Disability and Rehabilitation

ISSN: 0963-8288 (Print) 1464-5165 (Online) Journal homepage: http://www.tandfonline.com/loi/idre20

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To cite this article: Vera Baadjou, Rob de Bie, Christine Guptill & Rob Smeets (2017): Psychometric properties of the performing arts module of the Disabilities of the Arm, Shoulder, and Hand questionnaire, Disability and Rehabilitation, DOI: 10.1080/09638288.2017.1362707

To link to this article: http://dx.doi.org/10.1080/09638288.2017.1362707

DISABILITY AND REHABILITATION, 2017
https://doi.org/10.1080/09638288.2017.1362707

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Psychometric properties of the performing arts module of the Disabilities of the Arm, Shoulder, and Hand questionnaire

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ABSTRACT

Background: The Disabilities of the Arm, Shoulder, and Hand questionnaire (DASH) offers an optional performing arts module. The goal was to examine the psychometric properties of this module in musicians.

Methods: This study is a secondary analysis of a randomized controlled trial on the effectiveness of a biopsychosocial intervention to prevent or reduce playing-related disability in conservatory students. Baseline data were used to examine internal consistency and discriminative validity of the performing arts module of the DASH questionnaire. Construct validity was analyzed by hypotheses testing. The performing arts module outcomes were compared to scores from the general DASH questionnaire, pain disability index, Short-Form 36, playing-related musculoskeletal disorder (PRMD) intensity, and pain intensity.

Results: Questionnaires completed by 130 conservatory students were analyzed, 55% of the population was female. Median age was 20 years (IQR 4). The performing arts module showed good internal consistency (Cronbach's alpha 0.893). Discriminative validity between students with and without PRMDs was good. Three out of six hypotheses were accepted, indicating moderate construct validity.

Conclusions: The performing arts module showed good internal consistency, good discriminative validity and moderate construct validity in a population of conservatory students.

ARTICLE HISTORY
Received 20 March 2017
Revised 20 July 2017
Accepted 30 July 2017

KEYWORDS
Disability; validity; playing-related musculoskeletal disorder; musculoskeletal; music; upper extremity

➤ IMPLICATIONS FOR REHABILITATION

- Musicians suffer frequently from musculoskeletal disorders, mostly in the upper extremity.
- The Disabilities of the Arm, Shoulder, and Hand questionnaire is a well-known outcome measure, which also includes a performing arts module.
- This study is the first to explore psychometric properties of the performing arts module.
- The performing arts module of the Disabilities of the Arm, Shoulder, and Hand questionnaire showed good internal consistency, good discriminative validity, and moderate construct validity.

Introduction

Outcome measures used to quantify physical complaints in musicians vary widely and little is known about the validity of these measures when used in this specific population [1]. When measuring outcomes, it is important to know what the questionnaire intends to measure and how the quality of the measurement instrument might affect results. For example, is the construct of interest really measured and does the questionnaire provide reliable answers? In a recent review on pain prevalence in instrumental musicians [1], several self-reported questionnaires were summarized, with outcomes ranging from the presence of pain in general to disabling pain or playing-related pain and symptoms affecting playing capacity. The most common constructs used were pain, playing-related musculoskeletal disorder (PRMD), and disability. According to the International Classification of Functioning, Disability, and Health, pain is a function, which can be described as an unpleasant sensation. Disability is an umbrella term that includes impairments, activity limitations and participation restrictions [2]. Playing-related musculoskeletal disorders can be seen as a specific disability because, according to the definition established by Zaza et al., symptoms must interfere with the ability to play the instrument at the level to which the musician is accustomed [3].

Thus far, non-validated questionnaires have often been used which makes interpretation and generalization of results difficult. Several questionnaires have been developed specifically for musicians, of which two are recently validated: The Musculoskeletal Pain Intensity and Interference Questionnaire for professional orchestra Musicians [4] and the Musculoskeletal Pain Questionnaire for Musicians [5]. However, these questionnaires are validated based on small sample sizes and are not yet widely used. Items from the Disabilities of Arm, Shoulder, and Hand questionnaire (DASH) were incorporated into both these questionnaires [4,5]. The DASH has been proposed as a valuable tool in quantifying disability of the upper extremity in musicians and has been used frequently to quantify musician's disability [1,6,7]. The DASH includes an optional work module and an optional sports/performing arts module. The optional performing arts module consists of four items on disability when playing a musical instrument. Up until now, no research has been done to establish the

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internal consistency and validity of the DASH performing arts module for use in a population of musicians.

