Dysphagia (2019) 34:63–72
https://doi.org/10.1007/s00455-018-9914-7

ORIGINAL ARTICLE

Translation and Validation of the Dysphagia Handicap Index in Hebrew-Speaking Patients

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Received: 28 November 2017 / Accepted: 29 May 2018 / Published online: 7 June 2018

Abstract

The Dysphagia Handicap Index (DHI) is a 25-item questionnaire assessing the physical, functional, and emotional aspects of dysphagia patients' quality of life (QoL). The study goal was to translate and validate the Hebrew-DHI. 148 patients undergoing fiberoptic endoscopic examination of swallowing (FEES) in two specialized dysphagia clinics between February and August 2017 filled the Hebrew-DHI and self-reported their dysphagia severity on a scale of 1–7. 21 patients refilled the DHI during a 2-week period following their first visit. FEES were scored for residue (1 point per consistency), penetration and aspiration (1 point for penetration, 2 points for aspiration, per consistency). 51 healthy volunteers also filled the DHI. Internal consistency and test–retest reproducibility were used for reliability testing. Validity was established by comparing DHI scores of dysphagia patients and healthy controls. Concurrent validity was established by correlating the DHI score with the FEES score. Internal consistency of the Hebrew-DHI was high (Cronbach's alpha = 0.96), as was the test–retest reproducibility (Spearman's correlation coefficient = 0.82, $p < 0.001$). The Hebrew-DHI's total score, and its three subscales (physical/functional/emotional) were significantly higher in dysphagia patients compared to those in healthy controls (median 38 pts, IQR 18–56 for dysphagia patients compared to 0, IQR 0–2 for healthy controls, $p < 0.0001$). A strong correlation was observed between the DHI score and the self-reported dysphagia severity measure (Spearman's correlation coefficient = 0.88, $p < 0.0001$). A moderate correlation was found between the DHI score and the FEES score (Pearson's correlation coefficient = 0.245, $p = 0.003$). The Hebrew-DHI is a reliable and valid questionnaire assessing dysphagia patients' QoL.

Keywords Deglutition · Deglutition disorders · Dysphagia Handicap Index · Patient-reported outcome measure · Quality of life · Fiber optic endoscopic evaluation of swallowing · Dysphagia · Questionnaire · Translation · Hebrew

Introduction

Dysphagia is a common pathology, affecting 16–22% of the general population [1, 2]. Dysphagia arises from many causes, such as neurogenic (e.g., cerebrovascular accidents or neurodegenerative diseases) or head and neck tumors, surgery or radiation related, etc. [3–6]. The physical effects of dysphagia range from malnutrition and dehydration, to aspiration pneumonia and asphyxia [7, 8]. However, the effects of dysphagia are far wider—affecting many aspects of the patient's life including work, leisure, and social situations [6–9]. In recent years, there is a growing emphasis on the patient's quality of life (QoL) as a major factor to be considered when treating patients with dysphagia [10, 11].

Yael Shapira-Galitz and Michael Drendel have contributed equally to this study.

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A variety of patient-reported outcome measures (PROM) assessing dysphagia have been developed [11]. Some questionnaires are disease-specific, such as the M.D. Andersons Dysphagia Inventory (MD-ADI) which targets patients with head and neck cancer [12] and the Dysphagia Goal Handicap (DGH) for patients with esophageal dysphagia [13]. Others are more generic, designed for any-cause dysphagia, such as the Swallowing Quality of Life Questionnaire (SWAL-QOL) [14] or the Eating Assessment Tool—10 (EAT-10) [15]. In a review of the psychometric characteristics of PROM for oropharyngeal dysphagia, the Dysphagia Handicap Index (DHI) [16] and SWAL-QOL received the strongest psychometric ratings on all validity aspects and the interpretability of the questionnaire [11]. The SWAL-QOL, despite being a validated and widely used questionnaire, has complex wording of the statements and many response choices per statement, making it difficult for some patients to comprehend. The DHI was developed to formulate a more concise and user-friendly questionnaire.

