Content validity of the disability of the arm, shoulder, and hand questionnaire in a college-age patient population

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Objective: The Disability of the Arm, Shoulder, and Hand questionnaire (DASH) is a region-specific Patient Reported Outcome Measure and has been found to be valid and reliable. However, it has not been evaluated in a young patient population. Our objective was to understand how often the uninjured 'collegiate' population completes the specific tasks on the DASH.
Design: A questionnaire-based survey.
Methods: A total of 256 participants (age: 19.44 ± 1.83) completed the study. Participants were asked to track how often they completed 21 tasks taken from the DASH over a 14-day period. Data were analyzed using descriptive statistics and A Rasch partial-credit model.
Results: The 3 most commonly completed tasks are Recreational Activities in which you take some force or impact through your arm, shoulder, or hand (e.g., golf, hammering, tennis, etc.), Wash or blow-dry your hair, and Put on a pullover sweater while the least most commonly completed tasks were garden or do yard work, change a light bulb overhead, and sexual activities. Infit statistics ranged from .94 to 1.12, and Outfit ranged from .27 to 1.33. Person and item separation indices were 0.40 and 5.24, respectively. Person and item reliability indices were 0.14 and 0.96, respectively.
Conclusions: Findings from this study suggest that clinicians should be cautious when using the DASH with the 'college aged' patient population.

The patient-centered healthcare model is increasing in popularity nationally as it has been associated with increased patient satisfaction, adherence, and improved clinical outcomes.[12,14,24] Within this model, clinicians are asked to consider each patient as a whole person, and to address the entire physical, psychological, and social effects of their injury or illness rather than objective symptoms alone.[21] Patient-reported outcome measures (PROMs) are instruments, which have been developed to help evaluate patients' experiences of their own illnesses.[15] PROMs allow for the measurement of physical functions, global judgments of health, psychological well-being, social well-being, cognitive functioning, role activities, personal constructs, satisfaction with care, and health-related quality of life (HRQOL).[5] Many types of PROMs exist, including *Generic*, which ask broad questions applicable to many types of illness, *Dimension Specific,* which focus on a single health component such as physical activity or emotional well-being, and *Region/Site Specific,* which are developed for use in injuries to a particular anatomical area.[5]

The Disability of the Arm, Shoulder, and Hand questionnaire (DASH) is a region-specific PROM developed by the American Academy of Orthopedic Surgeons' Outcomes Research Committee and the Institute for Work and Health.[9] Its validity and reliability have been well-established across a wide variety of pathologies, including shoulder impingement, psoriatic arthritis, and cubital tunnel syndrome.[7,11,17,23,24] DASH respondents are asked to rate 30 items on a 5-point Likert scale based on their ability to specifically perform those tasks within the past week. Items include 21 questions that evaluate specific physical tasks (i.e. using a knife or turning a key), 5 items evaluating symptoms (i.e. pain, tingling), and 4 questions evaluating social functions (i.e. sleep, confidence). Of 30 items, 27 must be answered to be eligible for scoring.[13] An answer implies the task was performed at least once within the past week or that patients 'estimated' if they could complete the task. Scores are calculated by averaging the values of all responses, then converting this score to a 100-point scale by subtracting 1 and

multiplying by 25. Higher scores indicate greater disability, with 100 indicating severe disability and 0 indicating no disability.[11]

This method of score calculation has the potential to be problematic. Although the DASH is designed to be administered to the population at large, all respondents are asked about the same 21 physical tasks. Injured respondents with a higher base level of function may still find some of the simpler tasks (i.e. preparing a meal) easy, while they are significantly impaired in higher level tasks such as throwing a baseball, which are less emphasized. The questionnaire's skew toward simpler tasks could inhibit the ability to track the recovery over time from higher functioning respondents. Because scores of higher functioning respondents are typically low, as respondents recover, there are minimal opportunities for score change. This logic has been previously suggested in 2 separate cross-sectional studies, which found that adolescent athletes report a higher HRQOL than nonathletes requiring the development of new PRO normative values and that the DASH questionnaire is limited by a ceiling-effect in intercollegiate athletes.[9,13]

Furthermore, the daily tasks included in the DASH (i.e. gardening, carrying a briefcase) may be less likely to be performed by a younger population. This may limit the content validity of the DASH among young people and may even make questionnaires impossible to score due to the 27-item completion requirement. Our study's purpose is to better understand how often the uninjured 'collegiate' population completes the specific tasks on the DASH. A better understanding of how often this population is completing these tasks can help clinicians recognize if the DASH is a viable tool for evaluating arm, shoulder, and hand function for this specific demographic.

