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Development and empirical testing of a questionnaire-based algorithm to evaluate physical and psychosocial health status in performing artists

Entwicklung und empirische Testung eines fragebogenbasierten Algorithmus zur Erhebung des körperlichen und psychosozialen Gesundheitszustands darstellender Künstlerinnen und Künstler

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Abstract

Background: Health care providers like physiotherapists should address the needs of performing artists for a specific health care derived from physical and psychosocial (performance-related) complaints. The aims of this study were (1) to compose an algorithm including subjective outcome measures in order to suggest how to evaluate the physical and psychosocial health status of performing artists in its complexity in a manner as targeted and detailed as possible, and (2) to test the feasibility of applying this algorithm.
Methods: Questionnaires regarding different health dimensions were searched and assembled to an algorithm. The survey was applied to performing artists in order to test feasibility. The respective questionnaires were scored and interpreted in comparison to cut-off values.
Results: Performing-art-specific and body-region-specific standardized questionnaires in German with the highest possible psychometric quality were selected. The algorithm covers a series of questionnaires on health-related quality of life, complaints in physical matters—especially musculoskeletal and voice-specific—and in the psychosocial area. Based on specific predefined decision criteria the artist was guided individually through the survey. This was illustrated by the participants' flow through the survey. Profiles of physical and psychosocial complaints for subgroups of 103 participants were built based on multiple scores and showed problems in both dimensions.
Discussion: It is possible to illustrate the physical and psychosocial health status of performing artists in a multidimensional way using the novel algorithm. It could be used both for groups and individuals to build complaint profiles for research and clinical purposes.

Abstract

Hintergrund: Gesundheitsversorger/-innen wie Physiotherapeut/-innen sollten dem Bedarf von darstellenden Künstler/-innen an einer spezifischen Gesundheitsversorgung nachkommen, der sich aus körperlichen und psychosozialen (von der Ausübung der jeweiligen Kunst abhängigen) Beschwerden ableiten lässt. Die Ziele dieser Studie waren (1) einen Algorithmus aus subjektiven Erhebungsinstrumenten zu konstruieren, um einen Vorschlag vorzulegen, wie der körperliche und psychosoziale Gesundheitszustand von darstellenden Künstler/-innen in seiner Komplexität so gezielt und detailliert wie möglich beurteilt werden kann, und (2) die Machbarkeit der Anwendung dieses Algorithmus zu überprüfen.
Methoden: Es wurden Fragebögen zu verschiedenen Gesundheitsdimensionen recherchiert und zu einem Algorithmus zusammengestellt. Die Umfrage wurde bei darstellenden Künstler/-innen angewandt, um die Machbarkeit zu überprüfen. Die jeweiligen Fragebögen wurden ausgewertet und im Vergleich zu Schwellenwerten interpretiert.
Ergebnisse: Es wurden für Künstler/-innen- und körperregion-spezifische standardisierte Fragebögen in deutscher Sprache mit der höchstmöglichen psychometrischen Qualität ausgewählt. Der Algorithmus umfasst eine Reihe von Fragebögen zur gesundheitsbezogenen Lebensqualität, zu Beschwerden im körperlichen – insbesondere muskuloskelettalen und stimmspezifischen – und im psychosozialen Bereich. Auf der Grundlage bestimmter vordefinierter Entscheidungskriterien wurde der/die Künstler/-in individuell durch die Befragung geführt. Dies wurde durch den Teilnehmerfluss durch die Befragung veranschaulicht. Die Profile der körperlichen und psychosozialen Beschwerden für Subgruppen von insgesamt 103 Teilnehmer/-innen wurden auf der Grundlage der errechneten Scores erstellt und zeigten Probleme in beiden Dimensionen auf.
Diskussion: Mit dem neuartigen Algorithmus ist es möglich, den körperlichen und psychosozialen Gesundheitszustand von darstellenden Künstler/-innen multidimensional darzustellen. Er kann sowohl für Gruppen als auch für Individuen verwendet werden, um Beschwerdeprofile für Forschungs- und klinische Zwecke zu erstellen.

Keywords

performing art – feasibility – questionnaire – algorithm – musculoskeletal – psychosocial – health status – physiotherapy

Keywords

darstellende Kunst – Machbarkeit – Fragebogen – Algorithmus – muskuloskelettal – psychosozial – Gesundheitszustand – Physiotherapie

