Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Cross-cultural adaptation of the University of Canberra Fast Jet Aircrew Musculoskeletal Questionnaire (UC-FJAMQ) for musculoskeletal complaint surveillance in Brazilian Air Force pilots

Thaís de Albuquerque
Universidade da Força Aérea
Jose Roberto Andrade Nascimento Júnior
Universidade da Força Aérea
Guilherme Eugênio van Keulen
Universidade da Força Aérea
Helder Guerra de Resende
Universidade da Força Aérea
Peter G. Osmotherly
University of Newcastle Australia
James B. Wallace
University of Canberra
Vinicius de Oliveira Damasceno
viniciusvod@fab.mil.br

Universidade da Força Aérea

Research Article

Keywords: cross-cultural comparison, validation study, questionnaires, validity, reproducibility, military aviation, occupational health

Posted Date: October 16th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11038514/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background.

Musculoskeletal complaints are highly prevalent among military pilots and are associated with meaningful impairment of operational performance, quality of life, and occupational health. These complaints are frequently underreported and are linked to factors specific to military aviation, including biomechanical overload, vibration, sustained acceleration forces (+ Gz), and constrained cockpit ergonomics. In Brazil, no validated, culturally adapted instrument exists to capture the multidimensional nature of these complaints. The UC-FJAMQ is a psychometrically robust tool that assesses not only pain intensity but also its location, duration, and functional, cognitive, and operational impact. **Objective.** To perform the cross-cultural adaptation of the UC-FJAMQ for use with Brazilian Air Force (FAB) pilots. **Methods.** This was a methodological, observational, cross-sectional study conducted according to the Reichenheim and Moraes (2007) guideline, encompassing conceptual and item equivalence, semantic equivalence (translation, synthesis, back-translation, and blind expert review), operational equivalence, and measurement equivalence. Content validity was appraised by an expert panel and by the target population using a five-point Likert scale, with the item-level and scale-level Content Validity Index (I-CVI, Ave-CVI) and Universal Agreement (UA-CVI) computed. **Results.** Content validity was excellent, with Ave-CVI values of 0.98 for clarity, 0.97 for accuracy, and 0.98 for relevance, together with high UA-CVI values. Application to 31 active-duty pilots (mean flight experience 1,644 h; 41.9% fighter and 58.1% transport aviation) confirmed acceptance and applicability, with a negatively skewed response distribution and a mode of 4 across all items. Expert input broadened the instrument beyond fighter aviation to encompass rotary-wing, transport, and patrol operations and incorporated vibration among the flight-dynamics stressors. **Conclusion.** The cross-cultural adaptation of the UC-FJAMQ yielded a valid and reliable instrument for monitoring musculoskeletal complaints in military aviation, offering a standardised tool to support injury prevention, targeted intervention, and occupational-health surveillance within the defence-aviation context.

Background

Musculoskeletal complaints are closely tied to deterioration in occupational performance, translating directly into work absence and a decline in quality of life, with biopsychosocial implications.[1] Such symptoms impose a substantial burden on individuals and generate considerable costs for health systems, ranging from restriction of functional capacity to reduced productivity and increased sick leave.[2] This burden is felt broadly across society and, more specifically, among pilots—particularly military aircrew operating combat aircraft and rotary-wing platforms.[1]

The pain-related risk factors of military aviation are associated with the magnitude, duration, and onset rate of acceleration forces; vibration and resonance; ejection loads; prolonged exposure to low-ergonomic seating and constrained cockpit posture; and the mass of head-borne equipment—such as helmets, night-vision goggles, and oxygen masks—that increases spinal loading during flight and air-

combat manoeuvres.[3] Additional contributing factors include age, general health status, prior rest, cumulative flight hours, the interval between sorties, and the performance of anti-G straining manoeuvres, which are highly fatiguing.[4, 5, 6] Prolonged exposure to these conditions can produce muscle fatigue and load-induced tissue distortion persisting beyond exposure.[7] Although fighter pilots show radiological signs of spinal degeneration, controlled studies have not consistently found the degree or rate of change to differ from that of non-fighter pilots, and a meta-analysis reported no between-group difference in cervical disc degeneration.[8, 9] The true prevalence may be even higher, given underreporting driven by concern that disclosure could adversely affect the career.[10]

Against this background, musculoskeletal complaints—chiefly pain—and their impact on human performance should be measured in order to identify countermeasures that optimise performance and clarify the limits of the psychomotor tasks associated with the mission.[11] This requires multidimensional psychometric instruments that account for effects on daily activities such as sleep, mood, and physical activity, and that can be applied longitudinally for maximum benefit.[11]

