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Development and Validation of the Musculoskeletal Health Questionnaire (MSK-HQ) on an Italian Population of Padel and Tennis Players: A Cross-Sectional Study

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SUMMARY

Introduction. In racquet sports, players are particularly prone to a variety of musculoskeletal issues due to the repetitive and high-intensity nature of their movements, which can lead to overuse injuries, acute trauma, and chronic conditions. The Musculoskeletal Health Questionnaire (MSK-HQ) is a comprehensive tool designed to assess a wide range of musculoskeletal health parameters, including pain, function, physical activity levels, and the impact of musculoskeletal issues on daily living. This study aims is developing and validating an Italian version of the MSK-HQ for tennis and padel players.

Materials and methods. The study was conducted between May and September 2022. The simple study consists of athletes who practice padel, tennis, other sports and who do not practice at all. Each of the participants was administered the Italian version of the MSK-HQ for assessing the impact of musculoskeletal disorders during activities of daily living (ADL).

Results. A total of 269 participants were recruited in this study, including 100 (37.2%) padel players and 50 (18.6%) tennis players. MSK-HQ showed, for padel players, a value at Cronbach's alpha of 0.903 and for tennis players a Cronbach's alpha value of 0.868. Cross-cultural validity showed, between each of the cohorts of athletes and on the total score of the MSK-HQ, a P-value < 0.001.

Conclusions. In conclusion, the MSK-HQ can be used in relation to padel and tennis having a high level of internal consistency and validity.

KEY WORDS

Musculoskeletal disorders; MSK-HQ; padel; tennis; reliability; cross-cultural validity.

INTRODUCTION

The burgeoning popularity of racquet sports such as tennis and padel has led to an increased focus on the health and performance of athletes participating in these activities (1, 2). In Italy, both sports have seen significant growth, with tennis being a long-established discipline and padel rapidly gaining popularity in recent years (3, 4). This rise in participation underscores the importance of understanding and managing musculoskeletal health among players to prevent injuries, enhance performance, and prolong athletic careers (5, 6).

Musculoskeletal health is a critical aspect of overall well-being, encompassing the functionality and strength of bones, muscles, and connective tissues. For athletes, maintaining

optimal musculoskeletal health is paramount, as it directly influences their ability to train, compete, and recover from injuries (7). In racquet sports, players are particularly prone to a variety of musculoskeletal issues due to the repetitive and high-intensity nature of their movements, which can lead to overuse injuries, acute trauma, and chronic conditions (8, 9). Common issues include tennis elbow (lateral epicondylitis), shoulder impingement, lower back pain, and knee problems (10, 11).

Despite the clear need for effective assessment tools, there is a notable lack of specific, validated questionnaires tailored to evaluate the musculoskeletal health of racquet sport athletes (11). Existing general musculoskeletal health questionnaires often fail to capture the unique demands and injury patterns associated with these sports. Moreover, cultural and linguistic differences can affect the applicability of these tools in different populations, highlighting the necessity for validated translations and adaptations (12).

The Musculoskeletal Health Questionnaire (MSK-HQ) is a comprehensive tool designed to assess a wide range of musculoskeletal health parameters, including pain, function, physical activity levels, and the impact of musculoskeletal issues on daily living (13). It has been validated in various populations and settings, demonstrating robust psychometric properties (14-18). However, its application in the context of racquet sports, particularly within an Italian population, has not been thoroughly explored.

Given the specific physical demands and injury risks associated with tennis and padel, as well as the cultural nuances of the Italian sports community, it is essential to validate the MSK-HQ for this specific group. Such validation will ensure that the questionnaire is both reliable and relevant, providing accurate assessments that can inform clinical decisions, guide interventions, and ultimately improve player health and performance.

This study aims to fill this gap by developing and validating an Italian version of the MSK-HQ specifically for tennis and padel players. The process will involve ensuring cultural relevance through expert reviews and player feedback, and testing its reliability and validity in a sample of Italian racquet sport athletes. The ultimate goal is to provide a validated tool that can be used by healthcare professionals, coaches, and researchers to assess and monitor the musculoskeletal health of tennis and padel players, thereby contributing to better injury prevention and management strategies in these sports.

By undertaking this validation study, we aim to enhance the understanding of musculoskeletal health in racquet sports, promote the well-being of athletes, and support the continued growth and success of tennis and padel in Italy. The findings from this research will not only benefit the Italian sports community but also add to the global body of knowledge on musculoskeletal health assessment in athletic populations.