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BACKGROUND

Practicing a performing art, which in this study is understood to mean playing an instrument, singing, dancing, or acting, involves special challenges in terms of physical and psychosocial demands. Specific movement sequences are required that demand precision as well as endurance, strength, different speeds, and a large number of repetitions. Performing artists show special health problems, which are associated with the high physical and psychosocial demands of practicing the respective art. Past studies reported about various different musician-associated and instrument-specific complaints, especially in the (neuro-) musculoskeletal area (Fishbein et al., 1988; Middlestadt & Fishbein, 1989; Hoppmann & Patrone, 1989; Lederman, 1989; Schuppert & Altenmüller, 1999; Rosety-Rodrigues et al., 2003; Abreus-Ramos & Micheo, 2007; Böckelmann & Schneyer, 2009; Wilson et al., 2014; Demaree et al., 2017). Kok et al. (2013) found a markedly higher prevalence of musculoskeletal complaints during the previous 12 months in musicians (89.2% of n=83) in comparison to non-musicians (78.0% of n=494). In a cross-sectional questionnaire study by Paarup et al. (2011) 97% of the female and 83% of the male musicians experienced symptoms in at least one of nine anatomic regions during the last year. They also found that symptoms were more frequent and lasted longer in the musicians than in non-musicians and varied not only by gender but also by the instrument played (Paarup et al., 2011). In a meta-analysis of Pestana et al. (2017), singers showed a pooled prevalence of self-reported voice disorders of 46.09% (95%-CI: 38.16-54.12) (total n=1,429 across 11 studies). Lerner et al. (2013) found 59% first-year graduate-level drama students (n=30) to have laryngeal hyperfunction. In D'haeseleer et al. (2017), 50% of the theatre actors (n=30) reported vocal complaints after a performance on a regular basis. Compared to this, the lifetime prevalence of a voice disorder in the general population was much lower at 29.9% (n=1,326) (Roy et al., 2005). Among the different voice disorders there are those, that refer to the musculoskeletal system and/or posture (Rubin et al., 2004; Kooijman et al., 2005; Rubin et al., 2007). A systematic review by Hincapié et al. (2008) and an epidemiological review by Caine et al. (2015) also showed high prevalence rates of musculoskeletal complaints and injuries in dancers, which varied among others with dance style and anatomic region affected. Ahrend & Kerschbaumer (2003) found the most frequent musculoskeletal complaints in the lumbar spine (88%), the knee (80.5%), and the ankle (74%) in 77 dancers. Sobrino et al. (2015) evaluated 486 injuries occurring in professional dancers and found 83.6% of them in the most technically demanding discipline of classical ballet. Due to the special stresses and complaints, the health care for performing artists should be very specific. At the same time, health care practitioners of various disciplines are needed to manage the complexity of performing artists' health problems. Physiotherapy is one of the disciplines which in collaboration with other medical/therapeutic disciplines, may promote the specialized health care of performing artists. Especially in the field of (neuro-) musculoskeletal complaints, physiotherapists are skilled in terms of diagnosing and treatment (de Greef et al., 2003; Chan et al., 2013; Chan & Ackermann, 2014; Zalpour et al., 2021). Additionally, psychosocial complaints regarding stress reactions are already addressed in modern physiotherapy using techniques like relaxation techniques and patient education Cibulka et al., 2009; Blanpied et al. 2017).

In a common physiotherapeutic history taking addressing musculoskeletal complaints, the focus is on the individual's "major problem", its individual causes and risk factors. This information is crucial in order to be able to plan and carry out a specific physiotherapeutic treatment. The "major problem" is the one musculoskeletal problem which is most relevant to the person, e.g., because it causes the most pain and/or complaint or is the most important reason for impairment and/or disability. It is important for the physiotherapeutic clinical reasoning process to include the location of the major problem as well as the extent of the impairment. In addition, the physiotherapist asks for "individual risk factors", which are physical and/or psychosocial factors that might contribute to the development and/or maintenance of the musculoskeletal problem and influence its prognosis. In the case of performing artists, psychosocial factors (like stress, extreme perfectionism, or depression), external performing-related factors (like performance load, rehearsal room conditions), and pre-existing medical conditions might contribute to their musculoskeletal complaints (Vilkman, 2000; Roset-Llobet et al., 2000; Dommerholt, 2009; Chan & Ackermann, 2014; Kenny & Ackermann, 2015; Bowerman et al., 2015).

In the context of history taking, the common setting is a one-to-one dialogue between the patient and the physiotherapist. Additionally, the use of specific questionnaires is becoming increasingly important, particularly among academic physical therapists (Kyte et al., 2015; CSP, 2016). Of particular interest are patient-reported outcome measures (PROMs), which can be used to assess the impact of their symptoms, functional status, and health-related quality of life from the patient's perspective (Black, 2013; Kyte et al., 2015). PROMs can assist physiotherapists in their clinical reasoning to identify, together with the patient, the main problems of functioning and activities of daily living and participation (Kyte et al., 2015; Boyce et al., 2014). In one survey, therapists indicated that using PROMs helped them structure their history taking and provided additional information that they would not have obtained from

subjective or clinical examination (Rasmussen-Barr et al., 2021). In order to support the physiotherapeutic clinical reasoning process in the specific assessment of performing-art-associated complaints and to survey the artist's individual complaints in a manner as detailed as possible, validated PROMs should also be used additionally to the interview-based history taking. These should provide an artist-specific overview of the musculoskeletal complaints, impairments, and possible individual physical and psychosocial risk factors for the subsequent physiotherapeutic interview-based history taking. Such a combination of PROMs addressing both the physical as well as the psychosocial health dimension in the context of performing artists' health had not been compiled at the time this study was conducted. Ballenberger et al. (2018) already used a series of questionnaires to evaluate the physical and psychological health status of musicians, but these were provided in paper-and-pencil-format and did not include detailed information on performing-artists-specific complaints as well as body-region-specific information. These aspects should be taken into account in order to tailor an effective patient management for performing artists in a detailed way.