In clinical practice, unidimensional pain scales predominate on account of their simplicity, speed, and immediate applicability.[12] Although effective for quantifying pain intensity, they fail to capture the emotional, functional, and social complexity of the symptom, which may yield only a superficial understanding of the individual's experience.[12] Multidimensional instruments, by contrast, assess pain more comprehensively, encompassing its location and sensory quality and its impact on mood, sleep, physical activity, occupational performance, and interpersonal relationships.[12]

Surveillance of musculoskeletal complaints in military populations—especially armed-forces aircrew—is a complex undertaking, hampered by a shortage of reliable surveillance tools and by the absence of agreed definitions for recording such events.[13] Accurate data capture has proved challenging because of the heterogeneity of surveillance methods, which obstructs a comprehensive and reliable view of the musculoskeletal burden in this specific population.[13] Nationally, reliance on unidimensional instruments is limiting, as they capture only the site and intensity of pain without examining its biopsychosocial repercussions, and the absence of national instruments addressing pilot-specific pain constructs warrants attention. Adequate adaptation of existing instruments is therefore essential to ensure the validity and reproducibility of findings in the national context.

The University of Canberra Fast Jet Aircrew Musculoskeletal Questionnaire (UC-FJAMQ) was developed to address the specific complexities of injury surveillance in Royal Australian Air Force fast-jet aircrew and has demonstrated sensitivity and validity across a three-part structure.[13] The first part asks whether the respondent experienced any musculoskeletal complaint in the previous week—defined as pain, discomfort, stiffness, tingling, or numbness in any body region—and records the symptom location on a body chart. The second part comprises eight questions on the severity and duration of the complaint and its impact on flight performance, tolerance of gravitational forces (+ Gz), use of helmet-mounted devices, in-flight concentration, flight scheduling, and non-flying activities. The third part

comprises seven questions on complaint onset, current status, flying days lost, care-seeking, medication use, and loss of movement.

The choice of the UC-FJAMQ for cross-cultural adaptation is justified by its comprehensiveness relative to the unidimensional pain scales currently in national use. Beyond symptom intensity, it captures location; sudden or gradual onset; duration; first occurrence or recurrence; association with loss of movement; impact on flying performance in both physical and cognitive terms; repercussions for non-flying activities including sleep and rest; changes to the work routine; and care-seeking behaviour. It achieved international expert consensus on a registrable-injury definition and displayed sound psychometric robustness, outperforming conventional injury-surveillance methods.[13] Systematic-review evidence has further characterised the factors associated with neck pain in fighter aircrew.[14]

Cross-cultural adaptation of a validated questionnaire is more efficient than developing a new one, offering savings in time and resources, the capacity to compare studies across cultural and linguistic groups, and greater equity of assessment through consistent methods and comparable scores.[15] Adapting a self-report health questionnaire for a new cultural setting requires a specific method to secure equivalence between the original and translated versions;[16 Beaton] importantly, adaptation is broader than translation, since it also encompasses cultural adequacy.[17]

Despite the severity of the problem, Brazil has no validated, culturally adapted instrument capable of capturing, in a comprehensive and standardised manner, the multidimensional complexity of these symptoms and their impact on flight performance and quality of life. Dependence on limited unidimensional instruments, compounded by underreporting, precludes an accurate estimate of the musculoskeletal burden in this group and hampers appropriate training and injury-prevention planning. The present study therefore addressed the following question: how can the cross-cultural adaptation and validation of the UC-FJAMQ provide a robust and comprehensive surveillance tool for assessing musculoskeletal complaints in FAB pilots? Adapting and validating the instrument is not merely a methodological necessity but an essential step towards precise, standardised surveillance that supports early risk identification, effective prevention, and the optimisation of the health and operational human performance of FAB pilots.

The study aimed to cross-culturally adapt the UC-FJAMQ for use with Brazilian Air Force (FAB) pilots. Specific objectives were to: establish conceptual and item equivalence by exploring the construct and its domains in relation to the source context and the target population through an in-depth literature review; verify the pertinence of each item for capturing its domain through discussion with health professionals and military aircrew; analyse divergences between the synthesis version and the original instrument to preserve fidelity; submit the synthesis version to an expert panel to appraise clarity, accuracy, and relevance; apply the synthesis version to a sample of active-duty FAB pilots in a pre-test using a five-point Likert scale; and finalise the version on the basis of pre-test evidence, ensuring a comprehension threshold of at least 90%.

