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ORIGINAL RESEARCH

Validating the Emotional Well-Being Questionnaire in Type 2 Diabetes: A Pilot Confirmatory Factor Analysis

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Purpose: The Emotional Well-Being Questionnaire (EWQ) assesses a broad spectrum of mental health conditions and related symptoms—depression, anxiety, asthenia, and insomnia—highly relevant in type 2 diabetes (T2D), where emotional distress can impair adherence and outcomes. This pilot cross-sectional study provides preliminary validation evidence for the EWQ six-factor model in a T2D cohort using confirmatory factor analysis (CFA), evaluating reliability and convergent validity for mental-health screening.

Patients and Methods: A sample of 240 adults (T2D n = 122; control n = 118) with T2D completed the EWQ and nine-item Patient Health Questionnaire (PHQ-9). Confirmatory factor analysis (CFA) was conducted to assess the six-factor model fit, and convergent validity was evaluated through analysis of EWQ scores with PHQ-9 scores.

Results: Confirmatory factor analysis indicated acceptable–borderline fit for a pilot sample (CFI = 0.886; TLI = 0.883; RMSEA = 0.071), providing preliminary support for the six-factor structure. The EWQ demonstrated reliability in the T2D group (Cronbach's α = 0.79). Convergent validity was supported by a significant positive correlation with PHQ-9 scores ($r = 0.652$, $p < 0.001$), confirming the EWQ's capacity to assess depressive symptoms in this population.

Conclusion: The EWQ's six-factor structure showed preliminary adequacy in adults with T2D. While internal consistency and convergent validity with the PHQ-9 were supportive, overall model fit indices were moderate; therefore, findings should be interpreted with caution and replicated in larger, more diverse samples before clinical implementation. Future studies should focus on cross-cultural validation, measurement invariance, and longitudinal assessment to refine its clinical utility.

Keywords: confirmatory factor analysis, type 2 diabetes, depression, emotional well-being questionnaire, mental health, pilot study, cultural adaptation

Introduction

Type 2 diabetes (T2D) predominantly affects middle-aged and elderly adults, with a greater prevalence in males than in females; common complications include cardiovascular disease, neuropathy, and renal dysfunction.[1,2] Globally, the prevalence of T2D is increasing at an alarming rate, with recent estimates indicating that approximately 537 million adults are currently living with the condition, a number projected to rise to 643 million by 2030 and 783 million by 2045.[3] In Estonia, the prevalence of diagnosed T2D is estimated at around 7% of the adult population, with additional cases remaining undiagnosed.[4] In Estonia, diabetes management practices follow national clinical guidelines that align with European recommendations[5] but also reflect local healthcare structures. General practitioners play a central role in ongoing diabetes care, supported by endocrinologists for complex cases.[5] Cultural attitudes toward mental health may influence symptom disclosure, as psychological distress is often underreported, highlighting the need for integrated screening tools such as the EWQ[6] in routine diabetes care.

In addition to common complications, depression is frequently observed in individuals with T2D. An interplay of physiological, psychological, and lifestyle factors influences these complications.[7,8] These factors include coping with

Received: 6 May 2025
Accepted: 28 August 2025
Published: 13 September 2025

chronic conditions, biological changes in the brain, and lifestyle limitations related to health and mobility.[9] The prevalence of depression in individuals with T2D varies widely and is reported to be between 28% and 49%.[7,8] A systematic review of risk factors for depression in individuals with T2D highlighted that heightened anxiety worsens disease management, increases nonadherence to treatment guidelines, decreases quality of life, and increases mortality rates.[10] In T2D, depression and anxiety can be managed through various approaches, including pharmacological interventions (such as antidepressants), psychological interventions (such as cognitive–behavioural therapy), and combinations of these methods.[11,12] Lifestyle interventions, such as changes in diet, physical activity, and sleep habits, are beneficial not only for managing diabetes but also as effective measures against depression.[13] The comorbidity of depression and diabetes has a synergistic effect, increasing the risk of both microvascular and macrovascular complications, exacerbating hyperglycaemia, and predicting higher mortality rates. While both diabetes and depression individually decrease quality of life, their co-occurrence has a more profound negative impact.[14] It is crucial to treat diabetes and depression simultaneously rather than separately, emphasizing the need for an integrated healthcare approach.[15]

The American Diabetes Association *(ADA*) recommends mental health screening in diabetes management, not only at the initial diagnosis but also as needed during treatment changes or disease progression.[16] Various screening methods have been utilized to assess depression and other mental health concerns in individuals with T2D. Scales that are commonly used internationally include the 21-item Depression, Anxiety, and Stress Scale (DASS-21)[17] and the Hospital Anxiety and Depression Scale (HADS).[18] The Patient Health Questionnaire (PHQ-9) is frequently used in research for measuring depression,[19] whereas the Beck Depression Inventory (BDI-2)[20] and the WHO Well-Being Index have been used in other large-scale studies[21.] A systematic review of depression screening tools for diabetes underscores their effectiveness but also reveals deficiencies, particularly in terms of cultural adaptability, indicating a significant need for validation across diverse cultural contexts.[17]

The Emotional Well-being Questionnaire (EWQ) measures depression and anxiety on the basis of the International Classification of Diseases, Tenth Revision (ICD-10), and the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), diagnostic criteria,[6,22] and the EWQ is widely used in Estonian clinical settings to identify mood disorders; however, its factor structure has not been validated in the diabetes population. Although the DSM-5-TR is now the prevailing diagnostic manual in the United States,[23] the EWQ was originally developed and validated in Estonia using DSM-IV criteria[6] Unlike the DASS-21 and HADS,[17,18] which are focused primarily on general assessments of depression and anxiety, the EWQ provides[6] a more comprehensive mental health profile through six distinct subscales (depression, general anxiety, panic disorder, social anxiety, asthenia, and insomnia). This multidimensional structure is particularly advantageous in practical screening, as it allows clinicians to detect multiple co-occurring symptoms in a single assessment, rather than relying on separate tools for each condition. Such simultaneous detection reduces assessment time, improves the accuracy of differential diagnosis, and facilitates more targeted and individualized care planning.[11] Given the complexity of validating multidimensional instruments in culturally specific populations and the inherent challenges of diabetes-related psychological assessment, this pilot study aims to provide preliminary evidence for the EWQ's potential applicability in T2D patients, laying groundwork for larger-scale validation efforts. While acknowledging sample size and methodological limitations inherent to pilot investigations, this study provides initial evidence for the EWQ's utility in diabetes care settings and represents an essential first step.