Study objectives

The aims of the present study were (1) to compose an algorithm including standardized validated patient-related outcome measures (PROMs) for the evaluation of the individual physical and psychosocial health status of performing artists with musculoskeletal health complaints, taking into account its complexity and multidimensionality, and (2) to empirically test the application of the proposed algorithm in a broad sample of performing artists.

METHODS

Step 1: Selection of PROMs and algorithm composition

Questions on the individual characteristics of the patient like sociodemographic information as well as performing-art-specific information including the professional level were compiled in a self-administered General Questionnaire. The relevant aspects were selected on the basis of Dommerholt (2009) and were supplemented by aspects described in established performing-artists-specific literature (Ackermann & Adams, 2004; Sataloff et al., 2010; Chan & Ackermann, 2014; Ackermann et al., 2011).

Additionally, PROMs relevant for the performing-art-specific history taking were selected based on the literature search and following criteria, which were defined a priori by the authors. The included PROMs should

- be performing-artist-specific,
- cover either the physical or the psychosocial health dimension:
  - The physical dimension covering performing-artist-specific musculoskeletal or voice-related problems as well as additional information on problems/disability, especially in the anatomical location of the main musculoskeletal problem prioritized by the participant.
  - The psychosocial dimension covering health-related quality of life as well as psychosocial factors, which may contribute to the development and perpetuation of performance-related musculoskeletal disorders (Chan & Ackermann, 2014), general and/or performance anxiety, depression, and stress.
- be available in German, if possible, in a cross-cultural adapted and validated version.

Regarding the non-performing-art-specific questionnaires covering the psychosocial dimension and addressing the different body regions, it was decided to include well-established PROMs commonly used in the physiotherapeutic context, which cover the aspects mentioned above.

Regarding the performing-artist-specific PROMs, the database PubMed was searched for full texts in English or German using the terms

(instrumentalist* OR musician*) or (sing* OR vocal* OR voice) or (danc*)

AND ("patient related outcome measure" OR self-report OR questionnaire OR index OR inventory OR survey), respectively, in title/abstract.

Results were screened for relevant articles matching the above-mentioned criteria. Whenever an appropriate PROM was found, a transcultural adapted German version was searched. All selected PROMs are shown in table 1 (results section).

After the selection of the questionnaires, the order of the questionnaires was determined and the algorithm was defined. The fundamental idea of the algorithm was that the patient should be guided individually through a series of PROMs in order to address the individual health problem. Key questions were used at various points in this algorithm in order to decide which questionnaire or item will be displayed next. These optional questionnaires should address in depth either specifically one of the performing arts or musculoskeletal problems in a specific body region. Therefore, conditions were defined under which the participant was forwarded to specific questionnaires or items while other questionnaires or items were skipped.

The items of all questionnaires and the corresponding conditions were stored in German in the online survey tool LimeSurvey. The structure of the algorithm with the various redirects as well as spelling and grammar were pre-tested with 17 non-performing-artists. Corrections were incorporated and modifications were refined before the empirical test phase within the target group of performing artists.

Step 2: Algorithm application and empirical test phase

The survey was applied to instrumentalists, singers, dancers, and actors. It is not only for professionally trained artists that performing can have a major impact on their quality of life, but also for amateurs and non-professionals. Conversely, regardless of the level of artistic training, discomfort, and complaints can lead to significant impairment in the practice of the performing arts and, depending on the importance of the arts to one's life, can also affect quality of life. Therefore, performing artists of *all levels* of professionalism/ artistic training and of all genres were addressed. The survey was conducted within the region of Osnabrueck-Emsland. The aim was to get the largest possible sample so that each PROM would be completed at least once. Therefore, a snowball effect was intended and the artists were invited to forward the access to the survey to other artists as well. Internet searches were conducted for single artists of all 4 groups of performing artists as well as bands, music and dance sports clubs, choirs, theatres, etc. In a first wave, 953 performing artists were informed via email or mail about the background and aims of the project and invited to participate in the survey. In a second wave of recruitment, a reminder was sent and additional 72 instrumentalists', singers', dancers' and actors' associations, universities and other regional multipliers were informed and invited to participate or forward the invitation to their members. A link or a QR code was included in the e-mails/mails forwarding directly to the online survey.
Performing artists were surveyed from july 2019 to february 2020 in an exploratory observational design with one measurement point. The algorithm guided the study participants individually through the composition of PROMs depending on their answers to specific key questions (see Tab. 1). After stopping the online survey, the procedure of data preparation, scoring and interpretation was tested (see "statistical considerations"). One of the participants was selected by the authors, who had completed all PROMs in his/her algorithm-driven path through the survey without dropping out. His/her individual path through the survey was illustrated. The individual scores of his/her combination of PROMs were compiled in diagrams for both the individual physical and psychosocial health dimension.