The DHI is composed of 25 statements divided into three domains; physical aspects of dysphagia (9 items), i.e., how the patient perceives the physical discomfort caused by dysphagia; functional aspects (9 items), i.e., how dysphagia impacts the patient's daily activities; and emotional aspects (7 items), i.e., the affective response caused by the patient's dysphagia. For each statement, the patient checks whether it applies to him/her all the time, some of the time, or never, with a suggested scoring of 0, 2, and 4, respectively. Using this scoring system gives the DHI score a range of 0–100, with higher scores meaning worse QoL. After completing the questionnaire, the patient is also requested to rate a self-reported dysphagia severity measure reflecting his/her general impression of their swallowing difficulty on a scale from 1 (normal) to 7 (severe problem). The use of the DHI is becoming more prevalent, and it has been translated to Persian [17], Arabic [18], and Japanese [19].

The Swallowing Disturbance Questionnaire (SDQ) was the first validated PROM designed for Hebrew-speaking patients with dysphagia [20]. It was developed as a screening tool and adjunct to bedside evaluation in patients with dysphagia. It contains items relevant to pharyngeal dysphagia as well as oral dysphagia. However, all its statements are related to the physical aspects of dysphagia, and none pertain to the emotional or functional aspects. The goal of this study was to translate, culturally adapt, and validate the Hebrew version of the DHI.

Methods

Translation

Translation of the DHI questionnaire into Hebrew was carried out according to the principles of good practice for the translation and cultural adaptation process for patient-reported outcome measures, as defined by the International Society for Pharmacoeconomics and Outcome Research (ISPOR) Task Force for translation and cultural adaptation [21]. The questionnaire was forward-translated from English to Hebrew by two independent bilingual translators, fluent in both English and Hebrew. The translations were reconciled to a single forward translation by the two translators in collaboration with the authors, which was then back-translated into English by a third independent translator and compared with the original items of the English DHI. The back-translation was reviewed by the authors. The reconciled forward translation was then reviewed and pilot-tested on three consenting subjects with oropharyngeal dysphagia who are fluent in both English and Hebrew. No major suggestions were made, and the result was the Hebrew-DHI.

Population

The study group was recruited from two medical centers. It included patients visiting the dysphagia clinic at the Kaplan Medical Center, Rehovot or the Sheba Medical Center, Tel-Hashomer, between the years 2015 and 2017. Exclusion criteria were age below 18, declined cognitive state precluding the patient from filling the questionnaire, non-Hebrew-speaking patients, and patients who decided not to participate in the study. Illiterate patients or those who were unable to write their answers in the questionnaire by themselves were assisted by a family member or a designated person to write the patient's answers in their stead. The study was approved by the respective institutional ethics committees of both sites. All participants signed an informed consent form.

Eligible patients filled the DHI questionnaire during their visit to the dysphagia clinic. A sample of dysphagia patients were contacted via telephone to fill the questionnaire a second time. Re-filling the questionnaire took place during a 2-week period following the date after participants first filled the questionnaire and without major therapeutic interventions, such as surgical (e.g., vocal cord medialization) or nonsurgical (dysphagia rehabilitation exercises or medicine regimen changes) interventions taking place between the two times the questionnaires were filled.

The control group included healthy volunteers recruited from hospital personnel, patients' companions, and patients

admitted to the hospital for ambulatory surgery in areas other than the head and neck (e.g., elective orthopedic or urologic surgery). Exclusion criteria for the control group were a personal history of dysphagia, head and neck malignancy/radiation therapy or operations (except adenotonsillectomy), history of neurologic disease or cerebrovascular accident, inability to fill the questionnaire and age below 18.