MATERIALS AND METHODS

This research article was conducted by a research group of Sapienza University of Rome (RES - Riabilitazione Evidenze e Sviluppo) who was involved in different studies on rehabilitation (19-26).

Subject enrolment

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Ethics committee approval is not required for this study, this research involves secondary use of clinical data which is provided without any identifier or group of identifiers which would allow attribution of private information to an individual. Informed consent was obtained from all participants for being included in the study.

The study was conducted between May and September 2022. The study sample consists of athletes who practice padel, tennis, other sports and who do not practice at all. The cohorts that composed the study champion were recruited at the "Red Padel" club in Rome for padel players; at the other clubs in Rome for tennis players and other sports. The cohort of no-sports was instead randomly recruited among the citizens of Rome.

Subjects aged 18 to 99 years who did not have concomitant orthopedic, neurological, or cardiac conditions at the time of cohort inclusion were recruited for this study.

Each of the participants was administered the Italian version of the MSK-HQ for assessing the impact of musculoskeletal disorders during activities of daily living (ADL) together with a questionnaire for collecting demographic data. The administration of the questionnaire was carried out directly by a group of physical therapists to avoid comprehension errors.

Assessment tool

MSK-HQ is a patient-reported outcome measure (PROM) designed to assess the overall impact of musculoskeletal disorders on individuals. It evaluates multiple domains of health affected by musculoskeletal conditions, including

pain, physical function, and psychological well-being. In detail, its domains assess:

- Pain and discomfort: evaluates the level and frequency of pain experienced by the patient;
- Physical function: assesses the ability to perform daily activities and physical tasks;
- Stiffness: measures the degree of stiffness and its impact on movement;
- Work and daily activities: consider how musculoskeletal issues affect work, chores, and daily routines;
- Sleep: assesses the impact of musculoskeletal disorders on sleep quality;
- Fatigue: evaluates the level of fatigue related to musculoskeletal conditions;
- Emotional well-being: measures the psychological impact, including feelings of anxiety or depression related to MSK health;
- Social participation: assesses how musculoskeletal issues affect social interactions and activities.

MSK-HQ consists of 14 items, and for each of them the score goes from 4 to 0, where 4 means that the patient does not experience pain, 3 means little pain, 2 means moderate pain, 1 means intense pain, and 0 is high-intensity pain.

Statistical analysis

The software used for statistical analyses was SPSS Statistics version 27.

The demographic and clinical characteristics were calculated as mean ± SD or percentage where appropriate.

The analysis for the evaluation of psychometric properties was carried out following the directions of the COSMIN checklist for evaluating the methodological quality of studies on measurement properties (27). Reliability was assessed with Cronbach's alpha (the value of Cronbach's alpha has to be > 0.70); cross-cultural validity was conducted with analysis of variance (ANOVA), in which the four cohorts were compared on the basis of total score at the MSK-HQ (28).

RESULTS

A total of 269 participants were recruited in this study, including 100 (37.2%) padel players and 50 (18.6%) tennis players.

The mean age of the sample was 36.8 years and largely composed of men (68.8%). Of the participants, moreover, 75 (27.9%) were employed, while 65 (24.4%) were students; finally, 164 (61%) people claimed to have had a past orthopedic injury or surgery.

Table I. Demographics and clinical characteristics of the study sample.

Variables	
Types of sports, n (%)	
Padel	100 (37.2)
Tennis	50 (18.6)
Other sports	75 (27.9)
No-sports	44 (16.3)
Age, years, mean ± SD	36.8 (11.3)
Gender, n (%)	
Female	84 (31.2)
Male	185 (68.8)
Previous orthopedic trauma/surgery, n (%)	
Yes	105 (39)
No	164 (61)
Employment, n (%)	
Homely	5 (1,9)
Employee	75 (27.9)
Clerk	1 (0.4)
Worker	9 (3.3)
Teacher	6 (2.2)
Student	65 (24.2)
Freelancer	53 (19.7)
Health care worker	9 (3.3)
Manager	10 (3.7)
Entrepreneur	16 (5.9)
Other	20 (7.5)

SD: Standard Deviation.

The complete demographic and clinical characteristics of the sample are shown in **table I**.

Reliability

MSK-HQ showed, for padel players, a value at Cronbach's alpha of 0.903; this value shows excellent reliability of the instrument. **Table II** shows the values at alpha deleted analysis.

