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VALIDATION STUDIES

Validity and reliability of the Duruöz Hand Index in patients with psoriatic arthritis

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Abstract

Objective The Duruöz Hand Index (DHI) is a valuable scale developed for evaluating hand functions of patients with rheumatoid arthritis and subsequently proven to be valid and reliable in various diseases. This study aims to investigate the validity and reliability of the DHI in patients with psoriatic arthritis (PsA).

Methods Patients diagnosed with PsA according to CASPAR criteria were enrolled. The demographic, clinical, and functional characteristics of patients were evaluated. Functional assessment was performed with DHI, Hand Functional Index, Health Assessment Questionnaire, and VAS-disability scale. C-reactive protein level, patients' and physicians' global VAS, swelling and tenderness of the hand joints, gross grip strength and thumb strength, and disease activity assessments were recorded as non-functional parameters related to active disease status. Reliability was assessed by internal consistency (with Cronbach's-a) and test–retest intraclass correlation coefficient. Face, content, convergent, and divergent validities were applied.

Results One hundred and forty-four patients (74.3% female) were included in this study. The Cronbach's alpha coefficient was 0.963, and for the test–retest reliability of the DHI, the intraclass correlation coefficient was 0.904 ($p < 0.001$). DHI showed good correlations with the functional disability scales (Hand Functional Index, Health Assessment Questionnaire, VAS-disability), indicating its convergent validity and moderate to non-significant correlations with the non-functional parameters supporting its divergent validity.

Conclusions Despite the occurrence of significant deformities and functional loss in PsA patients, there is a noticeable absence of specific tools tailored for PsA. Considering the intricacies associated with skin, nail, tendon, entheseal involvement, and arthritis, there is a need for straightforward tools in both clinical practice and studies involving patients with PsA. The DHI is a valid and reliable scale to evaluate the functional disability of hands in patients with PsA.

Keywords Duruöz Hand Index · Psoriatic arthritis · Hand function · Outcome

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Introduction

Psoriatic arthritis (PsA) is a multifaceted and diverse chronic condition characterized by peripheral arthritis, axial involvement, enthesitis, dactylitis, uveitis, and psoriasis of the skin and nails. Moll and Wright clinically defined five subgroups of PsA in 1973, encompassing both axial and peripheral joint involvement [1]. Enthesitis plays a central role in the pathogenesis of psoriatic arthritis (PsA). When evaluating enthesitis, it is crucial to observe new bone formation, formations, and structural deteriorations of the enthesis tendon using imaging methods such as X-ray [2]. The disease's manifestations vary from enthesal discomfort to severe engagement of multiple peripheral joints, resulting in significant deformities. PsA affects both men and women equally. While PsA has a relatively low prevalence in the general population, its estimated occurrence is around 0.05–0.21% in Europe and 0.07–0.25% in the USA. Its prevalence is notably higher, affecting approximately 30% of patients with psoriasis [3].

Hand involvement is observed in roughly 40% of PsA patients and is the most frequently affected region. In four of the classifications based on Moll and Wright's criteria, the involvement of small joints in the hands and feet stands out [1]. Psoriatic arthritis can affect nearly all joints, leading to varying degrees of impact on hand function. It spans from mild monoarthritic cases to erosive deformative polyarticular forms. Additionally, periarticular involvements such as enthesitis, dactylitis, and tenosynovitis are observed in conjunction with arthritis. Symptoms like joint swelling, pain, restricted range of motion, decreased muscle strength, and deformities significantly impede hand functions, ultimately leading to profound limitations in the quality of life and daily activities for patients with arthritis mutilans [5].

While no specific test exists for evaluating hand functions in previous studies involving PsA patients, the Duruöz Hand Index has been employed. The DHI was initially designed to evaluate hand function in RA patients; its validity has since been confirmed in conditions impacting hand function, including systemic sclerosis, carpal tunnel syndrome, and hemodialysis patients [6–8]. It comprises 18 questions, assessing everyday functions across categories such as kitchen activities, dressing, cleaning, work-related tasks, and other daily activities. Each question is scored on a scale from 0 (challenging) to 5 (impossible). The total DHI score ranges from 0 to 90 points, with higher scores indicating poorer hand function and lower scores denoting better hand function [9]. The primary objective of this study is to validate the Duruöz Hand Index for assessing functional status in patients with PsA and to ascertain its psychometric properties.

