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Original Research

Innovation And Development Of Dash Instruments For Functional Examination Of The Hand In Brachialis Plexus Injury (BPI)

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ABSTRACT

Background: *The modified DASH instrument has been used as a measure of the functional ability of the hand in brachial plexus injury (BPI) until now, but its validity and reliability have not been tested. The aims of the study are to analyze the validity and reliability of the modified DASH instrument as a measure of the functional ability of the hand in brachial plexus injury (BPI) conditions.*

Methods: *This research uses an observational correlation approach. The design of the validity and reliability test uses the person-product moment test and Cronbach's alpha based on standardized items. The number of questions is 30, with 75 research subjects selected by purposive sampling.*

Results: *The majority of the research subjects were male, 56 subjects (74.7%), were in the late adolescent age group (17–25 years) of 46.7% (35 subjects). Construct validity test value > 0.227 with $\rho < 0.05$. The instrument reliability coefficient value is 0.925 with Cronbach's Alpha on each question item worth above 0.90.*

Conclusion: *All Q1-Q30 question items are valid and reliable so they can be used to measure hand functional abilities under BPI conditions.*

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INTRODUCTION

Brachial Plexus Injury (BPI) is an injury to peripheral nerve tissue originating from the fifth cervical root to the first thoracic (C5-Th1), which causes neurological deficits in the upper limbs it innervates (Khrisna et al., 2021). This has an impact on functional abilities and physical disabilities in the arms and hands. The level of the lesion can be analogous to the clinical manifestations of active and passive movements of the shoulder, upper arm, forearm, hand, and wrist, through various movements (Park et al., 2017).

The percentage of causes of BPI injuries around 90% are motorcyclist accidents (Nugroho, 2017). According to data from the Orthopedic Hospital Prof. dr. Soeharso Surakarta, 8 outpatients suffered brachial plexus injuries in January 2019 and were

referred to the medical rehabilitation unit. Where 5 of them are men aged 20–28 years and 3 of them are women aged 23–26 years (Direksi, 2020).

BPI conditions can change posture, alignment, and level of physical activity, which is more or less influenced by the role of changes in joint biomechanics, thus affecting the function and quality of life of patients (quality of life), such as daily functional activities that include self-care activities, work activities, and recreational activities (leisure). In BPI conditions, it can cause a decrease in the functional ability of the hand as a result of pain, inflammation, and joint stiffness. This condition is a statement that describes the patient's multi-dimensional condition obtained from the results of assessment and clinical considerations, which can indicate the presence of motion dysfunction and potential movement dysfunction, which includes disturbances or weaknesses in body functions, body structure, activity limitations, barriers to participation, and environmental and social constraints.

Personal factors, based on the International Classification of Functioning, Disability, and Health (ICF) or related to health problems as stated in the International Statistical Classification of Diseases and Related Health Problems (ICD-10) (Organization World Health, 2002). According to Utoyo et al., (2009) to get good treatment, an appropriate assessment or evaluation instrument is needed so that the healing process and the return of the functional ability of the upper limbs can be maximized. Jamar, objective assessment instruments can be used to measure the ability of the joint range of motion (ROM) in joint movement with degrees and grip strength measured by a dynamometer. However, these measurements have not been able to accommodate patient complaints, so sometimes the results obtained are different from their expectations.

Therefore, subjective measurements are very important to use to explore how people feel and complain about functional limitations in carrying out daily activities. The best subjective assessment instrument is a questionnaire that can measure the limitations of organ and individual functions in their role in society. Besides that, it is also cheap, practical, and comprehensive in exploring patient complaints so that clinicians can properly determine the next treatment (Utoyo et al., 2009).

In clinical research, standardized questionnaires measuring treatment outcomes and health-related quality of life are becoming increasingly important (Guyatt, 1993). One of the research measuring instruments used to measure the functional variables of the hand is the DASH (Disabilities of the Arm, Shoulder, and Hand) instrument. The DASH was developed by the American Academy of Orthopedic Surgeons as a region-specific instrument for measuring upper extremity disability and symptoms.

DASH was first described in 1996 by Hudak et al., DASH is a measuring instrument used to measure functional ability in hand, arm, and shoulder disorders. The DASH questionnaire consists of 30 items that evaluate symptoms and function, each with five response options. The DASH score is measured by dividing the number of responses by the number of responses completed minus one times twenty-five, which is the final score of this instrument using the following simple formula: DASH score. Total Outcomes Score on the DASH scale (0–100): Higher scores would indicate more severe disability or symptoms.