Dysphagia Evaluation

Examination Protocol

All patients in the study group underwent a full history taking and physical examination followed by a Fiberoptic Endoscopic Examination of Swallowing (FEES) on the same day they filled the DHI. The standard FEES protocol was followed with slight modifications as will be described later in detail [22]. A flexible digital video rhinolaryngoscope (ENF-V2, Olympus Medical System Corporation, Tokyo, Japan or Pentax Fiber naso-pharyngo-laryngoscope FNL 15RP3, Japan, or Storz video-rhinolaryngoscope VP 11101, Germany) was passed through the patient's most patent naris with administration of a small amount of topical anesthetic (2% Lidocaine hydrochloride gel) which has been shown not to significantly alter the FEES results [23, 24]. The base of tongue, pharynx, and larynx were viewed. Laryngeal sensation was evaluated by gently touching the aryepiglottic folds with the endoscope and noting cough or a laryngeal adductor reflex. Swallowing was evaluated directly with nine bolus challenges, three of each consistency (liquid, purée, and solid) of approximately 5 cc volume each, presented in the following order: Three boluses of purée consistency (green-dyed apple purée) followed by a solid consistency challenge of whole wheat bread (two pieces without crust and one with the crust), and concluded with three thin liquid boluses (green dyed 3% fat milk). Patients were encouraged to feed themselves, with assistance as needed, i.e., liquid with a straw or cup and purée with a spoon. All patients were allowed to swallow spontaneously, i.e., without a verbal command to swallow.

Evaluation of Penetration–Aspiration

For all patients, each bolus challenge was evaluated for presence of penetration or aspiration, and was scored using the Penetration Aspiration Score (PAS) [25]. Penetration was defined as PAS 2–5 and aspiration was defined as PAS 6–8. The worst PAS out of all bolus challenges in all consistencies was used for analysis.

FEES Score

In order to evaluate the overall dysphagia severity, each FEES received a score incorporating both penetration–aspiration and pharyngeal residue. In order to calculate the FEES score a binary residue scale was used. A score of 0 was given if residue was absent in all consistencies tested and a score of 1 was given for each consistency in which any severity residue was observed, with a maximal score of 3 if residue was present in all three consistencies tested. For penetration and aspiration—a score of 0 was given if no airway penetration or aspiration was observed, a score of 1 was given if penetration was observed, and a score of 2 was given if aspiration was observed. The scores for penetration–aspiration and residue were then summated. The possible FEES scores ranged from 0 (no residue, penetration, or aspiration in either of the three consistencies) to 9 (maximum 3 points for residue and 6 points for aspiration).

Evaluation of Pharyngeal Residue

A random subgroup of consecutive patients from one site (the Kaplan Medical Center) was also scored for residue using an ordinal scale, the Yale Pharyngeal Residue Severity Rating Scale (YPR-SRS) [26]. The Yale score was applied to the residue observed immediately after the first swallow of each bolus challenge. The worst YPR-SRS out of all bolus challenges of all consistencies was used for analysis. Mild residue was defined as YPR-SRS of 1 or 2. A score of $3\leq$ was considered severe pharyngeal residue.

Reliability Testing

The reliability of the questionnaire was tested by two methods: internal consistency and test–retest reproducibility. Internal consistency refers to the homogeneity of the questionnaire and the way in which the questions relate to each other within the questionnaire. Cronbach's alpha coefficient was used to evaluate internal consistency, with a minimum acceptable value of 0.7. Test–retest reproducibility, which reflects stability over time with repeated testing, was analyzed by correlating initial score results and subsequent questionnaire scores using Spearman's correlation coefficient. A minimum test–retest correlation coefficient of 0.7 was acceptable.

Validation Testing

The validity of the questionnaire, measuring its capacity to reflect differences between groups—in this case patients with dysphagia and a healthy control group—was tested using nonpaired *T* test. Concurrent criterion validity was evaluated by comparing the DHI score results with the

score given to the pathological findings on FEES, as detailed above. Convergent validity of the questionnaire was examined by comparing the questionnaire score to the patient's response to the self-reported dysphagia severity measure at the end of the questionnaire, which rates the patient's own perception of the severity of their swallowing problem.

Statistical Analysis

Normally distributed continuous variables are described as mean with standard deviation. Nonnormally distributed continuous variables are described as median and interquartile range (IQR). Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software version 20. Noncontinuous variables were compared using χ^2 test. Continuous variables were compared using Mann–Whitney test if two variables were compared, or Kruskal–Wallis test if three or more variables were compared. Correlations are presented with either the Spearman's correlation coefficient or the Pearson's correlations coefficient. p values of < 0.05 were considered significant results.