Methods

Research design

A questionnaire-based survey was administered both paper and online via Qualtrics. The goal was to quantify how many times tasks on the DASH were completed on a daily basis.

Participants

A total of 256 participants (age: 19.44 ± 1.83) who were at least 18 years of age or older, did not currently have an injury, and could read and write in English were included in the study. Twenty-one participants were removed from the analyses because they did not follow the directions or did not complete the full data collection.

Procedures

Participants were recruited from 2 universities in general education undergraduate courses. Participants were explained the study and provided an opportunity to answer any questions. If interested, participants were provided a consent form and either a paper copy of the tasks or a link to Qualtrics where the number of times they completed the tasks could be recorded. Participants who were interested were provided formal education on how to correctly complete the questionnaire. A questionnaire with each of the 21 items from the DASH was used. The questionnaire also had a place for the participant to tally how many times they completed the task each day. Participants were asked to record each time they completed 1 of the 21-items on the DASH for a total of 7 days. Reminders were sent to participants every other day and allowed the opportunity to ask any questions related to survey completion. After the 7 days, the research returned to collect the paper copies of

the questionnaire. This study was approved by the university institutional review board.

Statistical analysis

Descriptive statistics, specifically mean, standard deviation, and frequencies, were performed for each day using IBM SPSS statistics software version 24 (IBM, Armonk, NY, USA). A Rasch partial-credit model was used to examine the clinical presentation and frequency of 21 DASH items. This model has been previously used to examine the clinical presentation and frequency of the Standard Assessment of Concussion[8] and other PROMs within athletic training.[4] Relevant outcomes for a Rasch model in this study include item difficulty, personal ability, mean square residuals, person separation index, item separation index, person reliability index, item reliability index, and person-item map.

The likelihood of a patient reporting completing a task is indicated by the item difficulty, while person ability indicates the estimated shoulder function of an individual. The Rasch model estimates the probability that a given individual will complete a specific task relative to their level of shoulder function. Application of this model to the DASH will be useful for understanding the frequency that individuals report completing a task, as well as provide the ability to rank the difficulty or challenge associated with each task. Both item difficulty and person ability estimates are reported as logit values. A logit value ranges from negative to positive infinity, where a higher positive logit value indicates less frequently reported task or higher levels of shoulder function for item difficulty and person ability, respectively. Mean square residuals are used to investigate response patterns among items across participants to identify if items are demonstrating unusual response patterns. In general, this can be used to indicate if a particular task is appropriate for the specific population and described as how well each item 'fits' with the other items in the scale. The person separation index is used to classify people. Low person separation (<2 logits) suggests that an instrument may not be sensitive enough to distinguish between high and lower performers. The item separation index is used to verify the item hierarchy. Low item separation (<3 logits) indicates that the person sample is not large enough to confirm the item difficulty hierarchy (i.e., construct validity) of the instrument. Last, the person-item map provides an illustration of the distribution of participant responses relative to the included tasks. The person-item map can identify potential tasks, which are being unused or areas of limited task coverage (i.e., too few tasks available for a given range of ability).

Results

A total of 256 participants, 135 male and 121 females, completed the survey; 21 participants did not complete all the 7 days and were therefore removed from the data analysis. Table I provides additional demographic information about the participants.

Of the 21 physical tasks participants completed a mean of 7.09 ± 2.09 tasks within a 7-day period. The most tasks completed within the 7-day period was 13, while the minimum was zero. The frequency of the tasks is listed in Table II. The 3 most commonly completed tasks are Recreational Activities in which you take some force or impact through your arm, shoulder, or hand (e.g., golf, hammering, tennis, etc.), Wash or blow dry your hair, and put on a pullover sweater, while the least most commonly completed tasks were garden or do yard work, change a light bulb overhead, and sexual activities. Results of the Rasch Partial-Credit model analysis have been listed in Table III. Examination of infit and outfit statistics and the person-item map (see Fig. 1) suggests that some of the

Table I
Demographic information.

Demographic (n = 235)	Number (percentage)
Primary occupation	
Student	235 (92%)
Participation in physical activity	
1−3 day a week	120 (51%)
4 or more days a week	115 (49%)
Participation in rec or competitive league	
Yes	49 (23%)
No	186 (77%)

Rec, recreational.