According to Turchin et al., (2017), DASH is reliable and valid in a population of patients with elbow and other disorders associated with various upper extremity disorders (Beaton et al., 2001). Atroshi et al. carried out a cross-cultural adaptation of the DASH instrument in Sweden in 2000 using a process that included multiple forward

and backward translations, expert and lay reviews, and field testing to achieve linguistic and conceptual equivalence. Meanwhile, in Indonesia, modification of DASH has been carried out by changing the three question points to adapt to Indonesian culture in 2007, with the results of the study showing that there was no significant difference between operative and conservative measures in DASH and modification of DASH (Utoyo et al., 2009).

This research is novel because, so far, there has never been a re-study to determine the level of validity and reliability of the DASH instrument that has been modified to reflect Indonesian culture and language. This study applies the DASH modification to the condition of brachial plexus injury (BPI) in the BPI community in Central Java. Based on the above problems, the researchers aimed to measure the validity and reliability of the DASH instrument for examining the functional abilities of the hands in brachial plexus injury (BPI) conditions.

MATERIALS AND METHOD

This research was conducted in May–September 2022 in a community with BPI in Central Java. This study uses a quantitative approach to observational correlation. The population in this study were all members of the BPI community in the Central Java region. The research subjects were 75 people who were obtained through the purposive sampling technique with the following inclusion criteria: at least 17 years old and willing to be research subjects.

The research variables used were thirty question items contained in the Disabilities of the Arm, Shoulder, and Hand (DASH) instrument. Data collection techniques were carried out by filling out a questionnaire on DASH and documenting data on BPI community members. The questionnaire was filled out once. The validity test in this study was constructed using the Pearson product-moment correlation technique. Reliability test using Cronbach's alpha analysis technique.

RESULTS

Data on the characteristics of the research subjects included the following: the majority of the research subjects were in the late adolescent age range (17–25 years), as many as 35 subjects (46.7%). While the second order is in the age range (26-35 years) early adulthood as many as 22 subjects (29.3%). Then the age range (36–45 years) of late adulthood is several 9 subjects (12%). The age range (46–55 years) ranks the least, namely as many as 3 subjects (4%). The age range of the oldest subjects was at (56-65 years) late elderly with as many as 6 subjects. The majority of research subjects were male, namely 56 subjects (74.7%). While there were 19 female subjects (25.3%). This can be studied in Table 1.

Table 1. Characteristics of respondents based on age and gender

Characteristics	Category	Frequency	Percentage
Age			
17-25	Late teens	35	46.7
26-35	Early adulthood	22	29.3
36-45	Late adulthood	9	12
46-55	Early elderly	3	4
56-65	Late elderly	6	8
Total		75	100

Characteristics	Category	Frequency	Percentage
Gender			
Male		56	74.7
Female		19	25.3
Total		75	100

The measurement results obtained are the measurement results on each question item that has a high correlation score with the score on the total item. The validity test is carried out to assess the construct validity, using the Pearson product-moment correlation test. The results of the validity test are presented in Table 2 below.

Table 2. DASH Instrument Validity Test

Question Items	R_{Count}	R_{Table}	P Value
Unfold your finger	0,290		0,012
Write	0,633		0,000
Turn the key	0,626		0,000
Cooking	0,651		0,000
Push the door	0,750		0,000
Place items on the top shelf	0,617		0,000
Doing household chores	0,776		0,000
Clean the page	0,727		0,000
Making the bed	0,727		0,000
Carrying grocery bags	0,637		0,000
Carrying heavy objects	0,577		0,000
Replace the light bulb	0,556		0,000
Washing hair	0,672		0,000
Washing the back	0,631		0,000
Wearing sweaters/ jackets/ clothes	0,696	0,227	0,000
Using a knife to cut food	0,620		0,000
Recreational activities that require minimal effort	0,751		0,000
Recreational activities where you take some strength in your arms, shoulders, or hands	0,719		0,000
Recreational activities in which you move your arms freely	0,599		0,000
Managing transportation needs	0,563		0,000
Sexual activity	0,303		0,008
Disturbance in social activities during the past week	0,475		0,000
Limitations in work/ADL in the past week	0,407		0,000
Pain in the arm, shoulder, or hand	0,378		0,001
Pain in the arm, shoulder, or hand when doing certain activities	0,496		0,000
Tingling in the arms, shoulders, or hands	0,454		0,000

Question Items	R_{Count}	R_{Table}	P Value
Weakness in the arms, shoulders, or hands	0,422		0,000
Stiffness in the arm, shoulder, or hand	0,391		0,001
Had trouble sleeping during the past week	0,437		0,000
Feelings of inadequacy, lack of self-confidence, or uselessness due to problems with the arms, shoulders, or hands	0,465		0,000

Based on Table 2, it can be seen that the count on each question item has a value greater than r_{table}, where the value of r_{table} with a significance level of 0.05 in several 75 research subjects is 0.227. The ρ value of question item number 1 (Q) is 0.012. While ρ on question item number 21 is 0.008. The question items in Q24 and Q28 are 0.001, and the other question items show several 0.000 for each question item. The ρ value of Q1-Q30 has a value of less than 0.05. The reliability test on each question item on the DASH instrument can be observed in Table 3 below.