MSK-HQ also shows excellent internal consistency with regard to its applicability on tennis players, with a value at Cronbach's alpha of 0.868. **Table III** shows the values at alpha deleted analysis.

MSK-HQ shows an adequate internal consistency value for applicability on people playing other sports, with a value at Cronbach's alpha of 0.784. **Table IV** shows the analysis aplha deleted.

Table II. Alpha deleted analysis of MSK-HQ for padel.

	Medium Scale If the Item Is Deleted	Scale Variance If the Element Is Deleted	Correct Element-to-Total Correlation	Quadratic Multiple Correlation	Cronbach's Al-pha If the Item Is Deleted
ITEM 1	45.92	39.428	0.837	0.767	0.885
ITEM 2	45.54	42.877	0.594	0.585	0.897
ITEM 3	45.43	43.965	0.655	0.638	0.895
ITEM 4	45.28	46.709	0.459	0.648	0.902
ITEM 5	45.89	40.483	0.667	0.621	0.894
ITEM 6	45.45	44.997	0.571	0.588	0.898
ITEM 7	45.38	44.602	0.593	0.653	0.897
ITEM 8	45.21	48.127	0.326	0.309	0.905
ITEM 9	45.49	43.485	0.612	0.548	0.896
ITEM 10	45.74	43.265	0.582	0.502	0.897
ITEM 11	45.38	45.430	0.520	0.412	0.900
ITEM 12	46.00	40.323	0.594	0.732	0.900
ITEM 13	46.04	40.160	0.647	0.760	0.896
ITEM 14	45.81	40.357	0.854	0.795	0.885

Table III. Alpha deleted analysis of MSK-HQ for tennis.

	Medium Scale If the Item Is Deleted	Scale Variance If the Element Is Deleted	Correct Element-to-Total Correlation	Quadratic Multiple Correlation	Cronbach's Alpha If the Item Is Deleted
ITEM 1	43.08	40.361	0.727	0.696	0.847
ITEM 2	42.36	45.623	0.471	0.611	0.862
ITEM 3	42.56	43.353	0.590	0.524	0.856
ITEM 4	42.20	45.796	0.620	0.577	0.858
ITEM 5	42.94	40.792	0.643	0.612	0.852
ITEM 6	42.52	42.132	0.738	0.657	0.848
ITEM 7	42.42	43.596	0.668	0.623	0.853
ITEM 8	42.08	49.585	0.147	0.089	0.872
ITEM 9	42.40	44.163	0.530	0.706	0.859
ITEM 10	42.86	44.817	0.453	0.374	0.863
ITEM 11	42.50	44.867	0.476	0.664	0.862
ITEM 12	43.38	42.853	0.385	0.503	0.873
ITEM 13	43.50	43.602	0.348	0.475	0.874
ITEM 14	42.94	41.894	0.802	0.722	0.846

Table IV. Alpha deleted analysis of MSK-HQ for other sports.

	Medium Scale If the Item Is Deleted	Scale Variance If the Element Is Deleted	Correct Element-to-Total Correlation	Quadratic Multiple Correlation	Cronbach's Al-pha If the Item Is Deleted
ITEM 1	44.25	20.813	0.625	0.619	0.747
ITEM 2	43.57	23.897	0.451	0.572	0.769
ITEM 3	43.53	24.955	0.271	0.519	0.781
ITEM 4	43.36	25.423	0.427	0.555	0.777
ITEM 5	43.96	23.498	0.397	0.333	0.772
ITEM 6	43.68	23.356	0.571	0.584	0.761
ITEM 7	43.57	23.680	0.579	0.627	0.762
ITEM 8	43.35	25.878	0.298	0.479	0.782
ITEM 9	43.61	24.646	0.289	0.332	0.780
ITEM 10	44.28	22.772	0.460	0.340	0.766
ITEM 11	43.79	23.035	0.467	0.504	0.766
ITEM 12	45.00	22.027	0.359	0.723	0.782
ITEM 13	44.83	23.443	0.190	0.688	0.806
ITEM 14	44.03	21.513	0.669	0.600	0.746

Table V. Alpha deleted analysis of MSK-HQ for no-sports.