The DASH performing arts module was administered in a randomized controlled trial examining the effectiveness of a biopsychosocial intervention in preventing or reducing disabilities from musculoskeletal complaints in conservatory students [8]. This paper presents the results of the baseline questionnaire, to increase insights into several psychometric properties of this measurement instrument. The primary objective of this study is to examine the score distribution, internal consistency, discriminative and construct validity of the performing arts module of the DASH. A second goal is to broaden current knowledge on the relationship between PRMD and pain, by investigating the correlation between these two constructs.

Box 1. The Disabilities of Arm, Shoulder, and Hand questionnaire, performing arts module.

The following questions relate to the impact of your arm, shoulder or hand problem on playing your musical instrument. Tick the answer that best describes your physical ability in the past week. Did you have any difficulty:

1. Using your usual technique for playing your instrument?
2. Playing your instrument because of arm, shoulder or hand pain?
3. Playing your musical instrument as well as you would like?
4. Spending your usual amount of time practicing or playing your instrument

Answer options: no difficulty, mild difficulty, moderate difficulty, severe difficulty, unable.

Methods

Study design

This study is part of a randomized controlled trial studying the effectiveness of a biopsychosocial intervention in preventing or reducing disabilities from musculoskeletal complaints in conservatory students [8]. The trial is registered in the Nederlands Trial Register NTR3561. The Medical Ethical Committee of Maasstad Ziekenhuis Rotterdam approved the study (NL39564.101.12). During lectures at the start of the school year, first year students from 2012 to 2013 and first and second year students from the academic year 2013–2014, from five Dutch conservatories were invited to participate. Students were required to be able to understand Dutch or English language. Students with a specific self-reported comorbidity that could be associated with musculoskeletal complaints, such as rheumatoid arthritis or multiple sclerosis, were excluded. After providing written informed consent, students completed the baseline questionnaire. Since many conservatory students are from abroad, the main language of instruction at the music schools is English. General understanding of the English language in the Netherlands is at high level. We choose therefore to provide English questionnaires to all participants. A translation booklet was provided for Dutch students if needed. Only English outcome measures with valid Dutch translations were used. Data from the baseline questionnaire were analyzed for the present study. The data presented here include data for the whole population, as well as split between students who experience PRMD and students who do not experience PRMD.

Outcome measures

DASH

The DASH questionnaire is a self-reported 30-item questionnaire designed for use in a population with a variety of upper-extremity musculoskeletal conditions. It assesses symptoms as well as the ability to perform certain activities specific to arm, shoulder and hand function. Items are answered based on the condition during the last week. Components are symptoms (pain, weakness, stiffness, tingling/numbness) and functional status (physical, social, and psychological dimension). Physical components include: daily activities, house/yard chores, shopping/errands, recreational activities, self-care, dressing, eating, sexual activities, and sleep. Social components consist of: family care, occupation and socializing with friends/relatives. The psychological component is self-image. Scores are calculated using a scale ranging from 0 to 100. A higher score represents more disability. For the English version, validity is good, and correlation with a range of other upper extremity measures exceeded 0.70 for all tests in a cohort of patients with wrist/hand or shoulder problems. Test–retest reliability (ICC = 0.96) and responsiveness are good [9]. The Dutch version's internal consistency, Cronbach's alpha = 0.95, and validity (81% consistency with COPM; *k*-coefficient = 0.79) are good [10]. Additionally, it has been shown that the DASH is not only valid for measurement of non-traumatic upper extremity musculoskeletal complaints, but also for non-traumatic neck complaints [11].