Statistical considerations

For step 2 a data and a syntax file were extracted from the online tool LimeSurvey and imported to SPSS (IBM SPSS Statistics, Version 26) in order to test further analysis. For the description of the study population descriptive statistics such as mean with standard deviation, median with an interquartile range, and a range with a minimum and maximum were calculated for sociodemographic and performing-art-specific parameters extracted from the General Questionnaire. The PROMs were scored including preparation like recoding, reversed scaling, etc. as indicated by the respective authors (Tab. 1). In order to improve comparability, all PROM scales were normalized to a uniform 0-100 scale with lower scores indicating better outcome/less impairment. Therefore, the scales of the DASS, the K-MPAI-26, the Pain Intensity and Interference Scale of the MPIIQM-G, the NDI and the SVHI were normalized to a 0-100 scale and the scaling of the SF-12 was reversed from "higher scores indicate better outcome" to "lower scores indicate better outcome". Cut-off values and grading were used for the interpretation of the PROM scores whenever available (in the presented example: SF-12, NDI and SVHI) (Tab. 1).

Ethics

The present study was conducted in accordance to the ethical guidelines of the Osnabrueck University of Applied Sciences referring to the Guidelines for Safeguarding Good Research Practice by the DFG (2019) and the World Medical Association Declaration of Helsinki (WMA, 2013). Participants were informed about the background and aims of the study as well as contact persons and responsibilities during recruitment and again at the beginning of the survey. The first item of the online survey referred to the protection of the data to be collected and the possibility of its withdrawal at any time. If the participant gave informed consent, he or she was directed to further items. If he or she disagreed with the guidelines, the survey was stopped at that point and no data were stored. Before the analysis of the data of those who gave informed consent, personal data like email or names were removed from the data set.

RESULTS

Step 1: Description of selected PROMs and the survey algorithm

An overview and descriptions of the selected questionnaires as well as the algorithm is shown in Table 1 in the supplementary material. The table includes the description of the selected PROMs clustered by health

dimension and specification; the outcomes; further literature on development and psychometric properties of the original version; the availability and psychometric properties of the German versio; information on scoring and interpretation of scores; and indication of whether the questionnaire is mandatory or optional including the condition to be forwarded to the respective questionnaire (ADL = activities of daily living), and the adjustments made for the needs of the present study).

At the very beginning of the survey the participant was informed about the project, ethical considerations, data protection, and the possibility of withdrawal at any time. The online survey started with the General Questionnaire only if the participant gave informed consent.

The General Questionnaire was self-administered by the authors of the present study in order to assess sociodemographic as well as performing-art-specific characteristics which are relevant for further interview-based history taking. Additionally, items on general information in the MPIIQM-G, SVHI, VHI, and the MHQ were removed from these questionnaires and summarized in the General Questionnaire.

The SF-12, DASS-21, and K-MPAI-26 covered the psychosocial health dimension, all other questionnaires covered the physical health dimension. The K-MPAI, all three versions of the MPIIQM-G, the SVHI, and the VHI were selected as performing-art-specific PROMs. The MPIIQM was originally developed especially for orchestra musicians (Berque et al., 2014). However, in the present study, it was used for all types of instrumentalists and—in the reworded versions—also for singers/actors and dancers in order to compare the musculoskeletal complaints between groups. The SVHI and VHI were selected as voice-specific PROMs. In the present study, the VHI was used to evaluate voice-specific complaints in actors, even though it was originally developed for every type of voice patients, not especially for actors (Jacobson et al., 1997). The CF-PDI, NDI, QuickDASH, MHQ, ODI, HOOS-PS, KOOS-PS and the FAOS were selected as the body-region-specific PROMs.

A psychometrically tested German version was available for the DASS (Nilges & Essau, 2015), the NDI (Cramer et al., 2014), the QuickDASH (Institute for Work&Health, 2006a+b), the ODI (Mannion et al., 2006a+b), the HOOS-PS and the KOOS-PS (Roos, no year), and the FAOS (van Bergen et al., 2014). The General Questionnaire was not validated, because it was not used to gain information on a certain construct. Kenny et al. (2004) tested the original English 26-item-version of the K-MPAI for internal reliability and validity. A German version of the K-MPAI-26 was psychometrically tested for validity and reliability by Heimann and Kummermehr (2020) but has not yet been published in a peer-reviewed journal. The MPIIQM-G was validated in the German language by Möller et al. (2018). In the present study, it was slightly reworded use regarding singers/actors and dancers in order to assess the musculoskeletal problems in a performing-arts-specific way. However, the reworded versions were not tested psychometrically before use. The English version of the CF-PDI had already been validated at the time of questionnaire selection (La Touche et al., 2014). The German cross-cultural adapted translation (von Piekartz et al., 2021) was performed before questionnaire selection in the present study and was used with permission, even though the psychometric evaluation had not been completed. In the standardized translated and validated German consensus version of the MHQ by Knobloch et al. (2011c) no distinction between right and left hand was made in the subdimension of “pain”. Therefore, in the present study, the answers given in this subdimension were indicated to be currently affected the most in order to be able to apply the MHQ scoring algorithm provided by the licensors. The evaluation of the secondary disease was self-administered and not psychometrically tested. The questions were based on the standardized German Pain-Questionnaire (Deutscher Schmerzfragebogen) (DGSS, 2018).

