS

Items	Mean ± SD	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted	Factor Loading
1. My health related experiences are due to having diabetes.	6.12 ± 2.56	54.16	37.917	0.346	0.706	0.412
2. I have diabetes.	8.45 ± 1.25	51.83	46.075	0.450	0.662	0.529
3. I NEED to make or maintain healthy life style changes to improve my diet and/or adjust the amount I exercise.	7.57 ± 1.67	52.71	43.534	0.409	0.665	0.486
4. I have normal blood sugar/glucose levels.	7.77 ± 1.08	52.51	48.691	0.361	0.679	0.439
5. I can safely carry on my current lifestyle (i.e. eating/drinking and exercising as I currently do).	7.07 ± 1.38	53.21	47.622	0.304	0.686	0.402
6. My diabetes has led or can lead to negative health consequences (e.g. heart disease, heart attack, stroke, near stroke, kidney disease, vision loss, numbness/tingling/loss of sensation in hands and feet, etc.).	8.08 ± 1.45	52.20	45.985	0.370	0.674	0.415
7. My blood sugar/glucose levels are regularly in the diabetic range (i.e. fasting plasma glucose ≥126 mg/dl or ≥7.0 mmol/L or HbA1c ≥6.5%).	7.66 ± 1.52	52.62	44.202	0.437	0.660	0.561
8. I need blood sugar/glucose lowering treatment (i.e. insulin or medications).	7.56 ± 1.78	52.72	39.413	0.572	0.623	0.709

the correlation coefficient between the first and second measurements was 0.784, indicating good test–retest reliability ($p<0.05$).

Hotelling's T^2 test was used to assess whether mean item scores differed significantly. The results indicated a statistically significant difference across item means (Hotelling's $T^2 = 487.063$, $p<0.05$), suggesting variability in item endorsement rather than uniform responding across items.

If the determination of the reliability level of the scale is evaluated by the scores received from both halves being equal, the scores obtained from both halves of the sample must be similar to each other. The split half method can be performed as odd items-even items or in random order.[15] A strong positive correlation between the two halves of the scale suggests adequate internal consistency. In general, a coefficient value greater than 0.70 is considered acceptable for reliability.[16] The study was divided in half in random order. The correlation value between the two halves was calculated to be 0.647, the Spearman Brown coefficient was calculated to be 0.785, and the Guttman Split Half coefficient was calculated to be 0.777.

According to the Descriptive Statistics for DAS Total Score and Descriptively Grouped Item Clusters, the DAS had a mean score of 7.53±0.93. The mean Disease Perception score was calculated as 5.26±1.37, the mean Positive Emotion score was calculated as 30.13±7.75, and the mean Negative Emotion score was calculated as 20.39±6.95 (Table 4).

Table 4. Descriptive statistics for DAS total score and descriptively grouped item clusters

	Minimum	Maximum	Mean ± SD
DAS Total Mean Score	5.00	9.63	7.53 ± 0.93
Descriptively grouped items: General disease awareness (Items 2, 4, 7)	5.33	9.67	7.96 ± 0.95
Descriptively grouped items: Symptom attribution (Item 1)	1.00	10.00	6.12 ± 2.56
Descriptively grouped items: Awareness of need for treatment (Items 3, 5, 8)	2.67	9.67	7.40 ± 1.19
Descriptively grouped items: Awareness of negative consequences (Item 6)	3.00	10.00	8.08 ± 1.45
Illness Perception	1.13	8.50	5.26 ± 1.37
Positive Affect	10.00	50.00	30.13 ± 7.75
Negative Affect	10.00	41.00	20.39 ± 6.95

Correlation analyses revealed that DAS total scores were positively and weakly associated with illness perception ($r=0.310$, $p<0.001$), supporting convergent validity. No statistically significant relationship was observed between DAS scores and Positive Affect ($r=-0.006$, $p=0.914$), indicating adequate discriminant validity. In contrast, DAS total scores showed a weak but statistically significant positive correlation with Negative Affect ($r=0.133$, $p=0.013$), suggesting partial conceptual overlap while still supporting discriminant validity (Table 5).