Methods

Study Design

The study has a cross-sectional design and was performed at two Estonian medical centres *(´Confido´ and ´North Estonia´ medical centres)*. These centres were selected for their heterogeneous T2D caseloads and established endocrinology services, with the aim of improving sample representativeness and promoting consistency in data collection. The prior experience of these centres with mental health research also supported efficient study execution and ethical approval. Data collection occurred between February 2023 and March 2024. In this study, we adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines[24] for reporting observational studies. This pilot validation study aimed to provide preliminary evidence for the EWQ's psychometric properties in Estonian T2D populations. While

the optimal CFA sample size for a 28-item instrument is 280–420, our sample of 240 participants meets established minimum requirements for exploratory validation [31]. These findings require replication in larger, more diverse samples before clinical implementation.

Study Sample

Participants were recruited from an outpatient endocrinology department, where they were approached during their scheduled appointments. All participants were Estonian speakers. Out of 300 approached individuals, 60 declined to participate, resulting in a final sample size of 240, with 122 in the T2D group and 118 in the control group. This pilot study included a sample of 240 individuals, acknowledging the preliminary nature of this investigation given the complexity of multidimensional instrument validation in culturally specific populations. All questionnaires were checked for completeness. Incomplete responses were analysed on an item-by-item basis without imputation, and cases with substantial missing data (> 20% of items) were excluded. The reasons for declining participation were not systematically recorded, and we focused instead on adherence to the exclusion criteria. Inclusion criteria were a diagnosis of T2D for at least six months and no self-reported mental health issues. The control group (CG) consisted of the consenting spouses or partners of the diabetic patients; this design allowed matching of the living environments, dietary patterns, lifestyle choices, and ages between the CG and T2D group. CG members were informed and consented under conditions similar to those of the T2D patients to maintain data integrity, to validate the study results, and to reduce potential selection bias.

Data Collection

Assessments were held in private rooms to maintain confidentiality and lasted approximately 30–45 minutes each. Trained assistants performed the assessments by following a questionnaire that started with questions on sociodemographic details. The interviewers, trained in mental health assessments and distress recognition, assisted the participants as needed. Sociodemographic and clinical data were collected through a combination of patient self-reports and direct measurements. The participants provided information on their age (including age at diagnosis), sex, and treatment history via the questionnaire. Clinical data, such as body mass index (BMI), were measured onsite, with height and weight recorded to calculate BMI. Haemoglobin A1c (HbA1c) levels were self-reported, with participants asked to provide their most recent known values. Additional data on comorbid conditions, complications, and type of diabetes treatment were also gathered through verbal responses during the interview process. The data collection process was carefully designed to integrate both self-reported and objectively measured data for a comprehensive overview of participants' clinical profiles. The questionnaires associated with the study outcomes were completed onsite by the participants.

The average age of the T2D participants was 65.3 years (Table 1). The average age at diabetes onset was 51.5 years, with a mean duration of 13.8 years. Females dominated the groups, accounting for 61.2% of the sample. Clinical data revealed an average BMI of 31 and varied levels of glycaemic control, with an average HbA1c level of 7.27%. Treatment mainly included tablets (71%) and insulin (25%). The CG was slightly younger, with an average age of 59.8 years, with

Table 1 Participant Demographics and Clinical Background

	T2D (n =112)	**CG (n =118)**	**Test**	***p-value***
Age, years (mean; SD)	65.3 (0.884)	59.8 (0.888)	*t*-test (Welch)	<0.001
Age onset, years (mean (SD)	51.5 (0.969)			
T2D duration, years (mean (SD)	13.8 (1.03)			
Sex				0.241 (χ^2)
Male, n (%)	47 (38.8)	37 (31.3)		
Female, n (%)	74 (61.2)	81 (68.7)		

(*Continued*)

 https://doi.org/10.2147/PROM.S538578

Table 1 (Continued).

	T2D (n =112)	CG (n =118)	Test	*p-value*
Education level				0.227 (χ^2)
Primary education, n (%)	7 (5.7)	1 (0.8)		
Secondary education, n (%)	37 (30.6)	27(22.9)		
Vocational education, n (%)	21 (17.6)	36 (30.5)		
Bachelor's or applied higher education, n (%)	26 (21.5)	28 (23.7)		
Master's degree, n (%)	16 (13.2)	12 (10.2)		
Doctor of philosophy (PhD), n (%)	1 (0.8)	2 (1.7)		
Economic status				<0.05 (χ^2)
Working, n (%)	57 (47.1)	87 (73.7)		
Unemployed, n (%)	5 (4.1)	1 (0.9)		
Retired, n (%)	59 (48.7)	30 (25.4)		
BMI, mean (SD)	31 (0.439)	28 (0.437)	*t*-test (Welch)	<0.001
HbA1c level, mean (SD)	7.27 (0.091)			
Antidiabetic treatment				
Tablet treatment, n (%)	86 (71.0)			
Insulin treatment, n (%)	35 (25.0)			
Other treatments / comorbidities				
Antidepressant treatment, n (%)	5 (4.2)	3 (2.5)	χ^2	0.930
Sleep disorder treatment, n (%)	8 (6.7)	8 (7.1)	Fisher's exact*	1.000
Cardiovascular treatment *(β-blockers)*	37 (30.3)	17 (14.4)	χ^2	0.033
Hypertension, n (%)	87 (71.7)	38 (32.2)	χ^2	0.001
Retinopathy, n (%)	18 (15.0)			
Diabetic foot, n (%)	19 (15.8)			
Trophic ulcer n (%)	5 (4.2)			
Nephropathy, n (%)	12 (10)			
Neuropathy, n (%)	38 (31.7)			
Stroke, n (%)	2 (1.3)	1 (0.8)	(χ^2)	0.789
Myocardial infarction, n (%)	6 (5)	3 (2.5)	(χ^2)	0.681
Cardiac arrhythmias, n (%)	15 (12.2)	14 (11.8)	(χ^2)	1.000
Dyslipidaemia, n (%)	21 (17.6)	26 (22.0)	(χ^2)	0.677