Results

The Hebrew version of the DHI is presented in Fig. 1.

Population

The study group consisted of 148 dysphagia patients, 80 recruited from the Kaplan Medical Center and 68 recruited from the Sheba Medical Center (Table 1). 88 patients (59.4%) were males. Median age of the cohort was 70 years, IQR 62–78. Dysphagia etiology was heterogeneous, and consisted of neurogenic etiology (n = 50, 33.7%), head and neck surgery or radiation related (n = 47, 31.7%), esophageal dysphagia (n = 19, 12.8%), and other/unknown (n = 32, 21.6%). No significant differences were observed between the populations from both study sites in regards to age, gender, or dysphagia etiology. The control group included 50 healthy volunteers, with a median age of 63 years, IQR 59–68, and 25 of whom (50%) were males.

Reliability

The internal consistency (Cronbach's alpha) for the Hebrew-DHI total scores and physical, functional, and emotional domain scores were high with 0.96, 0.88, 0.91, and 0.91, respectively (Table 2). Test–retest reproducibility of the entire questionnaire was also high (Spearman's correlation coefficient = 0.82) and moderate to high for each of its three domains, based on a sample of 21 patients of various dysphagia etiologies: neurogenic (n = 7, 30.5%), H&N related (n = 7, 34.7%), esophageal (n = 2, 8.6%), and other/unknown (n = 5, 26%), who refilled the questionnaire (Spearman's correlation coefficient = 0.84, 0.71, 0.77, $p < 0.0001$ for all). Table 2 presents a comparison between the Hebrew-DHI reliability test results and the DHI questionnaire's reliability results [16].

Validation

The DHI score was significantly higher for dysphagia patients compared to healthy controls (median 38, IQR 18–56 points for dysphagia patients compared to 0, IQR 0–2 for healthy controls, $p < 0.0001$). Moreover, when comparing scores of each of the questionnaire's three domains, the median scores of the physical (14 points, IQR 10–20 compared to 0, IQR 0–2), functional (12 points, IQR 4–20, compared to 0, IQR 0–0) and emotional (8 points, IQR 2–16, compared to 0, IQR 0–0) domains of the questionnaire were each independently higher in the dysphagia patients group compared to controls ($p < 0.0001$ for all) (Table 3). The correlation between the DHI score and the self-reported severity measure score was strong [Spearman's correlation coefficient 0.88 ($p < 0.0001$)]. Table 4 presents the total scores and scores for each domain according the self-perceived dysphagia severity.

Comparison of DHI with FEES

Sixty patients (40.5%) received a FEES score of 0–1. 53 patients (35.8%) received a FEES score of 2–3, and 35 patients (23.7%) received a score of 4 or higher. 72 patients (48.6%) received a PAS of 1, meaning no penetration or aspiration was observed. 37 patients (25%) received a PAS of 6≤, meaning frank aspiration was observed. A significant correlation was observed between the overall FEES score and the DHI score with a Pearson's Correlation Coefficient (PCC) of 0.245, p = 0.003. Table 5 presents the DHI score distribution according to severity of the FEES score. We also examined how penetration–aspiration severity and residue severity independently affect the DHI scores. When examining the correlation of the PAS with the DHI score, we observed a weak and nonsignificant correlation (PCC = 0.158, p = 0.058). When comparing DHI scores between patients with PAS = 1 (non-aspirators), $2 \leq$ PAS ≤ 5 (patients with penetration only), and $6 \leq$ PAS ≤ 8 (aspirators), we found significant differences only in the functional domain and only between non-aspirators (median DHI score 8, IQR 2–16) and patients with penetration or aspiration of any degree, i.e., PAS≥2 (median DHI = 18, IQR 8.5–20 for penetrators, and 20, IQR 12–24 for aspirators, p = 0.017). Table 6 presents the

Fig. 1 The Hebrew version of the Dysphagia Handicap Index

שאלון הפרעות בליעה DYSPHAGIA HANDICAP INDEX

שם: _____ תעודת זהות: _____ מין: ז / נ

תאריך: _____

עבור כל הצהרה, אנא סמן/ני X בתיבה המתארת בצורה הנכונה ביותר את הפרעה הבליעה שלך:

מס'	הצהרה	אף פעם	לפעמים	תמיד
1P	אני משתעל/ת כשאני שותה נוזלים			
2P	אני משתעל/ת כשאני אוכל/ת מזון מוצק			
3P	הפה שלי יבש			
4P	אני חייב/ת לשתות על מנת לבלוע את האוכל			
5P	ירדתי במשקל כתוצאה מהפרעת הבליעה שלי			
1F	אני נמנע/ת מחלק מהמאכלים עקב הפרעת הבליעה שלי			
2F	שיניתי את הדרך בה אני בולע/ת על מנת שיהיה לי יותר קל לאכול			
1E	אני מתבייש/ת לאכול בחברת אנשים			
3F	לוקח לי יותר זמן לסיים ארוחה מבעבר			
4F	אני אוכל/ת ארוחות קטנות יותר ולעתים קרובות יותר עקב הפרעת הבליעה שלי			
6P	אני חייב/ת לבלוע פעם נוספת בשביל שהאוכל ייבלע			
2E	אני מרגיש/ה מדוכא/ת כי איני יכול/ה לאכול מה שאני רוצה			
3E	אני לא נהנה/ית מארוחות כפי שנהניתי בעבר			
5F	אני לא מתרועע/ת בחברה כפי שנהגתי בעבר בגלל הפרעת הבליעה שלי			
6F	אני נמנע/ת מלאכול בגלל הפרעת הבליעה שלי			
7F	אני אוכל/ת פחות בגלל הפרעת הבליעה שלי			
4E	אני בחרדה בגלל הפרעת הבליעה שלי			
5E	אני מרגיש/ה נכה בגלל הפרעת הבליעה שלי			
6E	אני כועס/ת על עצמי בגלל הפרעת הבליעה שלי			
7P	אני נחנק/ת כשאני נוטל/ת את התרופות שלי			
7E	אני מפחד/ת שאיחנק ואפסיק לנשום בגלל הפרעת הבליעה שלי			
8F	אני חייב/ת לאכול בדרך אחרת (לדוגמא זונדה) בגלל הפרעת הבליעה שלי			
9F	שיניתי את התפריט שלי בגלל הפרעת הבליעה שלי			
8P	אני מרגיש/ה תחושת מחנק כשאני בולע/ת			
9P	אני משתעל/ת מזון לאחר שאני בולע/ת אותו			

אנא הקף/הקיפי בעיגול את המספר שמתאים ביותר לחומרה של הפרעת הבליעה שלך:

(1=אין הפרעה כלל, 4=הפרעה בינונית, 7=ההפרעה הגרועה ביותר שיכולה להיות)

1	2	3	4	5	6	7
אין הפרעה			הפרעה בינונית			הפרעה גרועה

DHI scores for patients who are non-aspirators, patients with penetration, and patients with frank aspirations. For a subgroup of randomly selected consecutive 46 patients, residue severity was scored using the YPR-SRS as described above. When correlating the DHI with the YPR-SRS, a moderate correlation was observed between the

Table 1 Patients characteristics

	All patients, N = 148 (100%)	Kaplan Medical Center N = 80 (54%)	Sheba Medical Center N = 68 (46%)
Age, median (IQR)	70 (62–78)	71 (63–79)	70 (62.5–75)
Sex, N (%)	88 (59.4%)	44 (55%)	44 (64.7%)
Dysphagia etiology, N (%)			
Neurogenic	50 (33.7%)	27 (33.8%)	23 (33.8%)
Head and neck	47 (31.7%)	28 (35%)	19 (27.9%)
Esophageal	19 (12.8%)	8 (10%)	11 (16.2%)
Other/unknown	32 (21.6%)	17 (21.3%)	15 (22.1%)

Table 2 Comparison of the internal consistency and reproducibility between the Hebrew-DHI and the DHI