DASH performing arts module

The performing arts module is presented in Box 1. The optional module scores are presented as a sub-score ranging from 0 (not disabled) to 100 (most severe disability). In a content validity study, about 60% of the clinicians reported using the DASH optional modules. These included the work module (16.2%), sports/performing arts module (4.6%), or both work and sports/performing arts module (41.5%) [12]. Cronbach's alpha for the work and sports/performing arts scales was found to be 0.94 in a Swedish population with upper extremity condition [13]. Since the sports/performing arts categories form one module, data are often reported jointly which makes it impossible to split results into sports and performing arts categories. DASH norm scores for the general population have been reported [14], however, studies evaluating validity and norm scores for specific subgroups are limited and no data on the validity of the performing arts module are published to date. The DASH registry was contacted and they confirmed that they were not aware of any studies specifically reporting data or methodological appraisal of the performing arts module.

Pain Disability Index

The Pain Disability Index [15,16] is a generic measure for disability. Participants report on seven different daily activities (family/home responsibilities, recreation, social activity, occupation, sexual behavior, self-care, life-support activities), and whether or not they were disabled due to pain (score per question ranging from 0: no disability to 10: worst disability). The seven categories were summed into a total score ranging from 0 to 70. The higher the total score, the more disability. Evaluation of psychometric properties showed good construct validity, good internal consistency (Cronbach's alpha = 0.86), and good validity when compared to reports of psychological distress, pain intensity, and other measures of pain disability [16]. For the Dutch version, there was good internal consistency and test–retest reliability (ICC 0.76) [17].

Playing-related musculoskeletal disorders

Playing-related musculoskeletal disorders have been defined as: "pain, weakness, lack of control, numbness, tingling, or other symptoms that interfere with your ability to play your instrument

at the level you are accustomed to" [3]. This definition, which was developed from qualitative research with stakeholders, guides questionnaire development in the majority of research studies on PRMD. Based on self-reporting, the participants in this study first indicated whether or not they experienced playing-related complaints while playing their instrument in the past week. If they had, they indicated the location of their PRMD symptoms on a drawing of a human figure [18]. A Numeric Rating Scale (NRS) was used to quantify the severity of complaints experienced in the past week, where 0 means no complaints, and 10 indicates the worst complaints possible.

Pain

The presence of pain was assessed using parts of the Dutch language version of the McGill Pain questionnaire [18]. "With this questionnaire we want to get an overview of the pain you experience currently. It does not matter where you have pain or what causes the pain. Do you experience pain right now?" When the answer was positive, participants indicated on a drawing of a human figure where they experienced pain and circled the number on an NRS (0–10) which represented the severity of pain they experience currently. Reliability was good, Cronbach's alpha was 0.89 [19].

Short Form-36

Quality of life was assessed using the Short Form-36 Health Survey, SF-36v1 [20]. The Short-Form-36 is a generic measure composed of 36 items, of which physical and mental sub scores were calculated. Scores represent a reference to a standard population with an average score of 50 and standard deviation of 10. Scores higher than 50 represent a better quality of life compared to the reference population, while scores below 50 represent worse quality of life [21]. Much research has been conducted on reliability and validity of this survey in different populations. Most published statistics on reliability exceeded the estimate of 0.80. Reliability for physical and mental subscores generally exceeds 0.90 [22]. For the Dutch version, internal consistency (Cronbach's alpha = 0.84) and validity are also good [21].

Statistical analyses

Population characteristics and outcomes are presented descriptively as mean ± standard deviation or median with interquartile range for parametric and non-parametric data, respectively.