The performing artist was guided individually through the survey and was directed to PROMs, which address his or her complaints more in-depth. Irrelevant questions for the respective participant were skipped based on specific key questions. Depending on the indication of the main performing art practiced (information provided in the General Questionnaire) the participant was directed to one of the versions of the MPIIQM-G and to one of the voice-specific questionnaires if the main performing art was singing or acting, whereas these PROMs were skipped for instrumentalists and dancers. Furthermore, musculoskeletal problems were surveyed in the MPIIQM-G, but they were addressed in depth by one of the body-region-specific PROMs. The MPIIQM-G is constructed in such a way that the participant is asked about the prevalence of musculoskeletal problems within 4 different time slots (ever, during the last 12 months, during the last month/4 weeks, currently/in the past 7 days). If the participant indicates having musculoskeletal pain or problems within the last month and/or currently, he or she is directed to a body chart, in which *all* complaints as well as the *one* area of worst pain should be named (Möller et al. 2018). In the present survey, depending on the location of this main pain prioritized by the participant (MPIIQM-G, item no. 13b), the survey algorithm led to one of the PROMs, that specifically addressed complaints in that respective body region. For example, an artist, who indicated his/her main pain in the neck, was directed to the Neck Disability Index (NDI), the one, who reported his/her main pain in the lumbar spine, was forwarded to the Oswestry Disability Index (ODI) (Fig. 2).

Step 2: Survey application and empirical test phase

Description of the sample of participating performing artists

196 subjects started the survey, 176 subjects gave their informed consent to the privacy notice and to participate in the survey. 103 subjects completed the entire survey and their scores were used for further analysis (Tab. 2).

The data of participant no. P0014 (41 years, male, singer) was chosen by the authors in order to demonstrate his individual health status drawn from the algorithm-based survey.

Participants' flow through the algorithm-based survey

The order of the PROMs and the participants' flow through the survey are shown in Figure 1 and Figure 2 in the supplementary material. The figures illustrate the

Table 2: Description of the study population (N=103): Sociodemographic and performing-art-specific characteristics (PA=performing art; BMI=body mass index; IQR=interquartile range).

Age	**years mean (SD), range**	**38.57 (16.44), 18-82**			
Gender	n (%)	female male	60 (58.3) 43 (41.7)		
BMI	mean (SD), range	24.6 (5.0), 17.0-45.0			
PA (single answer) and specifications (multiple answers possible)	n (%)	**instrument playing** keys strings wind percussion others **singing** soprano mezzo soprano alto tenor bass baritone others	65 (63.1) 31 (47.7) 28 (43.1) 25 (38.5) 3 (4.6) 3 (4.6) 26 (25.2) 7 (26.9) 10 (38.5) 11 (42.3) 7 (26.9) 1 (3.8) 4 (15.4) 2 (7.7)	classic church music jazz pop rock folk music marching music musical others	65 (71.4) 34 (37.4) 18 (19.8) 32 (35.2) 15 (16.5) 8 (8.8) 4 (4.4) 16 (17.6) 9 (9.9)
		dancing	9 (8.7)	ballet jazz dance standard latin american modern others	6 (66.7) 2 (22.2) 2 (22.2) 2 (22.2) 3 (33.3) 2 (22.2)
		acting	3 (2.9)	theatre others	2 (66.7) 1 (33.3)
Age of starting the PA	years mean (SD), range	11.7 (8.9), 4-55			
Average time of practicing the PA (recently)	hours/week mean (SD), range	19.4 (15.8), 0-80			
Average time of practicing the PA (since starting to perform)	hours/week mean (SD), range	2.3 (2.5), 0-16.8			
Income regarding PA (recently)	n (%)	main income secondary income no income	44 (42.7) 27 (26.2) 32 (31.1)	n=44 with professional training in at least one of the PA n=20 with professional activity and/or professional training in at least one of the PA n=9 with professional training in at least one of the PA, n=3 with private lessons	
Individual meaning of the PA for the participant (NRS from 0=no meaning at all to 10=the greatest meaning)	median (IQR), range	9 (2), 2-10		For 88.4% of the artists, playing an instrument/singing/dancing/acting is very important (8-10/10 points on the NRS)	
Evaluation of how bad a PA failure would be (NRS from 0=no meaning at all to 10=the greatest meaning)	median (IQR), range	9(2), 1-10		For 85.4% of the artists, it would be very bad if they were no longer able to play their instrument/sing/dance/act (8-10/10 points on the NRS)	