	Hebrew-DHI		DHI [16]	
	Internal consistency (Cronbach's alpha)	Test–retest reproducibility (SCC)	Internal consistency (Cronbach's alpha)	Test–retest reproducibility (SCC)
Total	0.96	0.82	0.94	0.83
Physical	0.88	0.84	0.78	0.77
Functional	0.91	0.71	0.91	0.86
Emotional	0.91	0.77	0.86	0.75

SCC Spearman's correlation coefficient, *DHI* Dysphagia Handicap Index

Table 3 Comparison of DHI scores between dysphagia patients and healthy controls

	Dysphagia patients	Healthy controls
Total DHI	36 (18–56)	0 (0–2)
	38.44 ± 24.39	2.27 ± 5.04
Physical	14 (10–20)	0 (0–2)
	14.39 ± 8.16	1.52 ± 2.02
Functional	12 (4–20)	0 (0–0)
	13.38 ± 9.94	0.35 ± 2.52
Emotional	8 (2–16)	0 (0–0)
	10.09 ± 8.57	0.39 ± 1.38

Results are presented as median and interquartile range and mean ± standard deviation

DHI Dysphagia Handicap Index

DHI and residue scores both in the vallecula (PCC = 0.541, $p < 0.0001$) and pyriform sinuses (PCC = 0.454, $p = 0.001$). When comparing DHI scores for patients with a YPR-SRS ≤ 2 to those with YPR-SRS ≥ 3, significant differences were found in all three domains, and between the total scores of the questionnaire for residues in the vallecula and pyriform sinuses. Table 6 presents the DHI scores for patients with mild residue (YPR-SRS ≤ 2) and severe residue (YPR-SRS ≥ 3). Figure 2 presents the DHI score distribution for mild and severe pharyngeal residue severities.

Discussion

The impact of dysphagia on the lives of the individuals who suffer from it is wide, and includes physiological aspects, which can be measured by instrumental assessment such as FEES or videofluoroscopy. However, dysphagia also has a profound impact on the patient's well-being, including social and emotional implications, which are measured by patient-reported outcome measures (PROMs) [6–9]. In this study, we systematically and comprehensively translated the DHI to Hebrew using accepted methodology. The study results show that the Hebrew-DHI is a reliable PROM with good internal consistency and test–retest reproducibility. These parameters are similar to the original DHI [16], as well as translations of the DHI to other languages [17–19].

The Hebrew-DHI was also shown to be a valid tool, able to discriminate between healthy controls and dysphagia patients. The mean DHI score for our dysphagia patient group was 38.44 ± 24.39 (median 36, IQR 18–56), approximately 40% higher than Silbergiet's mean DHI score for her dysphagia patient group (27.33 ± 21.28) [16]. When comparing DHI scores between different translation studies, a wide range is observed [16–19]. Table 7 presents a comparison between data of different DHI translation studies. The Arabic [17] and Persian [18] versions are slightly higher than the English DHI [16]. The

Table 4 DHI scores distribution according to self-perceived dysphagia severity

	Mild (n = 20) self-perceived score 1–2	Moderate (n = 87) self-perceived score 3–5	Severe (n = 34) self-perceived score 6–7
Total DHI	12 (3.5–16.5)	38 (26–50)	69 (58–81.5)
Physical	7 (2–10)	14 (10–20)	25 (18–29.5)
Functional	1 (0–6.25)	14 (8–20)	24 (18.5–30)
Emotional	0 (0–2)	10 (5–13)	20 (14.5–28)

Values presented are median and interquartile range

DHI Dysphagia Handicap Index

Table 5 DHI scores distribution according to FEES scores

	FEES score 0–1 (n = 60, 40.5%)	FEES score 2–3 (n = 53, 35.8%)	FEES score 4≤ (n = 35, 23.7%)
Total DHI	26 (14–42)	39 (18–56.5)	51 (38–68)
Physical	10 (8–16)	16 (10–20)	20 (16–28)
Functional	8 (2–16)	16 (6.5–21.5)	22 (19.5–26.5)
Emotional	4 (0–14)	8 (4–16)	12 (10–23)