Table II
Frequency of task completion[*].

Tasks	Completed at least once by participants (n = 235)	Total times completed by all participants
Rec activities with some force	174	145
Wash or blow dry hair	164	221
Put on a pullover sweater	161	334
Turn a key	146	943
Rec activities move arm freely	141	161
Write	138	1258
Carry a heavy object (over 10lbs)	109	759
Push open a heavy door	109	661
Rec activities with little effort	106	288
Prepare a meal	69	268
Carry a shopping bag or briefcase	68	208
Place object on shelf above head	64	342
Make a bed	62	148
Wash your back	60	245
Manage transportation needs	59	347
Use a knife to cut food	28	177
Open a tight or new jar	8	52
Do heavy household chores	2	60
Garden or do yard work	1	6
Change a light bulb overhead	1	3
Sexual activities	0	0

Rec, recreational; *DASH*, Disability of the Arm, Shoulder, and Hand questionnaire.

[*]All data is based on a 7-day period to simulate the time associated with the DASH.

tasks listed on the DASH may not be suitable for this population. Both 'Sexual Activities' and 'Change a Light Bulb Overhead' had unacceptable model data fit (infit/outfit <0.5 or >1.5). In addition, several items had fewer than 10 participants complete the task a single time throughout the 7-day data collection period. Person and item separation indices were 0.40 and 5.24, respectively. Person and item reliability indices were 0.14 and 0.96, respectively.

Discussion

The purpose of this study was to examine the relative frequency that college-aged students reported completing tasks listed on the DASH. A major strength of PROMs is that they can assess the impact of an injury or condition using meaningful activities related to a patient's daily activities. This can only be accomplished when the tasks or activities being assessed are truly meaningful. Several of the tasks were completed by a very low (<1%) percentage of the study participants, which suggests that these tasks may not be valuable or useful for clinicians in this population. Some tasks, such as 'Change a Light Bulb' or 'Garden or Do Yard Work' may not be relevant to college-aged students due to the nature of student life. For student-athletes living on campus, many routine house chores

or maintenance tasks are completed by campus staff, therefore making them irrelevant. For example, the tasks 'Change a Light Bulb' and 'Garden or Do Yard Work' were only completed by a single participant in the study. The physical tasks represented in these activities are intended to provide clinicians with information relative to the movement patterns and activities that the athletes can perform; however, for the target population who rarely completes these tasks (even when healthy), their value diminishes significantly.

Another possible reason for low responses from participants could be that the items are not regularly completed due to technological changes within our society. The DASH was first developed in 1996.[10] Since then, many technological advancements have occurred, which have fundamentally changed how some individuals may perceive and engage in tasks. For example, the development of smartphones and modern computers and tablets has led to a significant decrease in physical writing.[2] In this study, only 138 participants stated that they 'wrote' within the last 7 days. It is possible that participants who used their phones or computers rather than a pen and paper may have perceived this as a separate task from writing. Other tasks that may be impacted by improvements in technology are 'turn a key' and 'push open a heavy door'. Many doors, particularly on college campuses, have electronic cards rather than traditional keys. As such, although they are using a key to open the door, there is no turning mechanism. Furthermore, many stores and college buildings now use electronic doors where it is no longer necessary for the participant to push open a door at all. These items may be a challenge to describe if they are not completed on a regular basis and therefore may make the responses on the DASH less valuable or relevant, particularly for college-aged populations.

Last, other activities with low response rates may be the result of motivational bias. In this study, no college-aged athletes reported engaging in sexual activities. While this scenario is not impossible, a more likely suggestion is that the participants of this study did not feel comfortable with sharing this information. Systematic reviews of studies investigating sexual risk behaviors have identified social contexts and motivational bias as significant methodological concerns.[20] Therefore, as clinicians ask participants to complete the questionnaire, they may also encounter a reluctance to complete those items.