Analyses of the psychometric properties of the performing arts module

Frequencies, distribution of data and ranges of scores were calculated. Frequencies of missing items per question were evaluated. Floor or ceiling effects were considered present if more than 15% of respondents achieved the highest or lowest possible score on the performing arts module [23]. Internal consistency between the four items of the performing arts module was evaluated by calculating Cronbach's alpha. Values of Cronbach's α between 0.70 and 0.95 are considered good [24]. Discriminative validity: Our hypothesis was that subjects with PRMD would have higher disability scores as compared to subjects without PRMD. Independent samples *t*-test, or Mann–Whitney's *U* tests in case of non-parametric data, were performed to test this hypothesis. Construct validity: Only participants with PRMD were included for this part of the analysis. Correlation testing (Pearson for data with normal distributed, Spearman for data with non-normal distribution) was applied to calculate correlations between the scores on the performing arts module and the general DASH, pain disability index, PRMD severity score, pain severity score, short-form 36 physical and mental sub score. A correlation lower than 0.30 was defined as weak, 0.30–0.60 moderate, and higher than 0.60 as strong [24]. *A priori* hypotheses were formulated on the strength of the correlation between the different scores and are summarized in Table 1. A higher number of confirmed hypotheses indicate stronger support for construct validity. Hypothesis 1: the score on the performing arts module correlates strongly (>0.60) with the DASH since they are supposed to measure the same construct; i.e., disability. Hypothesis 2: Pain disability index score correlates moderately (0.30 to 0.60) with the performing arts module score because this measure is not specific enough to correlate highly with performance-related disability. Hypotheses 3 and 4: Both PRMD severity score and pain severity score correlate strongly with the performing arts module score (>0.60). Prior research showed a 0.662 correlation between DASH and pain severity score in musicians [7]. It is assumed that performing arts module and PRMD severity score are even more specific measures for this population, so correlations are expected to be high. Hypotheses 5 and 6: Scores of the performing arts module correlate moderately (–0.30 to –0.60) with both the physical and the mental sub score of the SF-36. The DASH is based on parts of the SF-36, and incorporates common constructs [25]. More severe upper-extremity disability has been found to correlate with worse quality of life [13]. However, for the performing arts module particularly, we hypothesize that the correlation will only be moderate, because the SF-36 subscales will not be specific enough to capture the total influence of music-related disability. Statistical testing was performed using IBM SPSS Statistics for Windows, version 23 (IBM Corp., Armonk, NY).

Table 1. Hypothesized correlations between performing arts module and other measures.

Performing arts module	Questionnaire	Strength	Correlation
1	DASH	Strong	>0.60
2	PDI	Moderate	0.30 to 0.60
3	PRMD severity score	Strong	>0.60
4	Pain severity score	Strong	>0.60
5	SF36-PCS	Moderate	−0.30 to −0.60
6	SF36-MCS	Moderate	−0.30 to −0.60

DASH: Disabilities of Arm, Shoulder, and Hand questionnaire; PDI: pain disability index; PRMD: playing-related musculoskeletal disorders; SF-36: Short Form-36; PCS: physical component score; MCS: mental component score.

Correlations between PRMD and pain

Prevalence of PRMD and pain according to location indicated on the human drawing were categorized into five body regions: head/neck, hand/arm/shoulder, back, lower extremity, abdomen. Correlations between the dichotomous outcome measures PRMD (yes/no) and pain (yes/no) were evaluated using Spearman's correlation testing.

Results

Sample characteristics

All of the 130 music students interested in participation were determined to be eligible and were included. Of these, 71 were female and 59 were male. Median age was 20 years (IQR 4). More than half (57%) of the students were from the Netherlands, 29% were from other European countries, 14% were from other continents. Most of the students started in year 1 (91%) and were enrolled in the bachelor of classical music program (64%).

Instruments played were strings (39%), wind (22%), keyboard (18%), percussion (11%), and vocals (10%). See also Table 2. Sixty-five percent of the students reported current PRMD, with an average severity score of 4.55 ± SD1.88. Forty-one percent reported pain. Mean pain severity score was 3.36 ± SD1.97. Unfortunately, we did not have access to the total number of students at each conservatory, and we did not have ethics approval to seek information on drop-outs.

Table 2. Population characteristics and outcome measures.

	N	*N* (%), median (IQR), or mean ± SD
Sex	130	
Female		71 (55%)
Male		59 (45%)
Age (years)	129	20 (4)
Height (cm)	129	1.73 ± 0.10
Weight (kg)	129	65.98 ± 13.08
BMI	129	21.92 ± 3.09
Nationality	129	
Dutch		74 (57%)
Other Europe		38 (29%)
Asia		8 (6%)
South America		5 (4%)
Australia		2 (2%)
Africa		2 (2%)
School year	130	
1		118 (91%)
2		11 (8%)
3		1 (1%)
Bachelor	129	
Classical music		83 (64%)
Pop/Jazz music		19 (15%)
Music in education		18 (14%)
Other		9 (7%)
Instrument	130	
Strings		51 (39%)
Wind		28 (22%)
Keyboard		24 (18%)
Percussion		14 (11%)
Vocal		13 (10%)

N: number; IQR: interquartile range; SD: standard deviation.