Table 3. DASH Instrument Reliability Test Using Cronbach's Alpha

Question Items	Cronbach's Alpha Values
Unfold your finger	0,929
Write	0,922
Turn the key	0,922
Cooking	0,921
Push the door	0,920
Place items on the top shelf	0,922
Doing household chores	0,920
Clean the page	0,920
Making the bed	0,920
Carrying grocery bags	0,922
Carrying heavy objects	0,923
Replace the light bulb	0,923
Washing hair	0,921
Washing the back	0,922
Wearing sweaters/ jackets/ clothes	0,921
Using a knife to cut food	0,922
Recreational activities that require minimal effort	0,921
Recreational activities where you take some strength in your arms, shoulders, or hands	0,921
Recreational activities in which you move your arms freely	0,922
Managing transportation needs	0,923
Sexual activity	0,927
Disturbance in social activities during the past week	0,925

Question Items	Cronbach's Alpha Values
Limitations in work/ADL in the past week	0,925
Pain in the arm, shoulder, or hand	0,926
Pain in the arm, shoulder, or hand when doing certain ativities	0,924
Tingling in the arms, shoulders, or hands	0,925
Weakness in the arms, shoulders, or hands	0,925
Stiffness in the arm, shoulder, or hand	0,925
Had trouble sleeping during the past week	0,925
Feelings of inadequacy, lack of self-confidence, or uselessness due to problems with the arms, shoulders, or hands	0,925

The results of the reliability test using Cronbach's Alpha show that the value of the reliability coefficient on the instrument is 0.925 and the value of Cronbach's Alpha on each question item is above 0.90.

DISCUSSION

This research shows that the incidence of BPI is most common in the late adolescent age range (17–25 years), which is 46.7% (35 subjects). Arimbawa et al., (2017) also found the same thing where the victims of peripheral nerve injury incidents were mostly young men aged 15–25 years. The same thing was also found in the results of the Setiawan & Gessal, (2021) which found the highest incidence of BPI was in the young adult age range (19–34 years). This result is reinforced by Suroto's, (2019) where the distribution of BPI patients is in the 21-30 year age group.

Based on Table 1 on the research data, the research subjects were dominated by male sex, as many as 56 subjects (74.7%). This is supported by the results of the report from Arimbawa et al., (2017) stated that patients with brachial plexus conditions found in Surabaya were mostly men, which 70% were due to traffic accidents (motor vehicles). The same result was also presented by Setiawan & Gessal, (2021) namely 89% of BPI occurred in men.

The research subjects in this validity test were 75 subjects so the r_{table} value was set at 0.227. Table 2 shows that the 4 question items in Q1 Unfold your finger, Q21 Sexual activity, Q24 Pain in the arm, shoulder, or hand, and Q28 Stiffness in the arm, shoulder, or hand have results between 0.200 – 0.400. Eleven question items, namely Q11 Carrying heavy objects, Q12 Replace the light bulb, Q19 Recreational activities in which you move your arms freely, Q20 Managing transportation needs, Q22 Disturbance in social activities during the past week, Q23 Limitations in work/ADL in the past week, Q25 Pain in the arm, shoulder, or hand when doing certain activities, Q26 Tingling in the arms, shoulders, or hands, Q27 Weakness in the arms, shoulders, or hands, Q29 Had trouble sleeping during the past week, and Q30 Feelings of inadequacy, lack of self-confidence, or uselessness due to problems with the arms, shoulders, or handshave r_{count} in the range 0.400 – 0.600.