Values presented are median and interquartile range

DHI Dysphagia Handicap Index

Table 6 DHI score distribution according to residue severity and penetration–aspiration severity

	Pharyngeal residue						Penetration–aspiration			
	Vallecula			Pyriform sinuses			None	Penetration	Aspiration	p value
	YPR-SRS ≤ 2 (n = 23/46)	YPR-SRS ≥ 3 (n = 23/46)	p value	YPR-SRS ≤ 2 (n = 29/46)	YPR-SRS ≥ 3 (n = 17/46)	p value	PAS = 1 (n = 72, 48.6%)	PAS = 2–5 (n = 39, 26.3%)	PAS = 6–8 (n = 37, 25%)	
Total DHI	26 (12–46)	50 (38–68)	0.006	28 (16.5–42)	54 (40–74)	0.001	26 (14–42.5)	43 (28.5–55.5)	46 (34–68)	0.052
Physical	10 (6–16)	18 (14–25)	0.004	12 (6–18)	20 (16–28)	0.001	12 (8–18)	17 (10.5–20)	18 (12–26)	0.134
Functional	8 (0–18)	18 (12–23)	0.005	8 (2–18)	20 (18–26)	0.002	8 (2–16)	18 (8.5–20)	20 (12–24)	0.017
Emotional	6 (1–17)	12 (8–20)	0.039	6 (2–14)	16 (10–24)	0.019	7 (2–14)	10 (4.5–16)	10 (6–20)	0.268

Values presented are median and interquartile range

DHI Dysphagia Handicap Index, *PAS* penetration–aspiration scale, *YPR-SRS* Yale pharyngeal residue severity rating scale

mean Japanese DHI [19] is markedly lower than all others. One possible explanation could be the difference between the populations tested. The dysphagia group of Silbergiet et al. was composed mainly of patients with mild dysphagia, whereas more than half our cohort was composed of patients with moderate-to-severe dysphagia—both self-reported—and according to the FEES score, we applied to their objective instrumental swallowing studies. Another explanation could be cultural differences in the self-appreciation of dysphagia severity. For example, the geographic and ethnic proximity between Arab and Hebrew speakers might mean there is less of a cultural gap between them than between Japanese speakers. This could explain the relative similarity between the Arab-, Persian-, and Hebrew-DHI scores, while the Japanese population, with an entirely different cultural background showed markedly different scores. Further studies are required to illuminate the reasons for the differences in self-perceived dysphagia severity across cultures.

Of the three domains of the Hebrew-DHI, the physical domain score was higher than the functional and emotional domains. Similar results were observed in the translation studies of the DHI to other languages [16–19]. This finding might suggest that the physical aspect of dysphagia, such as coughing or choking during meals and weight loss, has a stronger impact on the patient's self-perceived severity of

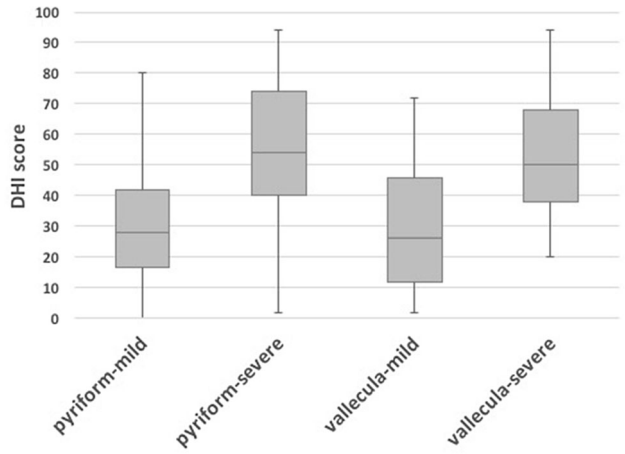

Fig. 2 Dysphagia Handicap Index score distribution for mild and severe pharyngeal residue severities. *DHI* Dysphagia Handicap Index. Mild pharyngeal residue was defined as a Yale Pharyngeal Severity Rating Scale score of 1–2, and severe residue was defined as a score of ≥ 3

dysphagia than the emotional of functional aspects do. However, the higher scores in this domain could perhaps be caused by the fact that this aspect of dysphagia is most familiar to the patients and is directly associated by them to their swallowing disorder. Despite the importance of the physical aspects of dysphagia, its emotional effects should not be underestimated. Martino et al. studied the priorities that patients give to the pulmonary, nutritional, and psychological implications of dysphagia, and observed that patients prioritized the psychological effects of dysphagia such as fear of choking to death, depression, and embarrassment of eating with others higher than nutritional or pulmonary effects [27].