Methods

This cross-sectional study was conducted at the Division of Rheumatology in the Department of Physical Medicine and Rehabilitation at Marmara University, as well as at the Division of Rheumatology and Immunology within the Department of Physical Medicine and Rehabilitation at the School of Medicine, Sakarya University. For this validation study, patients diagnosed with psoriatic arthritis (PsA) according to CASPAR criteria between August 2020 and August 2021, who agreed to participate in the study and signed the informed consent form, were included. Participants with a history of hand surgery or trauma within the last 90 days, neurological diseases (such as stroke, brain injury, or Parkinson's), upper extremity amputation, neuropathic pain, or any neurological disorder impacting the upper extremity, as well as those with a history of traumas and nerve damage, skin lesions, malignancy, pregnancy, psychological disorders, and clinically significant osteoarthritis resulting in limited hand movement were excluded. Those participating in the study received information regarding the research's objectives and assessment methods. Ethical approval was secured from the Research Ethics Committee at Marmara University, School of Medicine (approval number: 09.2020.845, date: 24/07/2022), before initiating the study. Informed consent was obtained from individuals willing to participate.

In this cross-sectional, two-phase study, patients were assessed through face-to-face interviews by a rheumatologist/immunologist. The physician recorded various details, including age, gender, education level, occupation, smoking habits (and smoking pack-years), comorbidities, disease duration, hand dominance, PsA subtype, medication, tender and swollen joint counts, dactylitis, enthesitis using the Leeds Enthesitis Index, tender enthesitis count, disease activity ındex for psoriatic arthritis (DAPSA), minimal disease activity (MDA), psoriasis area and severity ındex (PASI), and C-reactive protein (CRP) [10–12]. Swelling (rated on a scale of 0 = none, 1 = probable swelling, 2 = definite swelling, 3 = tense swelling) and tenderness (rated on a scale of 0 = no tenderness, 1 = tender, 2 = tender with a wince response, 3 = tender with a wince and withdrawal response) of hand joints (wrist, thumb's interphalangeal, five metacarpophalangeal, four proximal interphalangeal, and four distal interphalangeal) were assessed and scored (with a range of 0–15 points for each hand) [6]. A digital dynamometer (Jamar + Digital Dynamometer; Patterson Medical, Warrenville, IL, USA) and a pinch gauge (Jamar Hydraulic Pinch Gauge; Patterson Medical, Warrenville, IL, USA) were utilized to quantify gross grip force and thumb force, respectively. Both measurements were conducted in the standard position, as recommended by the American Association of Hand Therapists [13]. Thumb force was

evaluated in three ways: two-point compression (the compression meter was positioned between the tip of the thumb and the tip of the index finger), three-point compression (the compression meter was situated between the tip of the thumb and the tip of the index finger on the inside of the index and middle fingers), and side pinch (the pinch meter was placed between the underside of the thumb and the lateral surface of the index finger).For each strength assessment, three measurements were taken with 1-min intervals, and the highest values were utilized in the analysis.

Following the examination, patients completed questionnaires to assess various aspects: Patient global assessments of morning stiffness, pain, disability, and overall health over the past week were evaluated using the visual analog scale (VAS). Hand function was assessed using the Duruöz Hand Index (DHI) [6], Hand Functional Index (HFI) [14], Health Assessment Questionnaire (HAQ) [15], and VAS-disability scale. Quality of life was measured using the PsA-specific quality of life (PsAQoL) [16], in addition to the VAS-QoL scale. Patients were also required to complete the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) to assess axial involvement activity [17] and the Jenkins Sleep Scale to evaluate sleep quality [18].