Notes: Categorical variables are shown as n (%); p-values are from Pearson's χ^2-test (or Fisher's exact test when any expected cell count < 5). Continuous variables are presented as mean ± SD (if approximately normal) or median [IQR] (if non-normal); p-values are from Welch's *t*-test or Mann–Whitney U, respectively. Two-sided $\alpha = 0.05$. The decimal separator is a dot. *Fisher's exact test was used when expected cell counts were small (< 5) or when counts were identical.

a slight female predominance (68.7%). The educational levels of the CG were the same as those of the T2D group, with most having a secondary education. Clinically, the CG had lower rates of cardiovascular treatments and significantly fewer complications, with only 14.4% having received cardiovascular treatment and lower rates of hypertension (32.2%).

Measurements

Emotional Well-Being Questionnaire (EWQ)

Developed by the Psychiatry Clinic of the University of Tartu, the EWQ is used in Estonia to screen for anxiety and mood disorders and monitor patients with these conditions.[6,22] The questionnaire includes six subscales assessing depression (8 items), generalized anxiety (6 items), panic disorder (5 items), social anxiety (2 items), asthenia (4 items), and insomnia (3 items), with a total of 28 items. Participants rate how much these issues have affected them in the past month using a 5-point Likert scale (1 = not at all; 5 = constantly).[6] In the version used in this study, all items were phrased in the same (symptom-burden) direction; therefore, no reverse-scoring was required. Higher scores consistently reflect greater symptom severity.

Patient Health Questionnaire (PHQ-9)

The PHQ-9 is designed for preliminary depression screening in high-risk groups within primary care and other healthcare settings internationally.[25–27] The items correspond to diagnostic criteria for depressive and mental disorders, with questions translated into Estonian. Scores ranging from 0–4 indicate a minimal risk of depression, 5–9 suggest mild depression, 10–14 indicate moderate depression, 15–19 indicate moderately severe depression, and 20–27 suggest severe depression.[28] The widespread validation of the PHQ-9 extends to its effective use in mental health and chronic illness populations, including those with T2D, in whom it accurately identifies depressive symptoms critical for comprehensive disease management.[29,30] The PHQ-9 was utilized in this study, primarily because of its robust validation across various populations, and because it provides a reliable, quick assessment of depression, it is crucial for managing the comprehensive health needs of these patients.

Statistical Analysis

Descriptive statistics were chosen to outline the sociodemographic and clinical characteristics of the participants. Means and standard deviations were computed for continuous variables (eg, age, diabetes duration, and BMI) to summarize central tendencies and variability. Frequencies and percentages were calculated for categorical variables (eg, sex distribution, treatment type, and severity of depressive symptoms indicated by PHQ-9 scores). This methodological approach provides essential baseline insights, allowing a clear depiction of the profile of the study cohort and facilitating subsequent analytical comparisons.

Factor Analysis of the EWQ

In this study, CFA was used to rigorously test and provides preliminary support for the structural integrity of the EWQ for assessing its applicability in a population diagnosed with T2D. CFA was performed in Jamovi and Mplus (Jamovi 2.3.21, Mplus 8.8). CFA determines how well theoretical factor structures match empirical data, validating relationships between measured items and latent factors.[31] The CG data were included in CFA as a comparative reference. Analyses were conducted separately for the T2D and CG samples to test whether the six-factor model indicated similar structural properties in both groups. This allowed us to determine whether the observed factor structure and loadings were specific to diabetes-related emotional distress or reflected broader patterns in the general adult population[31] CFA allows the evaluation of how well the hypothesized model aligns theoretically and statistically with the data through several goodness-of-fit indices, such as the comparative fit index (CFI), root mean square error of approximation (RMSEA), and chi-square (χ^2) statistics.[32]

To ensure suitability for factor analysis, we conducted Bartlett's test of sphericity and the Kaiser–Meyer–Olkin (KMO) index. Bartlett's test evaluates whether the correlation matrix departs from an identity matrix, thereby supporting factorability.[33] KMO index assesses sampling adequacy (values $\geq$ 0.60 acceptable; $\geq$ 0.80 meritorious).[30] This was a strictly confirmatory evaluation of the pre-specified six-factor EWQ structure; alternative baseline models (eg, a unidimensional model) were not estimated or reported.[33] A six-factor model (Figure 1) was