varying sample size per PROM as well as the different paths through the survey, which result from the different conditions of forwarding (see Tab. 1). Figure 1 includes those PROMs, which were *independent* of a body region. Figure 2 refers to those PROMs, which gave detailed information on musculoskeletal problems in *one* specific body region depending on which area was named in the body chart in the MPIIQM-G item no. 13b ("Put an X on the ONE area that HURTS the most"; Berque et al., 2014). The arrows and labelling colored in pink show the individual path through the survey of participant P0014 (see Fig. 1+2 in the supplementary material).

Example of P0014's individual PROM scores and interpretation

In Figure 3, 4, and 5, the individual results of the performing artist P0014 are shown as an example of individual information extracted from the proposed algorithm. Figure 3 shows the results of the singer P0014 regarding the psychosocial health dimension. For the health-related quality of life the score of the Mental Component Summary (71.44, reversed scaling of SF12) is markedly higher than the score of the Physical Component Summary (51.94, reversed scaling of SF12). The score of the Depression Scale of the DASS-21 (42.9, normalized to a 0-100 scale) is lower than the cut-off value (47.6, normalized to a 0-100 scale), the score of the Anxiety Scale (38.1, normalized to a 0-100 scale) is above the cut-off value (28.6, normalized to a 0-100 scale) indicating an increased probability of the presence of an anxiety disorder, and the score of the Stress Scale is equal to the cut-off value (47.6, normalized to a 0-100 scale). Regarding music performance anxiety, the K-PAI score is within the 2nd quarter of possible values (41, normalized to a 0-100 scale). The self-perceived disability related to the additional symptom/disease "depression" is 40/100.

Figure 4 presents P0014's individual results of the questionnaire MPIIQM-G (singers'/actors' version). The four different kinds of prevalence of musculoskeletal pain are all answered with "yes", so the participant was forwarded by the algorithm to the body chart integrated in the PROM. There, he marked the location of *each* area where the participant experienced pain/problems, as well as the *one* area that hurts the most (neck).

Figure 5 shows the score profile of the same singer regarding the physical health dimension. The Musculoskeletal Pain Intensity and Interference Scores (MPIIQM-G, singers'/actors' version) lie within the 2nd quarter of possible values (Intensity: 40, Interference: 46). According to the conditions defined in the algorithm (Tab. 1), the artist was referred to the questionnaire Neck Disability Index (NDI) because he had indicated the main pain in the neck region in the body chart of the MPIIQM-G. His NDI score is between the grading of mild to moderate disability (28). The participant indicated he was a singer, so he was forwarded to the Singing Voice Handicap Index (SVHI) by the algorithm. The score for the individual handicap associated with singing voice problems lies within the grade of no handicap (19).

DISCUSSION

The aims of the present study were (1) to compose an algorithm including standardized validated patient-related outcome measures (PROMs) for the evaluation