	Medium Scale If the Item Is Deleted	Scale Variance If the Element Is Deleted	Correct Element-to-Total Correlation	Quadratic Multiple Correlation	Cronbach's Alpha If the Item Is Deleted
ITEM 1	40.75	89.215	0.868	0.854	0.919
ITEM 2	40.16	95.067	0.772	0.845	0.923
ITEM 3	40.27	92.156	0.800	0.793	0.922
ITEM 4	39.93	96.484	0.743	0.779	0.925
ITEM 5	40.41	91.085	0.852	0.913	0.920
ITEM 6	40.59	87.596	0.847	0.905	0.920
ITEM 7	40.34	90.835	0.775	0.880	0.922
ITEM 8	40.07	94.391	0.698	0.811	0.925
ITEM 9	40.25	93.680	0.732	0.754	0.924
ITEM 10	40.80	97.097	0.681	0.738	0.926
ITEM 11	40.20	93.887	0.754	0.795	0.923
ITEM 12	41.09	107.433	0.004	0.671	0.948
ITEM 13	40.91	103.573	0.235	0.582	0.938
ITEM 14	40.61	89.684	0.868	0.867	0.919

Table VI. Analysis of Variance (ANOVA) between MSK-HQ items and type of sports.

MSK-HQ	Other sport mean ± SD	No-sport mean ± SD	Padel mean ± SD	Tennis mean ± SD	P-value
ITEM 1	3.04 (0.91)	2.82 (1.13)	3.2 (0.9)	2.9 (0.97)	0.103
ITEM 2	3.72 (0.58)	3.41 (0.87)	3.58 (0.79)	3.62 (0.67)	0.166
ITEM 3	3.76 (0.57)	3.3 (1.03)	3.57 (0.62)	3.42 (0.81)	0.001*
ITEM 4	3.93 (0.3)	3.64 (0.81	3.84 (0.44)	3.78 (0.51)	0.019*
ITEM 5	3.33 (0.72)	3.16 (1.03)	3.23 (0.97)	3.04 (1.03)	0.370
ITEM 6	3.61 (0.57)	2.98 (1.25)	3.67 (0.57)	3.46 (0.79)	0.000*
ITEM 7	3.72 (0.51)	3.23 (1.14)	3.74 (0.6)	3.36 (0.71)	0.001*
ITEM 8	3.95 (0.28)	3.5 (1)	3.9 (0.32)	3.9 (0.3)	0.000*
ITEM 9	3.68 (0.62)	3.32 (1)	3.63 (0.71)	3.58 (0.79)	0.074
ITEM 10	3.01 (0.78)	2.77 (0.83)	3.38 (0.76)	3.12 (0.8)	0.000*
ITEM 11	3.34 (0.72)	3.36 (0.97)	3.74 (0.56)	3.48 (0.76)	0.016*
ITEM 12	2.29 (1.1)	2.48 (1.2)	3.12 (1.1)	2.6 (1.2)	0.000*
ITEM 13	2.47 (1.13)	2.66 (0.94)	3.08 (1.03)	2.48 (1.16)	0.001*
ITEM 14	3.27 (0.76)	2.95 (1.1)	3.31 (0.8)	3.04 (1.76)	0.053
TOTAL	47.29 (5.17)	43.57 (10.43)	49.12 (7.05)	45.98 (7.09)	0.000*

SD: Standard Deviation; *statistically significant.

Finally, MSK-HQ shows excellent internal consistency with regard to its applicability on tennis players, with a value at Cronbach's alpha of 0.931. **Table V** shows the values at alpha deleted analysis.

Cross-cultural analysis

ANOVA analysis performed between each of the items of the MSK-HQ and each of the cohorts of athletes under study showed statistically significant differences for a P-value < 0.05 at items 3, 4, 6, 7, 8, 10, 11, 12, and 13; a statistically significant difference was also shown on the total score of the MSK-HQ instrument (p < 0.001) corroborated by a higher mean value at the padel group.

Table VI shows in detail the values recorded on each of the items and the total score, while **figure 1** gives a box-plot representation of the difference between groups on the total score at the MSK-HQ.