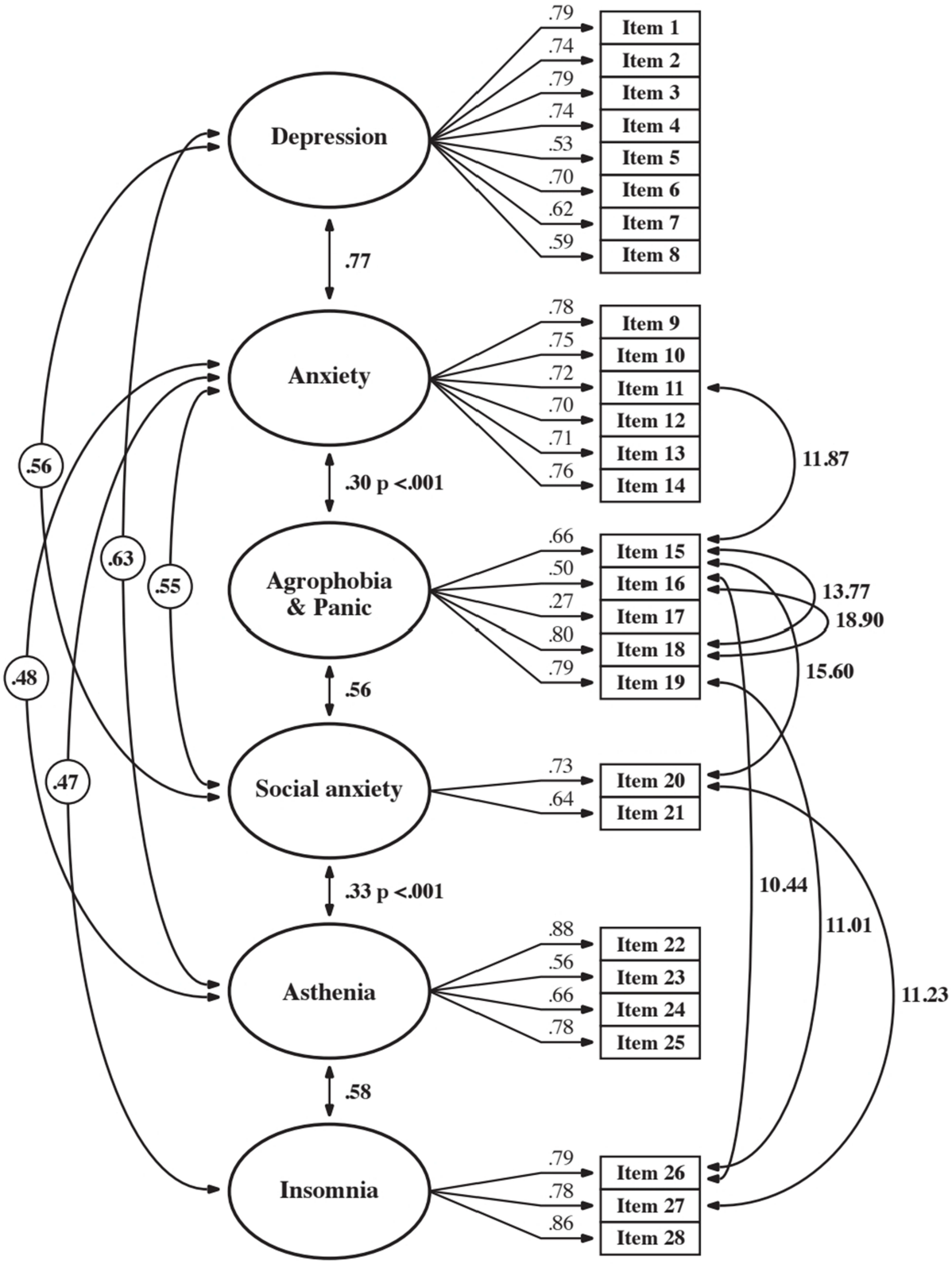

Figure 1 Standardized confirmatory factor analysis (CFA) path diagram for the six-factor Emotional Well-being Questionnaire (EWQ) model. Ovals represent latent variables (factors), rectangles represent observed items, and single-headed arrows indicate standardized factor loadings. Double-headed arrows represent correlations between latent variables.

subsequently tested, in which each item was associated with a single latent variable and the error terms were assumed to be uncorrelated. This model was theoretically derived to reflect distinct constructs within the EWQ scales. Modification indices were inspected to check for localized strain; no post-hoc parameters were freed, and the pre-specified model was retained. No reverse-scored items were administered in this study; all items were coded in the same direction (higher = worse).

Reliability and Validity

Internal consistency was assessed using Cronbach's alpha for both the overall scale and individual subscales. In the T2D group, the overall Cronbach's α was 0.79. For the combined T2D and control sample, the value was 0.83. Construct validity was confirmed through standardized correlations between factors and their respective items, with most factor loadings exceeding 0.5. Discriminant validity was supported by correlations between latent variables less than 1, ensuring the measurement of distinct constructs.[34] Convergent validity was established by correlating the EWQ depression subscale scores with the PHQ-9 scores, revealing a positive correlation (r = 0.652). These findings demonstrate that higher EWQ scores correspond reliably with higher PHQ-9 scores, confirming the ability of the EWQ to assess depressive symptoms in line with established clinical standards and supporting its convergent validity.[35] Combined with satisfactory CFA fit indices (CFI, TLI, and RMSEA), these results robustly reflect the underlying constructs, negating the need for additional metrics such as average variance extracted (AVE).[34]

Results

Factor Analysis

Item Description

Central tendency statistics and shape parameters for each item are presented in Table 2. The skewness values generally fall within the acceptable range (±3), with most items showing skewness values between −1 and 1, indicating minimal

Table 2 Descriptive Statistics of the EWQ for the T2D Group (n = 118)

			Skewness		Kurtosis		Shapiro–Wilk
	Mean	**SD**	**Skewness**	**SE**	**Kurtosis**	**SE**	**W**
1. Feelings of sadness	1.099	1.012	0.633	0.22	−0.2488	0.437	0.859
2. Feeling no interest or pleasure in things	0.719	1.058	1.358	0.22	0.8118	0.437	0.708
3. Feelings of worthlessness	0.512	0.958	1.928	0.22	2.961	0.437	0.6
4. Self-accusations	0.529	0.775	1.374	0.22	1.1756	0.437	0.695
5. Recurrent thoughts of death or suicide	0.174	0.558	3.557	0.22	12.7912	0.437	0.351
6. Feeling lonely	0.893	1.131	1.233	0.22	0.6817	0.437	0.768
7. Hopelessness about the future	0.587	0.946	1.398	0.22	0.6599	0.437	0.655
8. Inability to feel joy	0.579	0.901	1.358	0.22	0.6535	0.437	0.672
9. Feeling easily irritated or annoyed	1.066	0.955	0.625	0.22	−0.2328	0.437	0.857
10. A feeling of anxiety or fear	1.058	1.027	0.54	0.22	−0.9001	0.437	0.834
11. Tension or inability to relax	1.008	1.012	0.62	0.22	−0.5709	0.437	0.836
12. Excessive worry about several different things	1.264	1.131	0.515	0.22	−0.6151	0.437	0.872

(*Continued*)

Table 2 (Continued).