Functional indexes

The Duruöz Hand Index (DHI) is a validated questionnaire used to assess functional disability related to limitations in hand activities. Originally developed for rheumatoid arthritis, it has been subsequently validated for use in diabetes mellitus, carpal tunnel syndrome, scleroderma, cerebral palsy, tetraplegia, and stroke patients [19]. The questionnaire comprises 18 items related to hand abilities in various activities, including kitchen tasks, dressing, personal hygiene, office work, and general activities. Each item is scored on a Likert scale ranging from 0 (no difficulty) to 5 (impossible to do), reflecting the individual's experiences during the week before completing the questionnaire. The total DHI score ranges from 0 to 90 [6].

The Health Assessment Questionnaire (HAQ) was initially developed to evaluate the functional abilities of individuals with rheumatoid arthritis. It consists of eight groups of questions regarding daily living activities. Responses are categorized as 0 (able to do with no difficulty), 1 (able to do with some difficulty), 2 (able to do with much difficulty), or 3 (unable to do). The final HAQ score can vary from 0 to 3 [15].

The Hand Function Index (HFI) was derived from the first nine questions of Keitel's Function Test and is used to measure functional capacity through nine standard items. The sub-scores for the nine movements in both hands are summed to calculate the final score. HFI scores range from 4 to 42, with higher scores indicating poorer function [20].

Reliability analyses of DHI in PsA

To assess the reliability of the DHI in psoriatic arthritis (PsA), both internal consistency and test–retest reliability were examined. The internal consistency of the scale was determined based on the total score of the DHI questionnaire using the Cronbach alpha coefficient. Test–retest reliability was evaluated by asking patients to complete the DHI again after one week, and reliability was measured using the intraclass correlation coefficient.

Validity analyses of DHI in PsA

In examining the validity of the DHI in PsA, content, face, and construct validities were assessed. Content validity was determined by physicians to ascertain whether the items in the DHI were relevant to the daily living activities of patients with PsA. Face validity was assessed through cognitive debriefing interviews with patients to evaluate the readability and comprehensibility of the DHI. Construct validity was evaluated through convergent and divergent validity. Convergent validity was established by observing strong correlations between the DHI score and other functional parameters, such as HFI, HAQ, VAS disability, and grip strength. Divergent validity was determined by assessing correlations with other variables that had low or no apparent relationships with disability.

Statistical analysis

Statistical analysis was conducted using SPSS 24.0. Descriptive statistics were used, presenting categorical variables as numbers (with percentages) and numerical variables as mean (with standard deviation) or median (interquartile range). Reliability analyses for the DHI included Cronbach's alpha coefficient for internal consistency and the intraclass correlation coefficient (ICC) for test–retest reliability. Correlation analyses between quantitative variables were performed using Spearman's correlation coefficient. Correlation coefficients (ρ) greater than 0.6 were considered strong, those between 0.3 and 0.6 were considered moderate, and those lower than 0.3 were considered weak or indicative of no correlation. A significance level of $p < 0.05$ was adopted.

Results

A total of 144 patients, with a mean age of 45.33 (standard deviation: 11.58) years, were included in the study, and 107 of them (74.3%) were women. The average disease duration was 5.84 (SD: 5.35) years, and approximately 34.72% of the patients were undergoing biological treatment. The initial mean and median DHI scores were 12.62 (SD: 13.31) and

8.5 (ınterquartile range: 21), respectively. The demographic and clinical characteristics of the patients are detailed in Table 1.

Reliability analyses for DHI in PsA

Internal consistency: The Cronbach's alpha coefficient for the 18 items of the DHI was found to be 0.963.

Test–retest reliability: Twenty patients were able to complete the DHI scale again 1 week later. The Wilcoxon test was used to assess whether there were any significant changes in the distribution of DHI scores between the two time points. The analysis revealed no significant differences ($p = 0.108$). Subsequently, the intraclass correlation coefficient was calculated between the two time points, indicating excellent test–retest reliability with a coefficient of 0.904 ($p < 0.001$).

Validity analyses for DHI in PsA

DHI demonstrated good content validity, with its items being relevant to assessing hand disability in patients with psoriatic arthritis. Face validity was confirmed through cognitive debriefing interviews with the patients. Convergent validity: The correlation results of DHI with disability parameters are presented in Table 2. DHI scores exhibited strong correlations with HAQ (ρ: 0.779) and moderate correlations with VAS-p Disability (ρ: 0.599) and HFI (ρ: 0.484).