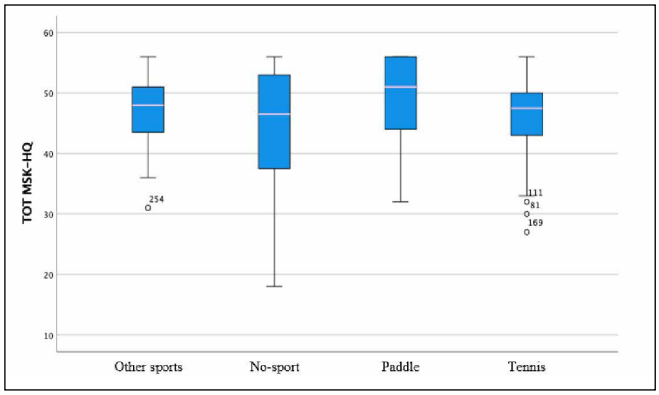

Figure 1. Box plot of the difference between types of sports by total score on the MSK-HQ.

DISCUSSION

The study had two common objectives with each other, which consisted of the evaluation of the psychometric properties of the MSK-HQ and correlation of musculoskeletal disorders with the quality of life of the population analyzed. This was possible precisely through the administration of the aforementioned questionnaire, which returned statistically significant values, both for Cronbach's Alpha (0.903) and alpha delete, thus showing a high level of reliability;

conversely, in the cultural adaptation on the Italian general population, the value of Cronbach's Alpha is slightly lower than that obtained with this study (0.871); In the original study that first dealt with the development and validation of the MSK-HQ, the mean value obtained from the questionnaire was 28.62 (± 9.61), with a range between 0 and 56; as for the study that validated the MSK.HQ in Italian, the mean value was 37.39 (± 9.36); our study, on the other hand, showed a significantly higher mean value of the questionnaire than the previous ones, showing a result of 47.12 (± 7.49) (13, 15).

As is now known from the literature, general sports practice can bring benefits on daily life and health, from cardiovascular, aerobic, metabolic, muscle performance and body balance points of view (29-31); in accordance with this, it was found that padel provides a better quality of life, in particular higher than tennis or the other sports analyzed.

The cross-cultural analysis also showed statistically significant data for some items; particularly for item 3, item 4, item 6, item 7, item 8, item 10, item 11, item 12, item 13. These can be grouped for convenience into 3 domains as follows: "Activities of Daily Living" (items 3, 4, 6, 7, 8), "Psychophysical Impact" (items 10, 11), and "Management and understanding of symptoms" (items 12, 13).

The higher average values obtained in the mentioned items for padel and tennis categories indicates that the injuries found in these players are not so important as to affect those certain actions found in players. Moreover, these injuries do not affect particularly those certain actions such as walking, sleeping, dressing and washing.

In conclusion, the MSK-HQ questionnaire can be used in relation to padel and tennis having a high level of internal consistency and thus reliability. In this way, one can therefore begin to use this scale for the assessment of the incidence of injuries on the daily lives of the millions of racquet players, ensuring basic data to the practitioners themselves.

Healthcare professionals can use the tool to monitor athletes' musculoskeletal health, identify early signs of overuse injuries, and tailor rehabilitation programs to individual needs (32). Coaches can integrate the questionnaire into routine assessments to optimize training loads and prevent injuries. Researchers can utilize the MSK-HQ to study the prevalence and impact of musculoskeletal conditions in Italian racquet sports, contributing to a broader understanding of athlete health in this context.

Limitations of the study

While the study provides robust validation for the MSK-HQ, it is not without limitations. The sample size, although adequate, could be expanded in future studies to include a more diverse representation of athletes across different regions of Italy. Additionally, longitudinal studies are needed to assess the responsiveness of the MSK-HQ over time and its ability to detect changes in musculoskeletal health following interventions.

Future research should also explore the application of the MSK-HQ in professional athletes and younger populations to determine its broader applicability. Moreover, comparative studies between different countries could provide insights into cultural differences in musculoskeletal health perceptions and injury patterns, further enhancing the tool's global relevance.

CONCLUSIONS

This study successfully developed and validated an Italian version of the MSK-HQ for padel and tennis players, demonstrating its reliability and cross-cultural validity. The questionnaire's robust psychometric properties make it a valuable tool for assessing and managing musculoskeletal health in Italian racquet sports athletes. By facilitating early detection and targeted interventions, the MSK-HQ has the potential to improve athlete health, enhance performance, and support the sustained growth of tennis and padel in Italy. The findings contribute significantly to the body of knowledge on sport-specific health assessment tools, underscoring the importance of culturally and contextually relevant instruments in sports medicine.

FUNDINGS

None.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

All authors: conceptualization, writing – review & editing. LL, MC, RS: methodology, data curation. GG; GS, IR: formal analysis. GS, LL, AB, FP: writing – original draft.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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