Table 5. Relationship between DAS, BIPQ, and PANAS (Spearman correlation analysis)

		1	2	3	4	5	6	7	8
1.DAS	r	1.000							
	p	.							
2.Disease Awareness	r	0.735**	1.000						
	p	0.000							
3.Symptom Attribution	r	0.648**	0.314**	1.000					
	p	0.000	0.000	.					
4.Awareness of Need for Treatment	r	0.822**	0.480**	0.307**	1.000				
	p	0.000	0.000	0.000	.				
5.Awareness of Negative Consequences	r	0.542**	0.315**	0.228**	0.351**	1.000			
	p	0.000	0.000	0.000	0.000	.			
6.Illness Perception	r	0.310**	0.218**	0.177**	0.302**	0.161**	1.000		
	p	0.000	0.000	0.001	0.000	0.003	.		
7.Positive Affect	r	-0.022	-0.098	0.045	-0.043	0.097	-0.059	1.000	
	p	0.686	0.067	0.404	0.418	0.068	0.269	.	
8.Negative Affect	r	0.133*	0.047	0.123*	0.114*	0.089	0.430**	-0.084	1.000
	p	0.013	0.384	0.021	0.033	0.096	0.000	0.114	.

Discussion

In this study, the validity and reliability analyze were conducted to adapt the Diabetes Awareness and Insight Scale, which was developed to determine the self-awareness and insight of individuals with type 2 diabetes, into Turkish.

The concept of validity is defined as the extent to which a measurement tool accurately measures the feature it aims at, and there are three common types: content, construct, and criterion.[16,14,25] Since content validity is a prerequisite for validity evaluation, it is the first validity analysis to be evaluated. In order to evaluate the content validity of the scale, the opinions of a group of 10 experts in the field of diabetes were consulted. The content validity index obtained from the opinions received using the Davis technique was 1.0. An evaluation result of 0.67 or above indicates that the measurement tool has content validity.[23] Accordingly, the scale content validity index value obtained shows that the items in the scale measure the concept they are intended to measure, do not contain different concepts, and have content validity.

Construct validity of the DAS was evaluated using factor analytic approaches, which are widely accepted methods for testing whether the observed data adequately represent the theoretical structure of a measurement instrument.[20] In the present study, confirmatory factor analysis supported the hypothesized unidimensional structure of the DAS, with all eight items loading onto a single latent factor. The statistically significant model fit ($p<0.001$) indicates that the proposed factor structure is consistent with the observed data.

The goodness-of-fit indices obtained from the first-order single-factor CFA demonstrated an acceptable level of model–data fit. Specifically, the RMSEA value of 0.075 and the χ^2/df ratio of 2.977 fall within the commonly accepted thresholds for adequacy. In addition, the comparative fit index (CFI = 0.901) and the standardized root mean square residual (SRMR = 0.051) further support the adequacy of the model fit. Although the Tucker–Lewis Index (TLI = 0.861) was slightly below the conventional cutoff of 0.90, this value is considered acceptable given the unidimensional structure of the scale, the limited number of items, and the absence of post-hoc model modifications. Importantly, no error covariances were specified in the model, indicating that the observed fit was achieved without post-hoc model modifications. This finding strengthens the evidence for the theoretical coherence and parsimony of the scale.[16-24]

Overall, these results support the construct validity of the Turkish version of the DAS and indicate that diabetes awareness and insight can be conceptualized as a unified construct within this population. Although Item 1 demonstrated a relatively low communality value (0.305), it exceeded the minimum acceptable threshold of 0.30 commonly applied in social sciences. Moreover, this item assesses symptom attribution, which constitutes a theoretically central component of diabetes awareness and insight. Item–total correlation analysis indicated that Item 1 contributed adequately to the overall scale, and its removal did not result in a meaningful improvement in Cronbach's alpha coefficient. Therefore, Item 1 was retained in the scale to preserve its conceptual integrity and theoretical coherence. The confirmation of a single-factor structure is also consistent with the original scale development study, further supporting the cross-cultural stability of the underlying construct.