			Skewness		Kurtosis		Shapiro–Wilk
	Mean	**SD**	**Skewness**	**SE**	**Kurtosis**	**SE**	**W**
13. Inability to sit or stand still	0.562	0.865	1.455	0.22	1.179	0.437	0.679
14. Easily startled	0.529	0.886	1.52	0.22	1.1456	0.437	0.64
15. Sudden attacks of panic with palpitations, shortness of breath, faintness, or other frightening bodily sensations	0.281	0.648	2.449	0.22	5.5882	0.437	0.494
16. Fear of being outside home alone	0.24	0.533	2.514	0.22	7.1373	0.437	0.501
17. Feeling afraid in streets or public places	0.207	0.482	2.327	0.22	4.7872	0.437	0.474
18. Fear of fainting in public	0.165	0.454	3.377	0.22	14.1481	0.437	0.406
19. Feeling afraid of travelling by bus, train, or car	0.116	0.346	3.027	0.22	9.1026	0.437	0.364
20. Fear of being the centre of attention	0.275	0.549	2.518	0.221	8.3909	0.438	0.524
21. Fear of communicating with strangers	0.208	0.62	3.698	0.221	15.5908	0.438	0.386
22. Feeling sluggish or tired	1.75	1.023	0.186	0.221	−0.3634	0.438	0.909
23. Decreased ability to pay attention or concentrate	1.283	0.9	0.18	0.221	−0.7402	0.438	0.874
24. Resting does not restore strength	1.192	1.063	0.673	0.221	−0.0889	0.438	0.866
25. Fatigue quickly	1.5	1.037	0.299	0.221	−0.5983	0.438	0.899
26. Difficulty falling asleep	1.466	1.224	0.378	0.223	−0.972	0.442	0.883
27. Restless or disturbed sleep	1.669	1.288	0.3	0.223	−1.0917	0.442	0.888
28. Waking up too early	1.076	1.235	0.962	0.223	−0.2383	0.442	0.797

Notes: EWQ items are scored 1–5 (1 = not at all; 5 = constantly); higher values indicate greater symptom burden. CI assumes a t-distribution with N–1 degrees of freedom. Adapted from Aluoja A, Shlik J, Vasar V, Luuk K, Leinsalu M. Development and psychometric properties of the emotional state questionnaire, a self-report questionnaire for depression and anxiety. *Nordic J Psychiatry*. 1999;53(6):443–449., by permission of the publisher (Taylor & Francis Ltd, http://www.tandfonline.com.[6]
Abbreviations: CI, confidence interval; SD, standard deviation; SE, standard error.

deviation from normality.[31] Kurtosis values remained within the recommended limits (range: –1.25 to 1.87), suggesting no extreme outliers or pronounced tails.[32] These results robustly reflect the underlying constructs, with satisfactory CFA fit indices (CFI, TLI, and RMSEA) (Table 3). Given non-normal item distributions (Shapiro–Wilk $p < 0.05$), we used maximum likelihood with robust standard errors (MLR). Sampling adequacy was middling (KMO = 0.72). Bartlett's test

Table 3 Standardized Loadings and Model Fit Indices for the Six-Factor EWQ Model

Item No.	6-Factor Model
8 (depression)	0.79
6 (generalized anxiety)	0.74
5 (panic disorder)	**0.37**
2 (social anxiety)	0.69
4 (asthenia)	0.72
3 (insomnia)	0.81

(*Continued*)

Table 3 (Continued).

Item No.	6-Factor Model
Fit Statistics	
$\chi 2$ (df)	532.58 (335), p <0.001
RMSEA (90% CI)	0.071 (0.059–0.082)
TLI	0.883
SRMR	0.059
CFI	0.886
Cronbach's α (T2D overall)	0.79

Notes: All factor loadings are standardized (values < 0.50 in bold). Estimator = MLR. Statistics computed for the T2D sample (n = 118).

Abbreviations: CFI, Comparative Fit Index; TLI, Tucker–Lewis Index; RMSEA, Root Mean Square Error of Approximation; 90% CI, 90% Confidence Interval; SRMR, Standardized Root Mean Square Residual; Cronbach's α – internal consistency coefficient.

of sphericity was significant (df = 378, p <0.001), supporting factorability of the item correlation matrix. Mardia's normalized multivariate kurtosis was 3.42, consistent with mild non-normality; robust estimation was therefore appropriate. A.[31] While normality assumptions may need further justification, the deviations are not severe enough to compromise the CFA results.[34] Given the data structure and analytic approach, these minor deviations do not affect the reliability of the model fit indices.[32]

Factor Structure

The item loadings and fit statistics for the six-factor EWQ model are presented in Table 3. Given the moderate fit indices (CFI = 0.886; TLI = 0.883; RMSEA = 0.071), the model is best described as showing acceptable–borderline fit in this pilot context. Model fit was evaluated using multiple indices: χ^2(df) = 532.58 (335), p <0.0001; RMSEA = 0.071, 90% CI = [0.059, 0.082]; CFI = 0.886; TLI = 0.883; SRMR = 0.059. Estimation used MLR to accommodate non-normality, and all loadings are standardized. Cronbach's α for the overall EWQ in the T2D group was 0.79.

Strong factor loadings (>0.80) observed in several areas are shown in Table 4. In the depression subfactor, "Feelings of worthlessness" (0.795) showed robust loading in the T2D group, whereas "Lack of interest" (0.812) was strongest in the CG. For anxiety, "Easily irritated" (0.785) was strongly associated with T2D patients. The insomnia subfactor

Table 4 Standardized Factor Loadings (and R^2) by Group for the Six-Factor EWQ Model

Item	Indicator	SE	p- value	SE	p value
		T2D group		CG	
Depression	Feelings of sadness	0.792	<0.001	0.786	<0.001
	Feeling no interest or pleasure in things	0.744	<0.001	0.812	<0.001
	Feelings of worthlessness	0.795	<0.001	0.734	<0.001
	Self-accusations	0.748	<0.001	0.649	<0.001
	Recurrent thoughts of death or suicide	0.543	<0.001	0.53	<0.001
	Feeling lonely	0.708	<0.001	0.711	<0.001

(*Continued*)

Table 4 (Continued).