Psychometric properties of the performing arts module

No missing responses in performing arts module scores were present. The frequencies of responses to performing arts module questions are presented in Table 3. Twenty-seven percent reported moderate or severe difficulty, or were unable to use their usual technique for playing the instrument. Thirty-two percent reported moderate difficulty or worse while playing the instrument because of arm, shoulder, or hand pain. Thirty-four percent reported moderate difficulty or worse in playing the instrument as well as they would like, and 42% reported moderate difficulty or worse in spending their usual amount of time practicing. For the total sample, data were positively skewed (skewness 0.952, kurtosis 0.192). Little differences in skewness existed between questions, and exact skewness was 1.08, 1.07, 0.90, and 0.92 for question 1, 2, 3, and 4, respectively. The median score was 18.75, interquartile range 31.25, minimum 0, maximum 81.25. For the students with PRMD, the median performing arts module score was 25 (31.35). Seven (8.3%) of the students with PRMD scored the lowest possible score (0). Score range was 0–81.25. Of the students not reporting PRMD, 62% scored 0 on the performing arts module (median score 0, IQR 6.25, range 0–31.25). Internal consistency was good, with Cronbach's alpha of 0.893, indicating good reliability. None of the items increased reliability when deleted. Discriminative validity was good, since a significantly higher performing arts module score was found in musicians with PRMD compared to musicians without PRMD. In Table 4, a schematic presentation of the aforementioned scores, supplemented with scores of the general DASH questionnaire, pain disability index, and SF-36 physical and mental sub scores, is provided. The differences in scores between students who do and do not experience PRMD were found to be highly significant for the performing arts module, DASH, and physical component score of SF-36. The difference in score distribution for the two groups is larger in the performing arts module as compared to the general DASH.

Construct validity: Table 5 depicts the Spearman correlations between the questionnaires. Missing values were handled by excluding cases pairwise. Correlation between performing arts module with DASH was strong, correlation with pain disability

Table 3. Frequencies of answers according to the performing arts module.

	No difficulty		Mild difficulty		Moderate difficulty		Severe difficulty		Unable	
Did you have any difficulty	PRMD+	PRMD−	PRMD+	PRMD−	PRMD+	PRMD−	PRMD+	PRMD−	PRMD+	PRMD−
Using your usual technique for playing your instrument?	33%	89%	40%	11%	20%	0%	7%	0%	0%	0%
Playing your instrument because of arm, shoulder or hand pain?	29%	89%	39%	11%	24%	0%	7%	0%	1%	0%
Playing your musical instrument as well as you would like?	19%	76%	46%	22%	20%	2%	13%	0%	1%	0%
Spending your usual amount of time practicing or playing your instrument?	26%	76%	32%	18%	24%	7%	13%	0%	5%	0%

PRMD+: students with playing-related musculoskeletal disorders; PRMD−: students without playing-related musculoskeletal disorders.

Table 4. Score distribution split for students with and without playing-related musculoskeletal disorders.

	n	Total	*n*	PRMD+	*N*	PRMD−	Sig.
Performing arts module	130	18.75 (31.25)	84	25 (31.35)	45	0 (6.25)	0.000***
DASH	129	8.33 (11.31)	84	10.83 (11.25)	44	3.75 (7.08)	0.000***
PDI	127	2 (9)	81	4 (11)	45	1.5 (4.75)	0.005**
SF36-PCS	130	50.69 ± 7.75	84	48.34 ± 7.69	45	54.79 ± 5.76	0.000***
SF36-MCS	130	41.62 ± 12.09	84	40.94 ± 12.30	45	42.83 ± 11.88	0.366

Scores are presented as median (interquartile range) or mean ± standard deviation; PRMD+: students with playing-related musculoskeletal disorders; PRMD−: students without playing-related musculoskeletal disorders. DASH: Disabilities of Arm, Shoulder, and Hand questionnaire; PDI: pain disability index; PRMD: playing-related musculoskeletal disorders; SF-36: Short Form-36; PCS: physical component score; MCS: mental component score; Sig.: significance according to Mann–Whitney's *U*-test.

*$p < 0.05$.

**$p < 0.01$.

***$p < 0.001$.

Table 5. Spearman correlations between performing arts module and other measures.