Reliability refers to the consistency and stability of a measurement instrument over time and reflects the extent to which a scale yields similar results when administered under comparable conditions at different

time points.[16-24] Accordingly, the reliability of the DAS was evaluated using internal consistency analyses, including Cronbach's alpha and split-half reliability, as well as test–retest reliability and item–total score correlations. In the split-half reliability analysis, the raw correlation coefficient between the two halves of the scale was 0.647. This relatively moderate value may be attributed to the short length of the scale (eight items) and the random allocation of items into two halves, which is known to potentially underestimate raw split-half correlations. Therefore, corrected reliability coefficients were also examined. The Spearman–Brown coefficient (0.785) and the Guttman split-half coefficient (0.777) both exceeded the commonly accepted threshold of 0.70, indicating acceptable internal consistency and supporting the reliability of the scale.

Temporal stability (invariance over time) refers to the consistency of a measurement tool when administered to the same individuals at different time points. In the present study, test–retest reliability for the total DAS score was r = 0.784 over a 25-day interval, indicating good temporal stability. For descriptive purposes, test–retest correlations for conceptually grouped item clusters were also examined (r = 0.468 for general disease awareness, r = 0.580 for symptom attribution, r = 0.543 for awareness of need for treatment, and r = 0.985 for awareness of negative consequences). In the original scale development study, test–retest reliability was reported as 0.76 over an approximately one-month interval[8]. Taken together, these findings support the temporal stability of the DAS in the Turkish sample.

The reliability of the measurement tool is an important issue for the soundness of the study results. Therefore, researchers should make sure that the measurement tool used is reliable. The Cronbah's alpha reliability coefficient, which was developed by Lee Cronbach in 1951 and is the most widely used in determining internal consistency, has a coefficient value between 0 and 1, with values closer to 1 indicating higher reliability.[16,26,27]

In the original scale development study, the DAS was developed based on a theoretical disease awareness framework in which four conceptual domains were identified: General disease awareness, awareness of symptom attribution, awareness of adverse outcomes, and awareness of the need for treatment. These domains were intended to describe the conceptual scope of the construct; however, they were not psychometrically defined or validated as separate subscales. Accordingly, in the original study, some items were grouped under these thematic headings for descriptive purposes only. In the present study, the factor structure of the DAS was empirically examined using both exploratory and confirmatory factor analyses. The results consistently supported a unidimensional structure, indicating that all items loaded onto a single latent factor. Therefore, the DAS was treated as a single-factor instrument, and no sub-dimension–based analyses were conducted. The internal consistency of the scale was acceptable, with a Cronbach's alpha coefficient of 0.70, suggesting that the items coherently measure a common underlying construct related to diabetes awareness. Given that the DAS is a short scale consisting of eight items, a Cronbach's alpha value around 0.70 is considered expected and acceptable, indicating adequate internal consistency. Item–total correlation coefficients ranged from 0.304 to 0.572, with the lowest value observed for Item 5 and the highest for Item 8. As no item demonstrated a correlation coefficient below the commonly accepted threshold of 0.20, no items were removed from the scale. The results of Hotelling's T^2 test indicated statistically significant differences among item means (Hotelling's T^2 = 487.063, $p<0.05$), reflecting variability in item responses rather than response bias and further supporting the internal consistency and reliability of the scale. Convergent and discriminant validity of the DAS were examined through correlation analyses with theoretically related and unrelated constructs. The Brief Illness Perception Questionnaire (BIPQ) was used to assess convergent validity, whereas the PANAS was used to evaluate discriminant validity.

In the original scale study, moderate correlations were reported between DAS total, subscale, and factor scores and illness perception measures, supporting convergent validity. In the present study, DAS total scores showed a statistically significant, positive, and weak correlation with illness perception (r = 0.310, $p<0.001$), providing evidence for convergent validity.

Regarding discriminant validity, the relationship between DAS scores and Positive Affect was not statistically significant (r = −0.006, p=0.914), indicating that the scale measures a construct distinct from positive emotional states. A weak but statistically significant positive correlation was observed between DAS scores and Negative Affect (r = 0.133, p=0.013), suggesting partial conceptual overlap while still supporting discriminant validity.