Item	Indicator	SE	p- value	SE	p value
Anxiety	Feeling easily irritated or annoyed	0.783	<0.001	0.804	<0.001
	Feeling anxious or fearful	0.759	<0.001	0.729	<0.001
	Tension or inability to relax	0.729	<0.001	0.771	<0.001
	Excessive worry about several different things	0.708	<0.001	0.758	<0.001
	Feeling so restless that it is hard to sit still	0.719	<0.001	0.704	<0.001
	Easily startled	0.765	<0.001	0.638	<0.001
Agoraphobia	Sudden attacks of panic with palpitations, shortness of breath, faintness, or other frightening bodily sensations	0.661	<0.001	0.875	<0.001
	Fear of being outside home alone	0.506	<0.001	0.94	<0.001
	Feeling afraid in streets or open places	**0.277**	0.005	0.659	<0.001
	Fear of fainting in public	0.809	<0.001	0.743	<0.001
	Feeling afraid of travelling by bus, train, or car	0.793	<0.001	0.628	<0.001
Social anxiety	Fear of being the centre of attention	0.739	<0.001	0.743	<0.001
	Fear of communicating with strangers	0.643	<0.001	0.628	<0.001
Asthenia	Feeling sluggish or tired	0.885	<0.001	0.825	<0.001
	Decreased ability to pay attention or concentrate	0.564	<0.001	0.705	<0.001
	Resting does not restore strength	0.668	<0.001	0.856	<0.001
	Fatigue quickly	0.782	<0.001	0.761	<0.001
Insomnia	Difficulty falling asleep	0.79	<0.001	0.84	<0.001
	Restless or disturbed sleep	0.792	<0.001	0.902	<0.001
	Waking up too early	0.862	<0.001	0.652	<0.001

Notes: Standardized factor loadings shown for both groups; loadings < 0.50 are in bold (borderline/problematic). p-values are Wald z-tests from the CFA (MLR estimator). T2D – type 2 diabetes.
Abbreviation: CG, control group.

contained the consistently strongest loadings across both groups, with "Waking up too early" (0.862) in T2D patients and "Restless sleep" (0.902) in controls, suggesting that these symptoms are particularly definitive of their respective constructs. Comparatively weaker loadings (<0.60) were found for "Fear of streets/public places" (0.277) within the panic disorder subfactor for T2D patients, potentially indicating that this item less effectively captures the intended construct in this specific population.

Factor Estimates

Factor covariance analysis (Table 5) revealed that depression was strongly correlated with anxiety (0.773) and asthenia (0.635), moderately correlated with social anxiety (0.564), and weakly correlated with panic disorder (0.342) and insomnia (0.353). Anxiety was strongly associated with social anxiety (0.555) and asthenia (0.671). No significant association emerged between panic disorder and insomnia (0.168, p=0.105). All other correlations were significant (p<0.001).

Table 5 Factor Estimates

Factor Covariances							
			95% Confidence Interval				
		SE	**Lower**	**Upper**	**Z**	**p**	**Stand. Estimate**
Depression							
	Anxiety	0.0503	0.6748	0.872	15.38	<0.001	0.773*
	Panic disorders	0.0949	0.1562	0.528	3.61	<0.001	0.342
	Social anxiety	0.0858	0.3962	0.732	6.58	<0.001	0.564*
	Asthenia	0.0678	0.502	0.768	9.36	<0.001	0.635*
	Insomnia	0.0953	0.1659	0.54	3.7	<0.001	0.353
Anxiety							
	Panic disorders	0.1019	0.0904	0.49	2.85	0.004	0.29
	Social anxiety	0.101	0.3574	0.753	5.5	<0.001	0.555*
	Asthenia	0.0685	0.5367	0.805	9.79	<0.001	0.671*
	Insomnia	0.0864	0.3138	0.653	5.59	<0.001	0.483
Panic disorders							
	Social anxiety	0.105	0.194	0.605	3.81	<0.001	0.4
	Asthenia	0.1006	0.0869	0.481	2.82	0.005	0.284
	Insomnia	0.1036	−0.0352	0.371	1.62	0.105	0.168
Social anxiety							
	Asthenia	0.1052	0.1291	0.541	3.19	0.001	0.335
	Insomnia	0.1099	−0.0735	0.357	1.29	0.197	0.142
Asthenia							
	Insomnia	0.0788	0.4261	0.735	7.37	<0.001	0.581*

Note: *-fixed parameter.
Abbreviations: SE, standard error; Z, *Z* Score; Stand Estimate, standardized estimate.

Matrix of Correlations

Analysis of the correlation matrix (Table 6) between EWQ and PHQ-9 items revealed significant associations across scales. The depression-related items were strongly correlated, with EWQ1 correlated with "Little interest" (r=0.408) and "Feeling depressed" (r=0.562), whereas EWQ7 was strongly associated with "Feeling bad about yourself" (r=0.503). The sleep- and energy-related items showed moderate correlations, with EWQ5 correlated with "Trouble sleeping" (r=0.35), EWQ4 with "Feeling tired" (r=0.436), and EWQ4 with "Moving slowly" (r=0.583). The consistent pattern of correlations between related constructs across both scales confirmed substantial overlap between EWQ and PHQ-9 measurements.

Discussion

This pilot validation study provides initial evidence for the EWQ's applicability in Estonian T2D populations. While the findings are promising, several important limitations preclude recommending its immediate clinical implementation. The results should therefore be interpreted strictly within the context of an exploratory investigation intended to inform larger-scale validation efforts. Within these preliminary findings, the EWQ indicated robust psychometric properties and