Divergent validity: The correlation results of DHI are shown in Table 3. It displayed no significant correlations with age (ρ: −0.033), disease duration (ρ: 0.041), and CRP (ρ: 0.151). Weak correlations were observed with the Leeds Enthesitis Index (ρ: 0.256), PASI (ρ: 0.292), minimal disease activity (ρ: −0.257), and Jamar strength of the right hand (ρ: −0.277). Moderate correlations were noted with the tender joint count, swollen joint count, DAPSA, tenderness hand index, swelling hand index, Jamar strength of the left hand, pinch strengths of both hands, BASDAI, VAS questionnaires (except disability), Jenkins Sleep Scale, and PsAQoL (ρ ranging from 0.305 to 0.590).

Discussion

This study aimed to assess the validity and reliability of the Duruöz Hand Index (DHI) in patients with psoriatic arthritis (PsA), demonstrating excellent reliability and good construct validity. The questions exhibited internal consistency, yielding consistent results upon repetition. Additionally, the index displayed positive correlations with similar questionnaires, affirming its reliability. The incorporation of this index facilitates effective patient monitoring and evaluation.

Table 1 Demographic and clinical characteristics of patients

Age, years	45.33 (SD 11.58)
Disease duration, years	5.84 (SD 5.35)
Level of education, *n* (%)	
Primary	56 (38.9%)
Secondary	62 (43%)
Tertiary	26 (18.1%)
Occupation, *n* (%)	
Active working	53 (36.8%)
Retired	13 (9%)
Marital status, *n* (%)	
Single	14 (9.7%)
Married	126 (87.5%)
Separated	4 (2.8%)
Smoking, *n* (%)	
Active smoker	38 (26.4%)
Ex-smoker	33 (22.9%)
Non-smoker	73 (50.7%)
Subgroups in PsA, *n* (%)	
Asymmetric oligoarticular	69 (47.9%)
Symmetric polyarthritis	46 (31.9%)
Spondylitis	23 (16%)
Distal interphalangeal predominant	3 (2.1%)
Arthritis mutilans	3 (2.1%)
Hand dominancy	
Right, *n* (%)	129 (89.6%)
History of hand surgery	4 (2.7%)
Tender joint count	3 (IQR 7)
Swollen joint count	0 (IQR 0) (min, max 0, 9)
Dactylitis ever, *n* (%)	15 (10.41%)
Leeds enthesitis index	2 (IQR 6)
PASI	0.8 (IQR 1.8)
CRP, mg/L	3.1 (IQR 6.58)
DAPSA	20 (IQR 26)
MDA total score	0 (IQR 3)
BASDAI	4.75 (SD 2.31)
Tenderness hand index	3 (IQR 8)
Swelling hand index	0 (IQR 0)
Morning stiffness, mins	20 (IQR 39)
Jamar's strength of right hand, kg	19.43 (SD 11.57)
Jamar's strength of left hand, kg	18.34 (SD 10.69)
Pinch strength of right thumb, pound	11 (IQR 9.67)
Pinch strength of left thumb, pound	10.41 (IQR 8.34)
VAS-p pain	50 (IQR 50)
VAS-p elbow/shoulder/neck pain	50 (IQR 40)
VAS-p general health	50 (IQR 40)
VAS-d hand disease activity	40 (IQR 30)
VAS-d general health	40 (IQR 30)
Jenkins Sleep Scale	6 (IQR 9)
PsAQoL	9.08 (6.28)

PASI Psoriasis Area Severity Index, *CRP* C-reactive protein, *DAPSA* Disease Activity in Psoriatic Arthritis Score, *MDA* minimal disease activity, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *VAS-p* visual analog scale of patient, *VAS-d* visual analog scale for doctor's opinion, *PsAQoL* Psoriatic Arthritis Quality of Life Questionnaire)

Table 2 Mean, median, and Spearman correlation coefficients of Duruoz Hand Index with functional parameters as convergent validity