Methods

Study design

This was a methodological cross-cultural adaptation study of observational, cross-sectional design.

Ethics

The study was approved by the Research Ethics Committee of the Galeão Air Force Hospital (HFAG) (CAAE 77396024.5.0000.5250; opinion no. 6,789,787) and was conducted following authorisation from the developer of the original UC-FJAMQ for use of the instrument. All participants provided written informed consent, and the commanders of the relevant military organisations were informed of the study.

Participants and sampling

The expert panel comprised health professionals with technical expertise in aviation and/or musculoskeletal complaints and injuries, together with professionals holding operational aviation expertise, including military pilots. The panel was assembled by convenience sampling on the basis of experience and availability; five experts were invited—four reserve FAB military pilots with extensive operational experience and one squadron physician with direct experience in aeromedical practice. Health professionals were identified through the research team's institutional network and invited by email, which detailed the study's objectives and the stages of participation.

The target population comprised all active-duty FAB pilots. This contingent included cadets in their first to fourth years and was distributed across air units in several states, spanning air bases and operational units of fighter, transport, rotary-wing, search-and-rescue, and intelligence, surveillance, and reconnaissance aviation. Pilots were invited through emails sent to their units detailing the project and the invitation to participate, with the questionnaire made available for electronic self-completion.

Eligibility

Active-duty FAB pilots from fighter, transport, rotary-wing, search-and-rescue, and intelligence, surveillance, and reconnaissance units were eligible. Experts who initially agreed to participate but did not sustain their engagement in the discussions were excluded. Pilots who completed the questionnaire inadequately or withdrew from any stage were excluded, as were aircrew who had not exercised a piloting role for more than one month, who were medically grounded, or who were assigned exclusively to remotely piloted aircraft operations.

Instruments and procedures

The UC-FJAMQ and the Reichenheim and Moraes [18] guideline were used; the latter underpinned the adaptation process. This guideline was selected because it incorporates, at the outset, an in-depth literature review attentive to the cultural features of both the source instrument and the target population, engages the population early, and involves an expert committee from conceptual appraisal through to semantic equivalence. The adaptation comprised four stages (Table 1).

Table 1
Stages and procedures of the cross-cultural adaptation process.

Stage	Procedures
Stage 1 – Conceptual and item equivalence	Literature review covering publications from the culture of the original questionnaire; discussion with experts and the target population on the need for validation; critical appraisal of items regarding correspondence across the two languages.
Stage 2 – Semantic equivalence	Step 1: translations; Step 2: consensus synthesis version; Step 3: back-translations; Step 4: equivalence between back-translations and the original; Step 5: expert discussion for final adjustments; Step 6: pre-test version to appraise acceptability, comprehension, and emotional impact.
Stage 3 – Operational equivalence	Research-team appraisal of the pertinence and adequacy of the vehicle and format of questions/instructions, the administration setting, and the mode of application and categorisation.
Stage 4 – Measurement equivalence	Psychometric study focusing on dimensional validity and adequacy of component items (content validity).
Source: translated and adapted from Reichenheim and Moraes (2007).	

<Insert Table 1>

In the first stage, conceptual and item equivalence were established by exploring the construct and its domains in relation to the source setting and the target population through a literature review, with the aim of confirming the pertinence of each item within the new context. In the second stage, the English original was translated into Brazilian Portuguese by two independent Brazilian translators fluent in English, producing two forward translations (T1 and T2). The translators then reconciled the versions into a single consensus synthesis (T1–T2), which was back-translated into English by two native English-speaking translators proficient in Portuguese, yielding versions BT1 and BT2. A fifth bilingual translator conducted an independent, blind appraisal of the equivalence between the original and versions BT1 and BT2, culminating in a final Brazilian Portuguese synthesis version; divergences from the original were then examined.

Semantic equivalence and construct appraisal were subsequently undertaken by the expert panel—an essential step for evaluating both literal correspondence and the emotional and affective implications of the translation arising from cultural differences. Finally, a pre-test was conducted with a group of active-duty FAB pilots to appraise the clarity, accuracy, and relevance of each item, recording agreement on a

five-point Likert scale (0 = completely disagree to 4 = completely agree). Successive rounds of appraisal were conducted until a comprehension threshold of at least 90% was reached for all items. During the third stage (operational equivalence), the research team appraised the pertinence and adequacy of the question format, opting for electronic self-administration. In the fourth stage (measurement equivalence), psychometric evidence was analysed to confirm the adequacy of the instrument's operationalisation.