Table 6 Matrix of Correlations Between EWQ1-8 and PHQ-9 Factors

Correlation Matrix																		
		EWQ1	**EWQ2**	**EWQ3**	**EWQ4**	**EWQ5**	**EWQ6**	**EWQ7**	**EWQ8**	**PHQ 1**	**PHQ 2**	**PHQ 3**	**PHQ 4**	**PHQ 5**	**PHQ 6**	**PHQ 7**	**PHQ 8**	**PHQ 9**
EWQ1	(*r*)	—																
EWQ2	(*r*)	**0.571**	**—**															
EWQ3	(*r*)	**0.626**	**0.562**	**—**														
EWQ4	(*r*)	**0.57**	**0.538**	**0.686**	—													
EWQ5	(*r*)	0.383	0.436	0.44	0.402	—												
EWQ6	(*r*)	**0.628**	0.476	0.535	0.521	0.413	—											
EWQ7	(*r*)	**0.635**	**0.624**	**0.566**	**0.585**	0.342	**0.62**	—										
EWQ8	(*r*)	**0.613**	**0.635**	**0.57**	0.524	0.428	0.429	**0.635**	—									
PHQ 1	(*r*)	0.408	0.438	0.409	0.347	0.41	0.391	0.458	0.403	—								
PHQ 2	(*r*)	**0.562**	0.338	**0.559**	0.457	0.417	0.447	**0.503**	0.429	**0.599**	—							
PHQ 3	(*r*)	0.311	0.29	0.291	0.385	0.241	0.253	0.246	0.293	0.35	0.428	—						
PHQ 4	(*r*)	0.366	0.341	0.428	0.436	0.334	0.248	0.264	0.317	0.39	0.399	**0.684**	—					
PHQ 5	(r)	0.117	0.147	0.085	0.135	0.257	0.172	0.186	0.156	0.345	0.286	0.333	0.439	—				
PHQ 6	(r)	**0.538**	0.279	**0.561**	0.498	0.338	**0.555**	0.48	0.384	0.446	0.47	0.249	0.273	0.189	—			
PHQ 7	(*r*)	0.262	0.3	0.396	0.35	0.23	0.254	0.257	0.323	0.371	0.319	0.453	**0.545**	0.391	0.265	—		
PHQ 8	(*r*)	0.313	0.451	0.413	**0.583**	0.285	0.245	0.341	0.385	0.245	0.211	0.21	0.328	0.039	0.123	0.345	—	
PHQ 9	(*r*)	0.329	0.259	**0.555**	0.487	0.496	0.355	0.364	0.414	0.384	0.373	0.265	0.361	0.135	0.395	0.34	0.23	—

Note: Correlations ≥ 0.50 are highlighted in bold to indicate stronger relationships.
Abbreviations: EWQ, Emotional Well-being Questionnaire; PHQ, Patient Health Questionnaire.

https://doi.org/10.2147/PROM.S538578

a multidimensional structure, suggest its capacity to capture key domains of emotional health in individuals with diabetes, including psychological distress and positive well-being.[6,22] By addressing these distinct facets of emotional wellbeing, the EWQ fills an important gap in patient-reported outcomes for diabetes care.

CFA indicated that most items indicated substantial factor loadings, supporting the robustness of the EWQ's measurement structure. The model fit indices were within acceptable ranges for the T2D, further confirming that the six-factor model adequately represents the intended constructs across populations. The internal consistency of the EWQ in the present T2D sample (Cronbach's $\alpha = 0.79$) is comparable to that reported in previous EWQ validation studies conducted in general or psychiatric populations, which have typically ranged from 0.78 to 0.86.[21,22] Similar reliability values have been observed for other multidimensional mood assessment tools used in diabetes research, such as the HADS and DASS-21, where α coefficients for subscales generally fall between 0.75 and 0.85.[17] This consistency supports the stability of the EWQ's internal structure across different populations and reinforces its potential utility as a screening instrument in diabetes care.

Analysis of item-level factor loadings provided additional support for the construct validity of the EWQ. The strongest loadings were consistently observed for items representing core symptoms within each construct, indicating that these subscales are theoretically coherent and empirically robust in both T2D patients and controls. This alignment between theoretical constructs and empirical indicators reinforces the scale's construct validity and underscores its suitability for both clinical practice and research in diabetes care. In contrast, certain panic-related and social anxiety items displayed comparatively lower loadings, particularly *Fear of streets/public places* in the T2D group, suggesting that these symptoms may be less central or differently manifested in this population. Such differences between T2D and control groups highlight the importance of interpreting EWQ results at both the subscale and item level to ensure nuanced and clinically meaningful assessment. In particular, the item *Fear of streets/public places* showed a low factor loading in the T2D group (0.277), indicating limited relevance in this population. While this suggests potential refinement in future versions, removal at this stage could affect comparability with previous EWQ studies. Further research should examine whether revision or replacement is warranted.

Despite these favourable outcomes, some limitations were evident, particularly the moderate fit indices that did not reach the optimal thresholds. These suboptimal values could be attributed to the limited number of items per factor and the inherent heterogeneity of the constructs these items are designed to measure.[31] To increase the model fit, the investigation of additional dimensions within the data should be considered in future research, as doing so could reveal latent structures previously unaccounted for.[36] These challenges are further compounded by constraints related to sample size and the granularity of the factor items, potentially affecting model precision and increasing measurement error.[33] Nevertheless, the overall findings affirm the utility of the EWQ as a reliable instrument for evaluating emotional distress in patients with T2D, particularly when accounting for the theoretical rationale behind error covariances and the symptomatic overlap between related constructs such as depression and anxiety.[31,36]

The validation of the EWQ in patients with T2D underscores its unique advantage over more conventional tools, such as the PHQ-9,[19] which primarily targets depression. Unlike other instruments that focus on a narrower spectrum of mental health issues, the ability of the EWQ to assess a broader range of conditions—depression, anxiety, social anxiety, and fatigue—is particularly valuable for managing chronic conditions such as T2D. In this population, these symptoms are not only prevalent but also mutually reinforcing, necessitating a comprehensive assessment tool for potentially useful diagnosis and therapeutic planning. The confirmation of the six-factor structure of the EWQ in a T2D cohort is particularly significant, as it ensures that the tool is finely tuned to the specific psychological challenges faced by these patients, thus increasing the precision and practical utility of EWQ results in clinical and research settings.

The EWQ in Clinical Practice

The validation of the EWQ represents an important step in improving the clinical management of T2D. By identifying multiple emotional dimensions, including asthenia and sleep disorders, the EWQ enables more targeted interventions that address both mental well-being and physical health. This integrated approach supports comprehensive strategies for managing diabetes and its mental health comorbidities, such as depression and anxiety, which are known to exacerbate each other and negatively impact patient outcomes.[14,15,37,38.]