	Mean (SD)	Median (IQR)	Correlations with DHI	
			ρ	p
Duruoz Hand Index (range 0–90)	12.62 (13.31)	8.5 (21)	–	–
HAQ (range 0–3)	0.57 (0.56)	0.45 (0.8)	0.779	**< 0.001**
VAS-p Disability (range 0–100)	39.1 (29.36)	45 (59)	0.599	**< 0.001**
HFI (range 4–42)	7.09 (5.45)	5 (5)	0.484	**< 0.001**

HAQ Health Assessment Questionnaire, *VAS-p* visual analog scale of patient, *HFI* Hand Functional Index
Significance of bold indicates **p < 0.001

Table 3 Spearman correlation coefficients of Duruoz Hand Index with non-functional parameters as divergent validity

Clinical parameters	ρ	Surveys	ρ
Age	−0.033	BASDAI	0.448**
Disease duration	0.041	VAS-p pain	0.359**
Tender joint count	0.396**	VAS-p elbow/shoulder/neck pain	0.391**
Swollen joint count	0.341**	VAS-p morning stiffness	0.590**
Leeds enthesitis index	0.256*	VAS-p general health	0.327**
PASI	0.292**	VAS-d general health	0.431**
DAPSA	0.312**	VAS-d hand disease activity	0.503**
MDA total score	−0.257*	Jenkins Sleep Scale	0.386**
Tenderness hand index	0.388**	PsAQoL	0.585**
Swelling hand index	0.335**		
Jamar strength, right	−0.277*		
Jamar's strength left	−0.305**		
Pinch strength, right	−0.338**		
Pinch strength left	−0.394**		
CRP	0.151		

PASI Psoriasis Area Severity Index, *DAPSA* Disease Activity in Psoriatic Arthritis Score, *CRP* C-reactive protein, *MDA* Minimal Disease Activity, *BASDAI* Bath Ankylosing Spondylitis Disease Activity Index, *VAS-p* Visual analog scale of patient, *VAS-d* visual analog scale for doctor's opinion, PsAQoL Psoriatic Arthritis Quality of Life Questionnaire
**$p < 0.001$, *$p = 0.001$–0.049

Various tools and outcome measures have been developed to evaluate hand function in different patient populations, primarily for rheumatoid arthritis (RA) and osteoarthritis (OA). However, there has been a lack of a specific tool for PsA, despite the necessity of assessing hand functions in patients with PsA, who may experience severe deformities and functional loss. Research indicates that both RA and PsA have comparable impacts on strength reduction, fine motor skills, and self-reported hand function. In fact, fine motor skill impairment can be more pronounced in PsA, likely due to greater entheseal and tendon involvement. Interestingly, patients with psoriasis, even without clinical signs of PsA, have exhibited impaired hand functions, implying a phenotype resembling functional arthritis [4]. Therefore, there is a need for simple, user-friendly tools in clinical practice and studies involving PsA patients, considering the complexities associated with skin, nail, tendon, and entheseal involvement in addition to joint inflammation. The DHI, initially designed for assessing hand functions in RA patients, has been validated in both inflammatory and non-inflammatory conditions, such as systemic sclerosis, cerebral palsy, carpal tunnel syndrome, and tendon injuries [8, 22–24].

PsA induces inflammation in the joints and enthesis sites and can disrupt daily life, primarily when it affects the hands. Although PsA is a member of spondylarthritis group diseases, it mostly demonstrates peripheral dominant involvement [25]. About 2–5% of the patients show only axial involvement, while the remains have peripheral involvement or both [26]. While previous studies have reported that the asymmetric oligoarthritic form is the most common type of PsA, recent studies have shown symmetric polyarthritis, most of which have hand involvement. In a study evaluating joint involvement, interphalangeal, metacarpophalangeal, and wrist involvement were 32.8%, 52.6%, 34.5%, and 35.3%, respectively [27]. Although these joint

involvements are generally thought of as benign arthropathy, structural damage has been shown with the progression of the disease and joint inflammation. At the end of a prospective study, 45% of patients developed the erosive and deforming disease, which was particularly at increased risk for those with polyarticular onset, and patients with erosive and deforming disease had poorer functional performance [28].

The mean DHI score for PsA patients in this study was 12.6. Comparatively, DHI scores for RA, systemic sclerosis, and traumatic hand flexor tendon injuries were reported as 9.7, 11.8, and 31.1, respectively. PsA patients exhibited hand disability similar to RA and lower than traumatic tendon injury patients, as expected [24, 29].