Content-validity analysis and statistics

The Content Validity Index (CVI) was calculated for the final instrument as the mean of the item content validity ratios. [19, 20, 21] In practice, each expert rated every item on the appraised criterion; for each item, the proportion of experts giving a favourable rating yields the item-level index (I-CVI), and the mean of these across items yields the scale-level index (Ave-CVI). The CVI was computed for each item (I-CVI) and for the overall instrument (Ave-CVI); the Ave-CVI was obtained as the mean of the I-CVIs across items, an approach more closely reflecting item quality than expert performance.[19; 20; 22] Following Lynn's criteria, an instrument was deemed to have excellent content validity when Ave-CVI exceeded 0.90 and I-CVIs exceeded 0.78 for a panel of six to ten experts, or when the I-CVI equalled 1 for panels of three or five experts.[21] Descriptive statistics (measures of central tendency, dispersion, and position) were computed in JASP v.0.19.3.0 for Windows.

Results

Semantic equivalence: translation and back-translation

Following authorisation from the developer of the original instrument, adaptation proceeded through a contrastive analysis of the four translated versions to appraise, on the basis of established translation procedures, the similarities and differences between them. The source text was in English and the target text in Brazilian Portuguese: two versions were produced by native Brazilian Portuguese translators (T1 and T2) and two by native English translators (BT1 and BT2). A final version was then compiled to incorporate the best solutions from each, prioritising clarity, accuracy, and adequacy for the target population.

Measurement equivalence: expert-panel appraisal

The expert panel reached consensus on 16 items for both clarity and accuracy and unanimous agreement on all 18 items for relevance. Given this level of agreement, the Ave-CVI and UA-CVI values for all criteria were excellent (Table 2). Clarity yielded an Ave-CVI of 0.98 and a UA-CVI of 0.89; accuracy an Ave-CVI of 0.97 and a UA-CVI of 0.84; and relevance an Ave-CVI of 0.98 and a UA-CVI of 0.89, confirming that the items are comprehensible, appropriate for measuring the intended construct, and essential for the assessment of FAB pilots.

Table 2
Expert-panel content-validity indices for clarity, accuracy, and relevance of the UC-FJAMQ items.

Criterion	Ave-CVI	UA-CVI
Clarity	0.98	0.89
Accuracy	0.97	0.84
Relevance	0.98	0.89

Ave-CVI, scale-level content validity index (average); UA-CVI, universal agreement content validity index. Reference criteria (Lynn): Ave-CVI > 0.90 and I-CVI > 0.78.

<Insert Table 2>

Qualitative expert input prompted substantive refinements. Panellists noted that an instrument originally confined to fighter aviation should accommodate other platforms: rotary-wing pilots use helmets combined with additional head-borne equipment, whereas transport pilots do not wear helmets. A further observation—that the instrument focused on gravitational (+ Gz) load while omitting vibration, which is constant in rotary-wing aircraft and potentially more injurious than acceleration—led to the incorporation of vibration among the flight-dynamics stressors and to the broadening of the instrument's scope across military-aviation types.

Measurement equivalence: target-population appraisal

After adjustments arising from the expert panel, the questionnaire was applied to the target population of active-duty FAB pilots. The sample comprised 31 pilots with a mean flight experience of 1,644 hours, of whom 41.9% were fighter and 58.1% transport aviators; their general characteristics are shown in Table 3.

Table 3
General characteristics of the target population (active-duty military pilots).

Variable	n	%	Mean	95% CI	SD
Age (years)	—	—	34.7	31.2–38.1	9.9
Body mass (kg)	—	—	82.23	79.15–85.3	8.7
Height (cm)	—	—	176.1	173.5–178.7	7.4
BMI (kg·m⁻²)	—	—	26.52	25.6–27.4	2.5
Flight experience (h)	—	—	1,644.3	1,285.3–2,003.3	1,019.8
Aircraft – Fighter	13	41.9	—	—	—
Aircraft – Transport	18	58.1	—	—	—

95% CI, 95% confidence interval; SD, standard deviation; BMI, body mass index

<Insert Table 3>

Descriptive analyses of the clarity and accuracy criteria (Tables 4 and 5) indicated a strong favourable tendency, corroborated by a negatively skewed distribution and a mode of 4 across all items. For clarity, 10 items received exclusively scores of 3 or above and 8 items exceeded 75% of responses in that band, with an Ave-CVI of 0.981. For accuracy, 9 items reached 100% agreement and a further 9 reached agreement of 75% or more, with an Ave-CVI of 0.983.