Patient-reported outcome measures serve to facilitate communication between patient and clinician, develop appropriate short-term and long-term rehabilitation goals, and track the efficacy of rehabilitation programs. This is often accomplished through the evaluation of a patient's typical behaviors and the influence of an injury on those behaviors. For the DASH questionnaire specifically, patients are asked to rate their ability to complete activities within the last week. Responses can range from no difficulty to unable to perform the tasks. Patients who did not complete a specific task may be asked to 'guess' about their ability to perform a task or skip those tasks when completing the survey. Both solutions are problematic. While the recall of physical activity behaviors is common practice for many different health-related questionnaires, these measures are subject to measurement error associated with difficulty accurately recalling activity behaviors.[18] Furthermore, as the length of the recall period increases (i.e., the time between last activity completion and survey completion) the risk of bias and error increases.[3] Inclusion of these 'estimated' tasks may provide more information about the patient's perception of their perceived function; however, it may also increase the risk of inaccurate estimation of function. The exclusion of noncompleted tasks also presents another problem. The instructions for the DASH state that a score cannot be calculated for individuals that are missing more than 3 tasks. Among the 235 participants included in this study,

Table III
Rasch Partial-Credit model results.

Item	Frequency (N = 235) n (%)	Item difficulty b(SE)	Infit	Outfit
Sexual activities	0 (0.00%)	5.65 (1.83)	-	-
Change a light bulb overhead	1 (0.04%)	4.44 (1.00)	0.98	0.27
Garden or do yard work	1 (0.04%)	4.44 (1.00)	1.01	0.95
Do heavy household chores	2 (0.90%)	3.74 (0.71)	1.02	1.33
Open a tight or new jar	8 (3.40%)	2.31 (0.36)	0.99	0.85
Use a knife to cut food	28 (11.91%)	0.92 (0.21)	0.94	0.97
Manage transportation needs	59 (25.11%)	−0.05 (0.16)	0.98	0.99
Wash your back	60 (25.53%)	−0.07 (0.16)	1.07	1.22
Make a bed	62 (26.38%)	−0.12 (0.15)	1.00	1.08
Place object on shelf above head	64 (27.23%)	−0.17 (0.15)	1.01	0.97
Carry a shopping bag or briefcase	68 (28.94%)	−0.26 (0.15)	0.99	0.93
Prepare a meal	69 (29.36%)	−0.28 (0.15)	0.95	0.92
Rec activities with little effort	106 (45.11%)	−1.02 (0.14)	1.09	1.10
Push open a heavy door	109 (46.38%)	−1.08 (0.14)	0.97	0.96
Carry a heavy object (over 10lbs)	109 (46.38%)	−1.08 (0.14)	0.99	1.01
Write	138 (58.72%)	−1.63 (0.14)	0.95	0.94
Rec activities move arm freely	141 (60.00%)	−1.68 (0.14)	1.12	1.12
Turn a Key	146 (62.13%)	−1.78 (0.14)	0.90	0.87
Put on a pullover sweater	161 (68.51%)	−2.09 (0.15)	0.94	0.93
Wash or blow dry hair	164 (69.79%)	−2.16 (0.15)	0.99	1.06
Rec activities with some force	174 (74.04%)	−2.39 (0.16)	1.06	1.14

Rec, recreational; *b*, item difficulty parameter; *SE*, standard error.
Note. This table depicts the results of the Rasch Partial-Credit model analysis. Frequency represents the number of participants who reported completing a specific task at least once during the 7-day data collection period. Infit and outfit statistics are expected to range from 0.5-1.5.

99.5% of the sample failed to complete 3 or more tasks during the data collection period. None of the participants reported completing all 21 tasks.

In college-aged participants, the DASH may not be a viable measure for evaluating function. This notion is further supported by the low person separation (0.40), and person reliability (0.14) values identified. The low person separation suggests that the frequency of task completion is unlikely to be reproducible in this population, meaning that activity completion is more random and may not be reflective of 'typical' behaviors. In addition, the limited coverage of items seen in the person-item map relative to the distribution of participants suggests that many of the items included in the DASH are not relevant or commonly completed by college-aged students. Although some of the physical tasks of the DASH are related to general recreational activities, the inclusion of additional (or more specific) physical tasks may provide a more thorough assessment of the potential impact of shoulder-related dysfunction.