Clinical Implementation

Routine use of the EWQ should follow clear protocols:

- Every 6 months for stable patients; every 3 months for those with poor glycaemic control or a history of positive screenings. Initial administration is recommended at diagnosis and during major treatment changes[39]
- Best conducted by diabetes educators or specialist nurses, given their regular patient contact and counselling expertise.[40] Patients can complete the EWQ independently (15–20 minutes) or with assistance; digital formats may improve efficiency[39]
- No cut-off thresholds were calculated in the present study. As an example from distribution-based approaches in previous research,[41] the depression subscale may be categorised as minimal (0–7), mild (8–15), moderate (16–23), and severe (24–32). These example thresholds require validation through ROC analysis before clinical use.
- Scores indicating moderate to severe distress should prompt follow-up, including brief counselling, GP review, or referral to mental health services[42]
- Diabetes care staff should receive basic mental health screening training, covering EWQ administration, scoring, interpretation, and crisis management[42,43]

Strengths and limitations

As a pilot study, this investigation provides valuable preliminary insights while acknowledging significant limitations that affect its clinical applicability. The moderate fit indices, which did not reach optimal thresholds, suggest that further refinement of the model is necessary. In clinical practice, this means that while the EWQ can identify key emotional domains, some constructs may be measured less precisely, requiring caution when interpreting borderline subscale scores. Our total sample of 240 participants (122 T2D, 118 controls) meets the minimum CFA requirement but is below the optimal 280–420 participants for robust validation of a 28-item instruments.[33] Conducting CFA separately for each group further reduced the effective sample size, which, combined with the moderate fit indices (CFI = 0.886, TLI = 0.883), may affect the stability of factor loadings and the precision of fit indices such as the CFI, TLI, and RMSEA A.[31] In smaller samples, these indices are prone to greater variability, which can misrepresent the adequacy of the model for capturing the underlying factor structure.[33] HbA1c levels were self-reported and not verified against records, introducing potential recall bias that should be considered when interpreting related associations.

Additionally, the cultural and linguistic specificity of the Estonian version of the EWQ may limit the generalizability of the findings to other populations. While the EWQ has been validated in Estonia, the interpretation of reversed items and the cultural context of fatigue and sleep disturbances may vary across different settings. In the analysis, reversed items were recoded to ensure their alignment with the direction of other items, aiming to maintain consistency across the dataset. This approach minimizes common method bias, which is often a challenge in psychological testing.[44] To further improve model reliability, robust estimation techniques could be considered, such as maximum likelihood estimation with robust standard errors and the chi-square statistic adjusted for nonnormality.[35] These factors could affect the reliability and validity of the instrument in other countries and cultures.[45] No clinical cut-off thresholds were derived in this study, which precludes immediate clinical implementation. Future research should establish thresholds via ROC analyses against structured diagnostic interviews to ensure diagnostic accuracy.

The cross-sectional design limits[46] causal inference, as associations between EWQ scores and clinical variables cannot be interpreted as causal relationships. The participant response rate was high; however, reasons for nonparticipation were not systematically collected. It is unknown whether nonparticipation could be related to emotional distress, potentially leading to underestimation of mental health issues in the sample. Recruitment exclusively from specialist endocrinology departments may not fully represent patients managed in primary care, introducing potential selection bias and limiting the generalizability of the findings. Future research should focus on larger-scale validation studies, especially those involving cross-cultural adaptation.

International validation efforts should maintain the six-factor structure while allowing for necessary cultural adaptations. How linguistic nuances, such as the interpretation of reversed items, influence measurement accuracy should be examined in studies. Furthermore, cultural differences in the understanding of fatigue- and sleep-related items, as this

study suggests through the observed correlations, should be carefully considered in future adaptations. Additionally, how scores on the EWQ evolve over time and their correlation with clinical outcomes in T2D patients could be elucidated in longitudinal studies. Given its strong psychometric performance in this Estonian sample, further research should examine its applicability across diverse cultural and linguistic contexts. Cross-cultural adaptation and validation would help ensure measurement equivalence and support the EWQ's integration into international diabetes care, enabling consistent assessment of emotional well-being and comparability of results across settings.

Conclusion

This pilot study provides preliminary evidence that the EWQ six-factor model may be useful for assessing emotional distress in T2D patients. Given the moderate psychometric indices and sample constraints, findings should be interpreted cautiously and do not support immediate clinical use. Essential next steps include large-scale, multicentre validation to confirm the factor structure, establish clinical cut-off values, test cross-cultural and linguistic equivalence, and assess longitudinal predictive validity for outcomes such as glycaemic control, adherence, and quality of life. If confirmed, the EWQ could be integrated into routine diabetes care as a brief screening tool administered by nurses or diabetes educators, with results informing referral pathways and recorded in the electronic health record. These findings support further validation before clinical implementation.

Abbreviations

CFA, Confirmatory factor analysis; EWQ, Emotional Well-Being Questionnaire; T2D, type 2 diabetes; PHQ-9, Patient Health Questionnaire; CFI, comparative fit index; RMSEA, root mean square error of approximation; ADA, American Diabetes Association; DASS-21, Depression, Anxiety, and Stress Scale; HADS, Hospital Anxiety and Depression Scale; BDI-2, Beck Depression Inventory; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders Fourth Edition; STROBE, Strengthening the Reporting of Observational Studies in Epidemiology; BMI, body mass index; HbA1c, Haemoglobin A1c; TLI, Tucker–Lewis index.

Data Sharing Statement

The datasets generated and/or analysed during the current study are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Ethics Committee of the Estonian National Institute for Health Development (*decision no. 1162*; 29.12.2022). Written informed consent was obtained from all participants prior to study commencement.

Acknowledgments

The authors would like to thank the patients who participated in the study.

Author Contributions

All authors made a significant contribution to the work reported, whether in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

This research was funded by Tallinn Health Care College grant number 446.

Disclosure

The authors declare that they have no known competing financial interests or personal relationships that could appear to influence the work reported in this paper.

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