Table 4
Descriptive statistics for the “clarity” criterion by the target population.

Item	Mean	SD	Min.	P25	Median	P75
1. Definition of “musculoskeletal complaint”	3.81	0.48	2	4	4	4
2. Had an MSK complaint in the past week	3.71	0.59	2	4	4	4
3. Area best describing the complaint site	3.84	0.45	2	4	4	4
4. Intensity of pain/symptoms in the past week	3.71	0.82	2	4	4	4
5. Duration of the complaint in the past week	3.84	0.37	3	4	4	4
6. Flight performance affected in the past week	3.74	0.77	2	4	4	4
7. Impact on tolerance of + Gz force	3.87	0.34	3	4	4	4
8. In-flight concentration affected	3.90	0.30	3	4	4	4
9. Planned flight schedule affected	3.74	0.68	1	4	4	4
10. Impact on non-flying activities	3.87	0.34	3	4	4	4
11. No. of days of missed flying duties	3.87	0.34	3	4	4	4
12. Consultation with a health professional	3.87	0.34	3	4	4	4
13. Perceived loss of movement	3.90	0.30	3	4	4	4
14. Medication used for the complaint	3.90	0.30	3	4	4	4
15. Which medication was administered	3.87	0.34	3	4	4	4
16. Sudden vs gradual onset	3.90	0.30	3	4	4	4
17. First occurrence vs recurrence	3.81	0.48	2	4	4	4
18. Any other MSK complaint in past 7 days	3.68	0.83	2	4	4	4

SD, standard deviation; P25/P75, 25th/75th percentiles. Maximum = 4 for all items.

Table 5
Descriptive statistics for the “accuracy” criterion by the target population.

Item	Mean	SD	Min.	P25	Median	P75
1. Definition of “musculoskeletal complaint”	3.68	0.60	2	3.5	4	4
2. Had an MSK complaint in the past week	3.74	0.58	2	4	4	4
3. Area best describing the complaint site	3.84	0.45	2	4	4	4
4. Intensity of pain/symptoms in the past week	3.61	0.95	2	4	4	4
5. Duration of the complaint in the past week	3.81	0.48	2	4	4	4
6. Flight performance affected in the past week	3.71	0.82	2	4	4	4
7. Impact on tolerance of + Gz force	3.87	0.34	3	4	4	4
8. In-flight concentration affected	3.90	0.30	3	4	4	4
9. Planned flight schedule affected	3.74	0.68	1	4	4	4
10. Impact on non-flying activities	3.87	0.34	3	4	4	4
11. No. of days of missed flying duties	3.87	0.34	3	4	4	4
12. Consultation with a health professional	3.87	0.34	3	4	4	4
13. Perceived loss of movement	3.90	0.30	3	4	4	4
14. Medication used for the complaint	3.90	0.30	3	4	4	4
15. Which medication was administered	3.87	0.34	3	4	4	4
16. Sudden vs gradual onset	3.90	0.30	3	4	4	4
17. First occurrence vs recurrence	3.81	0.48	2	4	4	4
18. Any other MSK complaint in past 7 days	3.68	0.83	2	4	4	4

SD, standard deviation; P25/P75, 25th/75th percentiles. Maximum = 4 for all items.

<Insert Table 4>

<Insert Table 5>

The instrument therefore demonstrated excellent content validity and fully met Lynn’s criteria, with adequate clarity and accuracy as judged by the target population. The adapted UC-FJAMQ is thus suitable for measuring the intended constructs within the FAB operational context.

Discussion

The study was undertaken in collaboration with the developer of the original instrument for cross-cultural adaptation of the UC-FJAMQ, ensuring its faithful application to the reality of FAB pilots. Direct contact with the researcher responsible for the original questionnaire underscores the value of scientific exchange for strengthening research nationally. This process enabled not only linguistic adequacy but also the adjustments required to capture the particularities of the target population, safeguarding the validity and reproducibility of the findings.

Beyond this collaboration, the developer endorsed broadening the instrument's scope to include military-aviation types other than the fighter aviation for which it was originally designed. This enabled the study to encompass patrol, transport, and rotary-wing pilots, ensuring a more comprehensive fit to FAB operations. International collaboration thus not only made the adaptation feasible but also reinforced its applicability, rendering the instrument more representative of the demands faced by Brazilian military pilots.