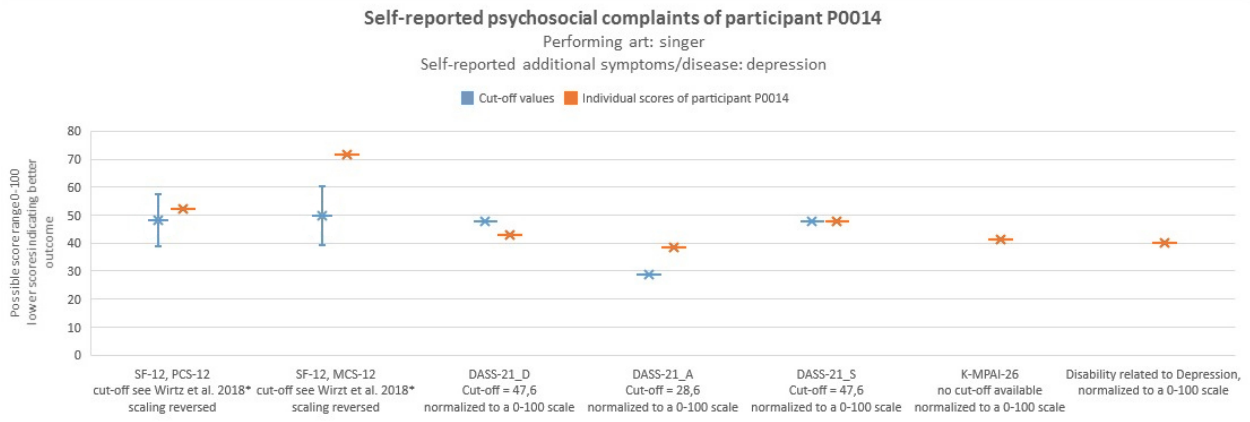


*Figure 3: Participant P0014's individual self-reported psychosocial complaints: Scores of the 12-item Shortform Survey (SF-12) aggregated to the Physical Component Summary (**PCS-12**) and the Mental Component Summary (**MCS-12**) scale (*cut-off values referring to Wirtz et al. 2018, electronic supplement 1, mean +/- 1SD for the relevant age group of P0014); scores of the 21-item Depression Anxiety Stress Scales aggregated to the Depression Scale (**DASS-21_D**), the Anxiety Scale (**DASS-21_A**), and the Stress Scale (**DASS-21_S**) (respective cut-off values referring to Nilges & Essau (no year)); total sum score of the Kenny Music Performance Anxiety Inventory 26-item form (**K-MPAI-26**) (no cut-off value available); Disability related to Depression, considered by P0014 as additional disease/symptoms).*

of the individual physical and psychosocial health status of performing artists with musculoskeletal health complaints, taking into account its complexity and multidimensionality, and (2) to empirically test the application of the proposed algorithm in a broad sample of performing artists.

Prevalence of musculoskeletal pain/ problems (P0014)	Yes	No
Ever	X	
During the last 12 months	X	
During the last month/ 4 weeks	X	
Currently/ in the past 7 days	X	

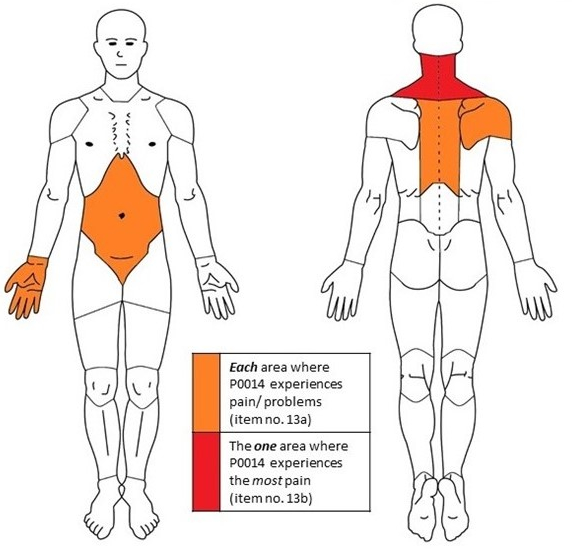


Figure 4: Participant P0014's individual descriptions and location of musculoskeletal pain/problems (physical health dimension): orange areas represent „…each of the areas where you experience pain/ problems." (MPIIQM-G, item 13a); red area represents "…the one area that hurts the most" (MPIIQM-G, item 13b).

Step 1: Selection of PROMs and algorithm composition

In step 1, PROMs in German covering both the physical and psychosocial health dimensions were selected based on a literature search in order to determine the self-perceived health status of performing artists as comprehensively as possible and to provide a basis for further interview-based history taking. The focus was on musculoskeletal complaints and the associated individual risk factors that may contribute to their development or maintenance. The psychosocial health dimension was measured by the SF-12, the DASS, and the K-MPAI-26. The physical health dimension focusing on voice-specific complaints was measured by the SVHI or the VHI. The physical health dimension focusing on musculoskeletal complaints was measured with the MPIIQM-G and the 8 body-region-specific questionnaires CF-PDI, NDI, QuickDASH, MHQ, ODI, HOOS-PS, KOOS-PS, and FAOS. With the help of a newly composed algorithm, the individual performing artist is offered only those questionnaires that are relevant to him/her, skipping all other questions.

With the selected PROMs, the algorithm covers all criteria that were determined a priori by the authors (cf. result section, step 1). Providing the survey in online format allowed automatic skipping of those questionnaires that are not relevant for the individual participant and therefore allowed a specifically tailored questionnaire-