While the 15 question items Q2 Write, Q3 Turn the key, Q4 Cooking, Q5 Push the door, Q6 Place items on the top shelf, Q7 Doing household chores, Q8 Clean the page, Q9 Making the bed, Q10 Carrying grocery bags, Q13 Washing hair, Q14 Washing

the back, Q15 Wearing sweaters/ jackets/ clothes, Q16 Using a knife to cut food, Q17 Recreational activities that require minimal effort, and Q18 Recreational activities where you take some strength in your arms, shoulders, or hands have r_{count} of 0.600 – 0.800. In the construct validity test, a value of 0.012 was obtained in Q1 Unfold your finger; 0.008 in Q21 Sexual activity; 0.001 in Q24 Pain in the arm, shoulder, or hand and Q28 Stiffness in the arm, shoulder, or hand, and the remaining 0.000 which means $\rho < 0.05$ with $r_{count} > r_{table}$ on all question items in the modified DASH instrument. These results indicate that the construct validity for the modified DASH questionnaire shows low validity ($0.200 < r \leq 0.400$) to high ($0.600 < r \leq 0.800$).

Based on the data obtained, it can be concluded that the items in Q1 to Q30 are valid. According to Vaus, (2002) valid questions are questions that can measure what should be measured. This study uses the person product moment correlation test to determine the construct validity of each question item in the instrument. Construct validity is one type of validity that focuses on the extent to which the question items in an instrument can measure according to the conceptual definitions and specific concepts that have been set (Kristanti et al., 2021).

For construct validity assessment to be easy to do, the definition of the variable must be clear. If the definition has been formulated based on the right theory and the question items are appropriate, then the instrument is declared valid in terms of construct validity (Yusuf, 2018). Cronbach's alpha reliability test was conducted to measure internal consistency. While the interclass correlation coefficient is used to measure test-retest reliability.

Based on Table 3, shows that the lowest Cronbach's alpha value is 0.920 a total of 4 questions, namely on question items Q5 Push the door, Q7 Doing household chores, Q8 clean the page, and Q9 make the bed. The five-question items each with a Cronbach's alpha value of 0.921 and 0.922, namely in Q4 Cooking, Q13 Washing hair, Q15 Wearing sweaters/ jackets/ clothes, Q17 Recreational activities that require minimal effort, and Q18 Recreational activities where you take some strength in your arms, shoulders, or hands, each had a Cronbach's alpha value of 0.921. While the question items in Q2 Write, Q3 Turn the key, Q6 Place items on the top shelf, Q10 Carrying grocery bags, and Q19 Recreational activities in which you move your arms freely have a Cronbach's alpha value of 0.922.

For three question items, including Q11 Carrying heavy objects, Q12 Replacing the light bulb, and Q20 Managing transportation needs, Cronbach's alpha is worth 0.923. One question item, namely on Q25 Pain in the arm, shoulder, or hand when doing certain activities Cronbach's alpha is worth 0.924. Q24 Cronbach's alpha is 0.926. The majority of Cronbach's alpha is worth 0.925, namely on the question items Q22 Disturbance in social activities during the past week, Q23 Limitations in work or ADL in the past week, Q26 Tingling in the arms, shoulders, or hands, Q27 Weakness in the arms, shoulders, or hands, Q28 Stiffness in the arm, shoulder, or hand, Q29 Had trouble sleeping during the past week, and Q30 Feelings of inadequacy, lack of self-confidence, or uselessness due to problems with the arms, shoulders, or hands.

The highest Cronbach's alpha value was found in the Q1 question item Unfold your finger, which was 0.929. The results of the correlation coefficient on Cronbach's alpha test are 0.925, with Cronbach's alpha value on each question item worth above 0.90. As a result, the DASH instrument's reliability test results showed a very high or very good internal consistency reliability score (0.800 r 1,000).

Budiastuti & Bandur, (2018) stated that Cronbach's alpha is the most appropriate internal consistency test. The use of this method will produce a number called the reliability coefficient. The reliability coefficient that is getting closer to one indicates that the thing being researched is more reliable (Matondang, 2009). According to Kristanti et al. in 2021, a good measuring instrument must have good validity and reliability to prove that it can be trusted.

CONCLUSION

Based on the results of the research that has been done, the construct validity test obtained values of 0.012 and 0.000, which means $\rho < 0.05$ with $r_{count} > r_{table}$ on all question items on the DASH instrument. These results indicate that the construct validity for the DASH questionnaire shows low validity ($0.200 < r \leq 0.400$) to high validity ($0.600 < r \leq 0.800$). Based on the data obtained, it can be concluded that the items in Q1 to Q30 are valid.

The results of the correlation coefficient on Cronbach's alpha test are 0.925, with Cronbach's alpha value on each question item worth above 0.90. So it can be concluded that the reliability test results on the DASH instrument showed a very high/very good internal consistency reliability score ($0.800 < r \leq 1{,}000$). Some suggestions that can be given for further research are to compare or find a correlation between the DASH instrument and the modified DASH. In addition, it also applies the DASH instrument in different disturbance conditions.

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