When examining how the DHI correlates with objective findings on instrumental assessment, which in our study was FEES, we observed that the DHI shows a weak–moderate correlation to the FEES score as a whole, which was composed of both penetration–aspiration severity and the presence of pharyngeal residue. However, when examining penetration–aspiration and pharyngeal residue independent of each other, it was pharyngeal residue represented by the YPR-SRS which was tested on 46 patients, and not penetration–aspiration which showed the stronger correlation with the DHI. The stronger effect of pharyngeal residue than that of penetration–aspiration on the patient's QoL has been shown in another study by Meyer et al. [28]. Those authors showed that both penetration–aspiration and oropharyngeal residue are correlated with functional status of the head and neck cancer survivors, but only residue was associated with the patient's QoL. Perhaps this is because patients' QoL is less affected by their concern of developing pneumonia but rather by the frustrating sensation of food stubbornly sticking in their throats. Although deglutologists give a lot of weight to the consequences of penetration–aspiration, rightfully dreading its severe clinical outcomes, our study emphasizes that in order to improve patients QoL, similar emphasis should be placed in addressing pharyngeal residue in treatment plans and patient assessment.

Our study is not without limitations. Our approach to illiterate patients, who were assisted by a family member or companion to read them the questionnaire and help them fill it out, might have skewed this subpopulation's results. In addition, while ensuring that patients did not undergo therapeutic interventions during the 2-week interval between test and retest, we could not control the natural course of the patient's disease, such as after a cerebrovascular accident. Furthermore, the Hebrew-DHI was not compared to another validated PROM and was not evaluated for responsiveness, the ability of the PROM to reflect change after intervention. To date, only one study used the DHI to quantify a therapeutic intervention's effect on patients' QoL [29]. In addition, our validation method was based on Classical Test Theory (CTT). Recent

Table 7 Comparison among data of different DHI translation studies

	Hebrew DHI	DHI [16]	Persian DHI [17]	Arabic DHI [18]	Japanese DHI [19]
Total DHI	39 (18–56)	–	28 (0–92)	–	10 (2–24)
	38.44 ± 24.39	27.33 ± 21.18	32.14 ± 25.32	32.489 ± 24.737	–
physical	14 (10–20)	–	11 (0–33)	–	4 (0–10)
	14.39 ± 8.16	11.52 ± 6.86	15.23 ± 7.97	13.3 ± 9.6	–
Functional	12 (4–20)	–	12 (0–34)	–	2 (0–8)
	13.38 ± 9.94	10.04 ± 9.79	10.19 ± 10.86	12.3 ± 10.1	–
Emotional	8 (2–16)	–	4 (0–28)	–	2 (0–8)
	10.09 ± 8.57	5.76 ± 6.78	6.53 ± 5.76	6.9 ± 7.4	–

Values presented are either mean ± standard deviation or median and interquartile range, or both when available

DHI Dysphagia Handicap Index

literature suggests that Item Response Theory (IRT) using Rasch model analysis has advantages over CTT in validating PROM [30, 31]. Future studies are required to validate the Hebrew-DHI using IRT, and to examine the responsiveness of the DHI after implementation of behavioral strategies, and medical or surgical interventions.

Conclusion

Our study demonstrates that the Hebrew-DHI has good internal consistency, test–retest reproducibility, and concurrent and convergent validity. It has proven to be a reliable and valid instrument for assessment of dysphagia patients' QoL for the Hebrew-speaking population.

Compliance with Ethical Standards

Conflict of interest The authors have no conflict of interest to declare.

Ethical Approval All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent All participants signed an informed consent form.

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