Performing arts module	Hypothesized	True
DASH	>0.60	**0.626**
PDI	0.30–0.60	**0.340**
PRMD severity score	>0.60	0.232
Pain severity score	>0.60	0.044
SF36-PCS	−0.30 to −0.60	**−0.337**
SF36-MCS	−0.30 to −0.60	−0.035

DASH: Disabilities of Arm, Shoulder, and Hand questionnaire; PDI: pain disability index; PRMD: playing-related musculoskeletal disorders; SF-36: Short Form-36; PCS: physical component score; MCS: mental component score.
Bold values indicate accepted hypotheses.

Table 6. Characteristics of playing-related musculoskeletal disorders and pain.

	PRMD ($n = 130$)	Pain ($n = 130$)
Positive answer, *n* (%)	84 (65%)	53 (41%)
Average score (NRS 0–10)	4.55 ± 1.88	3.36 ± 1.97
Complaints per body region		
Head, neck	44 (18%)	20 (19%)
Hand, arm, shoulder	121 (50%)	36 (33%)
Back	63 (26%)	39 (36%)
Lower extremity	12 (5%)	12 (11%)
Abdomen	2 (1%)	1 (1%)
Total	242 (100%)	108 (100%)

PRMD: playing-related musculoskeletal disorders; NRS: numerical rating scale.
Results are presented as number (%) or mean ± standard deviation.

index and SF-36 physical sub score was moderate, and correlation with PRMD severity score was weak. No correlation was found between the performing arts module with pain severity score and mental sub score of the SF-36. Three out of six (50%) of hypotheses were confirmed. Hypotheses on the relationship between performing arts module with PRMD severity score, pain severity score and mental sub score of short-form-36 were rejected.

Association between PRMD and pain

Most of the PRMD occurred in hand, arm or shoulder (50%), followed by back (26%) and head/neck (18%). Most of the pain occurred in the back (36%), followed by hand, arm, or shoulder (33%), and head, neck (19%). When comparing PRMD and pain locations, PRMD was more reported in the hand, arm, shoulder region; and pain was more reported in the back and lower extremity regions. Spearman's correlation coefficient between the presence of PRMD and pain was 0.240. See also Table 6.

Discussion

This first analysis of the psychometric properties of the performing arts module of the DASH demonstrated a good internal consistency, meaning that the items measure the same constructs [23]. None of the items would increase reliability if deleted. The performing arts module showed a good discriminative validity between students with and without PRMD. The DASH also was able to discriminate between students with and without PRMD, but the score distribution in the performing arts module was larger, presumably because the performing arts module is more sensitive than the DASH. Construct validity is moderate, the performing arts module correlates highly with the DASH and moderately with pain disability index and physical sub score of SF-36 as expected. Sixty-five percent of our population experienced PRMD. For the students with PRMD, the median performing arts module score was 25. No floor or ceiling effects were found when considering this specific group. Scores reported in the current study were similar to prior reported results in a Spanish conservatory population [26] and correspond with the disability level of high-level amateur student musicians at the end of an intensive music project [27]. Results of the general DASH questionnaire in this population of music students are comparable with prior reported disability levels of college instrumental musicians [7], and are only somewhat higher than disability levels in young, active adults without complaints [28]. Since the occupational demands of music students are much higher than the demands in general daily life, this suggests that more general assessments such as the DASH are not sensitive enough to reveal disability due to PRMD.