The physical tasks included in the DASH primarily assess activity limitations as defined by the International Classification of Function, Disabilities, and Health (ICF) model.[6] Among the 21 physical tasks included, only 3 tasks provide information relating to restrictions in participation; the tasks related to recreational and sexual activities.[6] Be aware that it focuses on a limited range of motion patterns. Furthermore, most of the included tasks assess the same basic movement patterns. Therefore, it may be helpful to include additional items that emphasize additional movement patterns. Previous studies investigating the validity of the DASH in patients with subacromial pain syndrome indicated that while most of the tasks are adequate; in patients with an angular onset of pain above 120° of abduction, the DASH was not useful.[1] In patients with humeral shaft fractures, however, Van Lieshout and colleagues[22] reported the DASH tasks to be appropriate and valid. Clinicians using the DASH should be cautious in making interpretations regarding the validity of scores for specific injuries.

Limitations

There were a few limitations in this study. The sample size for the Rasch analysis used in this study was relatively small. However,

Müller[16] conducted a simulation study on various sample sizes and item combinations to examine the validity of fit statistics estimated during a Rasch analysis. The findings suggested that even studies with sample sizes as large as n = 200 can sometimes produce biased estimates of fit statistics. In general, however, a minimum sample size of 150 is widely considered the standard, with some authors suggesting that sample sizes as small as 30 are sufficient for some outcomes of the Rasch analysis.[19] It is also important to mention that despite the low person separation indices, the item separation (5.24) and item reliability (0.96) indices were both relatively high. These values indicate that the participant sample size was sufficient to determine the hierarchy of 21 physical tasks. Therefore, it can be concluded that the sample size used for this study was sufficient.

The participants recruited for this study primarily consisted of college-aged adults, which may limit the generalizability of the results. The activities and tasks included in the DASH, however, are relatively low function and require minimal effort. Examining these activities in specific populations, such as athletes, would likely provide additional information on the value of these items in those populations. It is presumable the problems identified in this study would likely be more pronounced in an athletic population; however, future research is necessary to determine if this is true.

As with all survey-based research, there is the limitation of self-report bias. The authors are unable to determine whether low task completion is the result of true task completion or low compliance. However, the research team did provide reminder messages to maximize participant compliance. Thus, replication studies would enhance the conclusions drawn from this study.

Conclusion

The results of this study suggest that the DASH may not be appropriate for measuring function in college-aged students. Clinicians using the DASH should consider revising the instrument to better fit their needs based upon the clinical setting and patient population they are working with and develop their own tool. There are significant concerns with the frequency that tasks were completed by participants suggesting that many of the tasks located in the DASH are not relevant for college-aged students.
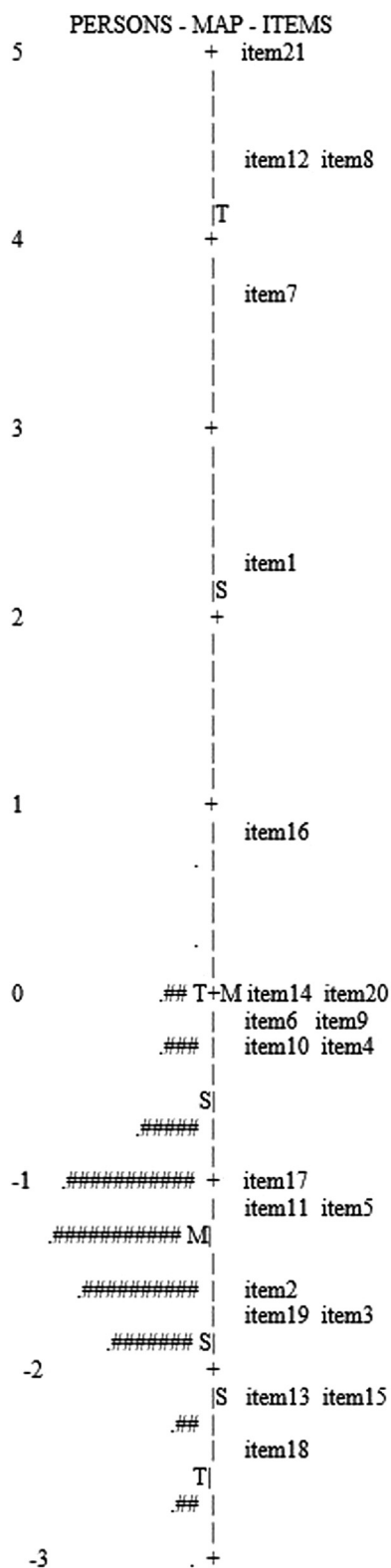
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Figure 1 Person-item map.

Future studies should investigate potential reasons for the low frequency of task completion or identification of alternative items, which can be included to better assess function in this population.

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