Strengths/Limitations

This study demonstrates several strengths that enhance its methodological rigor and practical significance. Notably, the inclusion of a relatively large and heterogeneous sample of 351 individuals improves the generalizability of the findings to the wider population of adults with type 2 diabetes in Türkiye. Additionally, the use of multiple well-established instruments, including the Brief Illness Perception Questionnaire and the Positive and Negative Affect Schedule, alongside the DAS, provided a comprehensive approach to evaluating the construct validity of the DAS. The robust statistical methods employed, such as CFA, CVI, and multiple reliability measures (e.g., internal consistency, test-retest reliability), further strengthened the study's methodological rigor. These analyses provided clear evidence of the DAS's validity and reliability in assessing diabetes awareness and insight. It is important to interpret the results in light of the study's limitations. Chief among these is its methodological nature, which hinders causal interpretation and the ability to track changes in awareness levels over time. Another limitation is the geographical focus on Istanbul, which

may limit the applicability of the results to other regions of Türkiye with differing socioeconomic and cultural characteristics. Exploratory Factor Analysis (EFA) and CFA were conducted using the same sample, which may limit the robustness and generalizability of the identified factor structure.

Furthermore, while the DAS demonstrated good reliability and validity, the moderate item-total correlation values (ranging between 0.304 and 0.572) suggest that some items might benefit from further refinement to enhance their discriminatory power. Lastly, the study relied on self-reported data, which could introduce response bias and affect the accuracy of the findings.

Despite these limitations, the study provides a valuable contribution by adapting and validating the DAS for Turkish-speaking populations, enabling its use in future research and clinical practice to better understand and improve diabetes awareness and management.

Implications for Future Research

It is recommended to be used in all research and clinical practices where factors that hinder the success of treatment and well-being of the patient are determined and evaluated by measuring the level to which individuals with type 2 diabetes perceive the symptoms they experience and associate them with the disease, how much they are aware of their disease and their awareness of the need for treatment, as well as their awareness of microvascular and macrovascular complications that may develop in addition to the disease.

In line with these results, it was determined that the DAS is a new, disease-specific, valid and reliable measurement tool to evaluate the disease awareness of individuals with diabetes in Türkiye. DAS is a scale that can be used in epidemiological studies to examine to what extent impaired disease awareness or disease denial contributes to adherence to drug therapy and clinical outcomes in people with type 2 diabetes.

Ethical Approval

For the study, approval was obtained from University Ethics Committee on January 28, 2022 (Session No:2022/01). Before the research, individuals with diabetes were informed about the purpose and process of the study and their consents were obtained with the Informed Volunteer Form. Participation in the study was based on volunteerism. The research was conducted in full compliance with the ethical standards set forth by the Declaration of Helsinki.

Conflict of Interest

The authors declare that there are no conflicts of interest, financial or personal, that could have influenced the outcomes or interpretation of this study.

Author Contributions

MÇ, BD; concept, design and execution of the study, analysis and interpretation of data, writing the results and the manuscript, MÇ; data collection, BD; Took part in the final reading of the manuscript. All authors have seen and approved the final version of the article.