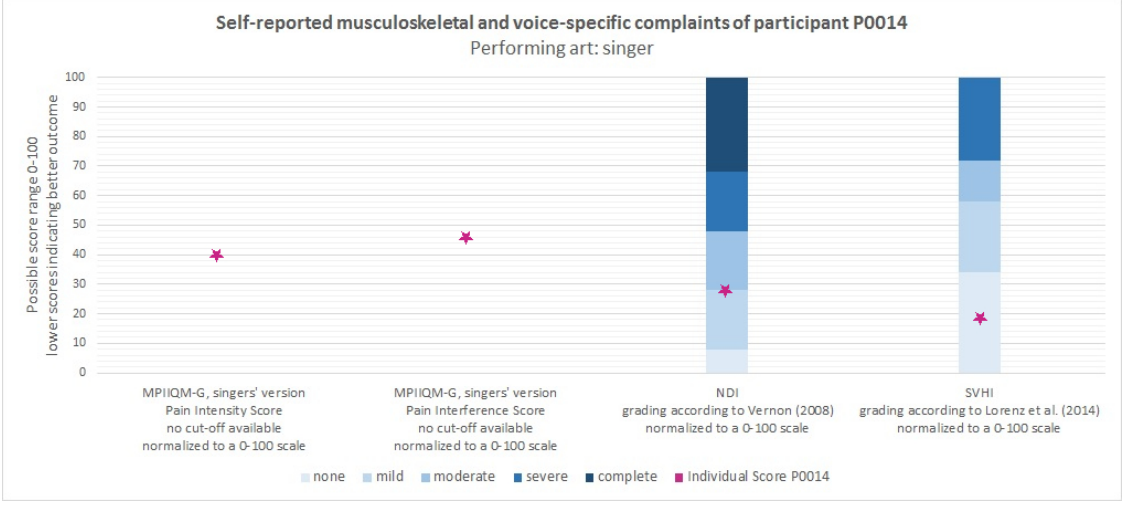


Figure 5: Participant P0014's individual musculoskeletal and voice-specific complaints (physical health dimension): Scores of the Pain Intensity Scale of the Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians (MPIIQM-G, singers'/actors' version) (no cut-off value available) and the Pain Interference Scale of the MPIIQM-G (MPIIQM, singers'/actors' version) (no cut-off value available); Scores of the Neck Disability Index (NDI) (grading shown in stacked bars); Score of the Singing Voice Handicap Index (SVHI) (grading shown in stacked bars).

based history taking. The pre-test supported the technical function of the algorithm before it was applied to the target group.
Regarding psychometric properties, it should be taken into account that the validation of the German versions of the MPIIQM-G, which has been reformulated by the authors for the groups of singers, dancers and actors, respectively, has not yet been carried out. Therefore, the psychometric quality of the algorithm cannot yet be clearly determined.

Step 2: Survey application and empirical test phase

In step 2, the algorithm was applied to performing artists in order to empirically test it within the target group and within subjects with "real" performing-arts-associated complaints. Each PROM was completed by at least one subject (cf. Fig. 1&2) as intended. For one individual subject (P0014) who was exemplarily selected by the authors, the data from all PROMs that resulted from his individual path through the survey, were analyzed (scores were calculated and graphically presented). This exemplifies what information on both the physical and psychosocial health dimension of a performing artist the algorithm could provide in order to support the physiotherapist in further patient management. The evaluation and graphical representation of the results have an interesting added value for further history taking in the personal interview. At this point in time, the creation of these diagrams and interpretation of scores is rather time consuming and should be automated for the implementation in the common physiotherapy practice.
The respective participant was asked to fill various PROMs (ranging from 6 to 8) in order to cover both the physical and psychosocial dimension of health at a high level of detail. In order to reduce client's burden, it is recommended to use validated short versions of the PROMs.

Limitations and strength of the study

In the present study, a high level of detail in evaluating both the physical and psychosocial health status of performing artists was intended. This was achieved by addressing the different possible localizations of the individual major problem as well as artist-specific complaints and both physical and psychosocial individual risk factors through the different PROMs. Additionally, the sample covered a wide range of performing artists from different artistic disciplines and level of experience and reported on "real" performing-arts-associated complaints as intended. The online format enabled the participant to complete the survey independently of the restricted time with a therapist. The physical and psychosocial health status of an individual performing artist presented in its complexity and multidimensionality represents a therapeutically important basis for comprehensive patient management.
As soon as there are relevant PROMs with a higher psychometric quality, these should be integrated in the algorithm. That might improve the psychometric quality of the proposed algorithm to provide valid and reliable information on the individual's physical and psychosocial health status and improve clinical benefits. However, detailed questioning with the proposed algorithm as well as graphical representation of the results might provide important information as a basis for further physiotherapeutic patient management.

Future research and implementation

For an application in physiotherapeutic practice, the use of short versions is recommended in order to save time when filling the algorithm. An automation of provision and interpretation of the information resulting from the survey would be a helpful and timesaving step in the implementation to the physiotherapy practice. In future research, performing artists should be asked to provide feedback on the usability of the algorithm.
In addition, physiotherapists would need instruction on scoring and interpretation of PROM scores in order to reliably use the algorithm and PROMs. The clinical benefits for individually tailored patient management should be evaluated based on the feedback of physiotherapists using the algorithm for their therapeutic work.
For the clinical use of the algorithm, the evaluation of changes of complaints over time would be of special interest for both the therapist and the patient. Therefore, the algorithm, or at least selected PROMs that have revealed problems in one of the areas, have to be used repeatedly. In that case, additional values like the minimal detectable change (MDC) or minimal clinical important change (MCIC) are important for clinical interpretation. The benefits of the proposed algorithm for better artist-specific outcomes over time should be evaluated, as well.

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ETHICAL APPROVAL/REGISTRATION

The present study was conducted in accordance with the ethical guidelines of the Osnabrueck University of Applied Sciences referring to the Guidelines for Safeguarding Good Research Practice by the DFG (2019) and the World Medical Association Declaration of Helsinki (WMA, 2013).

CONFLICT OF INTEREST

No conflict of interest is to be announced.

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