In this study, internal consistency and reliability of the DHI were evaluated using the Cronbach's alpha coefficient and intraclass correlation coefficient (ICC). The high ICC score of 0.96 indicates that the DHI is reliable, a pattern consistent with previous studies using the DHI in different patient populations. ICC values of 0.80, 0.97, and 0.97 were observed in patients with systemic sclerosis, stroke, and carpal tunnel syndrome, respectively [20, 21, 29]. Furthermore, the test–retest reliability of the DHI was high (ICC = 0.904), consistent with studies in patients with cerebral palsy and carpal tunnel syndrome [23, 30]. These findings confirm the reliability and reproducibility of the DHI, consistent with observations in various populations [21, 24]. Additionally, the DHI offers advantages such as convenience, comprehensiveness, and minimal time and financial investment.

The correlation between the DHI and other functional parameters was investigated to assess the convergent validity of DHI scores in PsA patients. We found that the DHI scores demonstrated moderate to good correlations with HAQ, VAS disability, and HFI. Among these functional parameters, HAQ exhibited the strongest relationship with the DHI. Originally developed to assess physical function in RA, HAQ has been extensively utilized in inflammatory arthritis, including PsA. The evaluation of physical function is a component of the Group for Research and Assessment of Psoriasis, and PsA OMERACT Core Outcome Set for PsA, with HAQ being the most commonly used instrument in PsA clinical trials [31]. Moreover, one of the five parameters that should be met in the minimal disease activity state is functional assessment, evaluated with HAQ [32]. While HAQ, the most frequently used scale in physical function, assesses both the upper and lower extremities, the DHI specifically focuses on hand function [33]. Nevertheless, both are strongly correlated due to the broad involvement of the hand in physical function. Similar to our findings, a robust correlation was observed between the DHI and HAQ in patients with RA [34]. Although HFI has not been previously evaluated in PsA, it has been frequently employed in RA patients and demonstrated correlation with HAQ [35].

In assessing the divergent structure's validity, the DHI exhibited no correlation with non-functional parameters, including age, disease duration, and CRP, thereby supporting discriminative validity. A weak to moderate correlation was observed with disease activity parameters such as tender joint count, swollen joint count, BASDAI, and DAPSA. In diseases primarily affecting peripheral joints, such as PsA and RA, it is anticipated that hand functions would be influenced by disease activity [29]. In a study involving RA patients, the mean DHI scores for those with active disease were significantly higher than for those in remission. The authors further noted that the primary factors limiting hand functions were morning stiffness, pain, tenderness, and swelling [36]. Regarding hand grip strength, a significant low to moderate correlation with DHI was observed. Similarly, in a study evaluating hand functions in PsA, a moderate correlation was noted between hand grips and scores on the Michigan Hand Outcome Questionnaire, indicative of hand function [37].

This study holds several strengths and limitations. It is the first validation study for a scale used to assess hand function in PsA, providing a valuable tool for routine clinical practice in evaluating hand functions in PsA patients. Moreover, the inclusion of patients from two distinct rheumatology clinics and a sufficient number of patients with test–retest scores enhances the study's reliability. However, the study did not evaluate responsiveness, and the proportion of patients with severe deformities was relatively low. While the prevalence of arthritis mutilans can vary from 2 to 21% based on different definitions adopted in various studies, only 2.1% of patients in this study were classified as arthritis mutilans [38].

In conclusion, the results of this study highlight the utility of the Duruöz Hand Index as a practical tool for assessing hand functions in routine clinical practice and clinical studies involving PsA patients. This tool proves valuable in cases where joint involvement leads to severe deformities. Its use facilitates patient follow-up and adherence to the core set of parameters for PsA.

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Declarations

Conflict of interest The authors declare that there are no conflicts of interest.

Ethics approval All procedures performed in studies involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Ethical approval was taken from the Marmara University Ethics Committee (approval no:09.2020.845 and date: 24/07/2022).

Consent to participate Informed consent was obtained from all subjects before enrollment.

Consent for publication Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

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