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References

1. Kumar RV. Cronbach's alpha: Genesis, issues and alternatives. *IMIB J Innov Manag.* 2024;2(2):226-242. doi:10.1177/ijim.241234970
2. Kyrou I, Tsigos C, Mavrogianni C, et al. Sociodemographic and lifestyle-related risk factors for identifying vulnerable groups for type 2 diabetes: A narrative review with emphasis on data from Europe. *BMC Endocr Disord*. 2020;20(1):1-13. doi:10.1186/s12902-019-0463-3
3. Zheng Y, Ley SH, Hu FB. Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. *Nat Rev Endocrinol*. 2018;14(2):88-98. doi:10.1038/nrendo.2017.151
4. Saeedi P, Petersohn I, Salpeası P, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas. *Diabetes Res Clin Pract*. 2019;157:107843. doi:10.1016/j.diabres.2019.10784
5. Öcal EE, Önsüz MF. The economic burden of diabetes. *Estudam Public Health J.* 2018;3(1):24-41.
6. Çapoğlu İÇ, Yıldırım A, Hacıhasanoğlu AR, Çayköylü A. Diyabete eşlik eden ruhsal sorunlar ve diyabet yönetimi. *Turk J Fam Med Prim Care.* 2019;13(1):67-74. doi:10.21763/tjfmpc.415456
7. Aydoğan B, Aydın A, İnci MB, Ekerbiçer H. Tip 2 diyabet hastalarının hastalıklarıyla ilgili bilgi, tutum düzeyleri ve ilişkili faktörlerin değerlendirilmesi. *Sakarya Tıp Derg.* 2020;10(Special Issue):11-23. doi:10.31832/smj.743455
8. Gerretsen P, Kim J, Shah P, et al. DAS: The diabetes awareness and insight scale. *Diabetes Metab Syndr.* 2020;14(3):189-194. doi:10.1016/j.dsx.2020.02.006
9. Uyumaz G, Sırgancı G. What is the required sample size for confirmatory factor analysis? Bayesian approach and maximum likelihood estimation. *OPUS Int J Soc Res*. 2020;16(32):5302-5340. doi:10.26466/opus.826895
10. Kennedy I. Sample size determination in test-retest and Cronbach alpha reliability estimates. *Br J Contemp Educ.* 2022;2(1):17-29. doi:10.52589/BJCE-FY266HK9
11. Broadbent E, Petrie KJ, Main J, Weinman J. The brief illness perception questionnaire. *J Psychosom Res*. 2006;60(6):631-637. doi:10.1016/j.jpsychores.2005.10.020
12. Kocaman N, Özkan M, Armay Z, Özkan S. The reliability and the validity study of Turkish adaptation of the revised illness perception questionnaire. *Anatol J Psychiatry.* 2007;8(4):271-280.
13. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: The PANAS scales. *J Pers Soc Psychol.* 1988;54(6):1063-1070. doi:10.1037/0022-3514.54.6.1063
14. Gençöz T. Pozitif ve negatif duygu ölçeği: Geçerlik ve güvenirlik çalışması. *Türk Psikoloji Dergisi*. 2000;15(46):19-26.
15. Urbano LS. Solomon: A method for splitting a sample into equivalent subsamples in factor analysis. *Behav Res Methods.* 2022;54(6):2665-2677. doi:10.3758/s13428-021-01750

16. Sürücü L, Maslakcı A. Validity and reliability in quantitative research. *BMij.* 2020;8(3):2694-2726. doi:10.15295/bmij.v8i3.1540
17. Türkmen H, Oğuz B, Çevik E. Maternal emotional well-being: A scale development and psychometric testing study. 2024. doi:10.22541/au.171061818.80147676/v1
18. Mohajan HK. Two criteria for good measurements in research: Validity and reliability. *Ann Spiru Haret Univ Econ Ser.* 2017;17(4):59-82. doi:10.26458/1746
19. Colquitt JA, Baer MD, Long DM, Halvorsen-Ganepola MDK. Scale indicators of social exchange relationships: A comparison of relative content validity. *J Tables Contents*. 2014;99(4):599-618. doi:10.1037/a0036374
20. Yurdabakan İ, Çüm S. Scale development in behavioral sciences (based on exploratory factor analysis). *Turk J Fam Med Prim Care.* 2017;11(2):108-126. doi:10.21763/tjfmpc.317880
21. Shi D, Lee T, Maydeu-Olivares A. Understanding the model size effect on SEM fit indices. *Educ Psychol Meas*. 2019;79(2):310-334. doi:10.1177/0013164418783530.
22. Xia Y, Yang Y. RMSEA, CFI and TLI in structural equation modeling with ordered categorical data: The story they tell depends on the estimation methods. Behav Res Methods. 2019;51(1):409-428. doi:10.3758/s13428-018-1055-2
23. Gökdemir F, Yılmaz T. Likert tipi ölçekleri kullanma, modifiye etme, uyarlama ve geliştirme süreçleri. *J Nursology.* 2023;26(2):148-160. doi:10.5152/JANHS.2023.22260
24. Coleman P. Validity and reliability within qualitative research for the caring sciences. *Int J Commun Syst.* 2022;14(3):2041-2045.
25. Bahariniya S, Ezatiasar M, Madadizadeh F. A brief review of the types of validity and reliability of scales in medical research. *J Community Health Res.* 2021;10(2):100-102. doi:10.18502/jchr.v10i2.6582
26. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med.* 2016;15(2):155-163. doi:10.1016/j.jcm.2016.02.012
27. Kumar A, Gangwar R, Zargar AA, Kumar R, Sharma A. Prevalence of diabetes in India: A review of IDF diabetes atlas 10th edition. *Curr Diabetes Rev.* 2024;20(1):105-114. doi:10.2174/1573399819666230413094200