Unexpectedly low correlations were found between the performing arts module and the mental subscore of the SF-36, pain severity score and PRMD severity score, resulting in only moderate construct validity. When considering these results, some arguments might explain these three unexpected low correlations and possibly false *a priori* hypotheses. First, in retrospect, the absence of a correlation between the performing arts module and the mental sub score of the SF-36 seems logical, because the four performing arts module questions all relate to physical ability. Besides, our results show that levels of mental wellbeing in music students is lower when compared to a reference group, yet there are no differences in wellbeing scores between students who experience PRMD and students who do not. This could suggest that the level of mental wellbeing is not influenced by experiencing PRMD and thus may also not have a large influence on disability levels. A second unexpected low correlation was found between the performing arts module score and pain severity score. When reviewing the performing arts module items, we realized that performing arts module is particularly related to measuring disability due to PRMD, and only one of the four items is related to pain. Since we also found only a weak correlation between PRMD and pain, this implies that PRMD and pain are different constructs. This could explain the absence of a correlation between performing arts module and pain severity score. Third, the finding that the performing arts module only correlates weakly with PRMD severity score is interesting. A point of consideration is the use of the NRS to measure PRMD- and pain severity. In a recent study on psychometric properties of the pain NRS in musicians, it was found that the ability of the NRS to distinguish between different levels of pain was poor among musicians with milder pain [29]. It appears that an NRS is not a valid tool to assess pain in musicians with low pain levels. Although we do not know whether these results impacted the relationship with PRMD severity scores, we can speculate that if the NRS is not sensitive enough to measure PRMD severity in our population with only moderate levels of PRMD and pain, this could have caused the lower correlation between the performing arts module and PRMD severity score. This might also indicate that the performing arts module is a more sensitive measure than the NRS for measuring the extent of PRMD in a population with mild to moderate levels of PRMD. However, these speculations should be substantiated by future research on the psychometric properties of numerical rating scales for measuring PRMD severity. In retrospect, it seems likely that we formulated some false hypotheses, leading to only three out of six hypotheses being accepted. Hence, the conclusion that the performing arts module has only moderate construct validity is conservative.

The lack of correlation between PRMD and pain is an interesting secondary finding of this study. For our participants, PRMD were mostly reported in the arm, shoulder, and hand region; pain was mostly reported in the back and lower extremity region. PRMD is related to performance symptoms (including weakness, paresthesia, and lack of control, for e.g.), and not just pain.

One can have relatively mild symptoms, and these can still have a major impact on the ability to perform at the level to which one is accustomed. In other words, PRMD are not always experienced as pain. Our findings may point to an underlying tolerance for pain as a "normal" occurrence during the everyday work of conservatory students. Results underline that some musicians might interpret PRMD and pain as different constructs, whereas the construct PRMD seems more sensitive than pain when asking about their physical complaints. It is important to note, however, that in this study, the participants were also reflecting on different time periods when reporting PRMD (in the past week) and pain (right now).

The outcome measures in this study were chosen for two main reasons. First, these outcome measures are widely used in different (pain) populations. Extensive information is available on validity of these measures which makes results clearly interpretable. This allows comparison of results between musicians and other population and provides insight on difference in pain experience between these groups. Second, we selected only questionnaires that had a validated Dutch translation. An issue encountered in this study was the multinational origin of the population under study. The validity of a score is dependent on the situation in which the questionnaire is distributed. For example, language and cross-cultural differences may lead to different interpretation of the question and can affect scores [23]. In a multinational population such as ours it is not practical to provide every student with a questionnaire in his/her own language. We chose to provide everyone with an English questionnaire and gave the Dutch students a translation booklet in case it was needed. As Dutch students have significant English language skills, most classes at the conservatory are given in English, and all students were living in the same cultural environment at the time of participation in our study, we believe that cross-cultural and language issues on validity in this study were minimal.

When interpreting results, it should be noted that this study was not originally designed to validate outcome measures. However, we believe that the results of this study aid in interpreting outcomes in musician populations and will also assist clinicians and researchers in determining which outcome measure to use. A new study should be conducted with the specific goal of validating the performing arts module of the DASH. Information from this study can also be used to formulate more accurate hypotheses regarding construct validity. We believe it is also important to make use of experts (i.e., music students themselves) to determine the construct validity of the four questions. It would be useful to establish normative data to be able to correctly interpret research results and to detect treatment-related changes in scores. Also, test–retest reliability of the DASH performing arts module and interpretation of score changes (smallest detectable change and minimal clinically important difference, and responsiveness) should be researched in future.

With the new information provided by this study, we conclude that the performing arts module is a short four-item additional module of the DASH which gives a fair representation of music students' physical disability. The performing arts module seems to be more sensitive than the DASH in this population, and can be used on its own. Internal consistency and discriminative validity are good. Conservative estimates are that construct validity is moderate; the performing arts module primarily reflects physical aspects of disability. The weak correlation found between PRMD and pain severity scores suggests that PRMD and pain are different constructs and should be measured separately.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by a grant from the University Fund Limburg/Ans Samama Fund.

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