The UC-FJAMQ was originally developed to monitor musculoskeletal injuries in Royal Australian Air Force fast-jet aircrew, demonstrating sensitivity in data capture and efficacy in appraising aircrew physical condition. Transposition to the Brazilian context nonetheless required careful adaptation to account for operational, cultural, and environmental differences—adaptation that is essential to ensure validity in the new research setting and to enable precise analyses that support the occupational health of FAB pilots.

Adaptation followed the staged approach of Reichenheim and Moraes [16], ensuring a systematic and rigorous process. Semantic equivalence—one of its central pillars—was achieved through translation by a multidisciplinary team of four bilingual translators, two native Portuguese speakers and two native English speakers, with differing degrees of familiarity with the instrument's technical jargon. Contrastive analysis of the four resulting versions revealed not only linguistic variation but also stylistic choices and cultural interference; from this fine-grained analysis, a final version was compiled that prioritised clarity, accuracy, and adequacy for the target population and was subsequently submitted to the expert panel for content-validity appraisal.

The experts' judgement-quantification process yielded fundamental refinements, ensuring adequate measurement of the target construct. The scope broadening, discussed with and approved by the original developer, highlighted operational differences across military-aviation types. The observation regarding the absence of vibration analysis in rotary-wing aircraft was particularly relevant, given its potential to affect pilots' musculoskeletal health; although the instrument initially centred on + Gz load, incorporating other platform-specific risk factors broadened the analysis. A further structural refinement allowed multiple responses in the item selecting the complaint site, which is expected to reduce the risk of non-completion.

Content validity was excellent across clarity, accuracy, and relevance, and application to 31 active-duty pilots confirmed strong acceptance. The sample's technical profile—a mean of 1,644 flight hours, with a substantial representation of both transport (58.1%) and fighter (41.9%) aviation—reinforces the instrument's fit to the FAB operational context.

Some limitations warrant consideration. The favourable response distribution may reflect contextual biases—such as military hierarchy and organisational culture—that could favour more conservative answers owing to concern about consequences related to grounding. This validation addressed content validity; further psychometric properties, including construct and criterion validity and test–retest reliability, remain to be established. Future stages should therefore include larger, more heterogeneous samples that represent different operational categories and ranks, and should incorporate complementary qualitative methods such as interviews or focus groups to deepen understanding of the items. The critical input of both the expert panel and the target population reinforces that instrument development is a dynamic, iterative process requiring continual refinement to sustain maximum effectiveness.

Conclusions

The study set out to cross-culturally adapt the UC-FJAMQ for use with FAB pilots, and this objective was fully achieved. The final version meets the established criteria, ensuring applicability within the operational context of military pilots and reliability in the assessment of musculoskeletal complaints. As instrument development is a continuous, iterative process, successive refinements will further enhance its effectiveness. The adapted UC-FJAMQ thus constitutes a valid and reliable tool, providing a sound resource for future research and interventions in the occupational health of military aviation.

Abbreviations

AGSM
anti-G straining manoeuvre
Ave-CVI
scale-level content validity index (average)
BMI
body mass index
CI
confidence interval
CVI
content validity index
FAB
Brazilian Air Force (Força Aérea Brasileira)
HRQOL
health-related quality of life
I-CVI
item-level content validity index
JHMCS
Joint Helmet-Mounted Cueing System
MSK

musculoskeletal
NVG
night-vision goggles
SD
standard deviation
UA-CVI
universal agreement content validity index
UC-FJAMQ
University of Canberra Fast Jet Aircrew Musculoskeletal Questionnaire
+Gz
positive gravitational acceleration.

Declarations

Competing interests:

The authors declare no competing interests.

Ethics approval:

Research Ethics Committee of the Galeão Air Force Hospital (CAAE 77396024.5.0000.5250; opinion no. 6,789,787). All participants provided written informed consent.

Ethics approval and consent to participate

The study was approved by the Research Ethics Committee of the Galeão Air Force Hospital (HFAG), Brazilian Air Force (CAAE 77396024.5.0000.5250; approval no. 6,789,787). All procedures were performed in accordance with the Declaration of Helsinki. All participants provided written informed consent to participate.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors' contributions

TA and VOD conceived and designed the study. TA conducted the cross-cultural adaptation, data collection, and analysis under the supervision of VOD. JRANJ contributed to the statistical analysis and interpretation of the data. GEvK and HGR contributed to the study design and to the interpretation of the results. PGO and JBW contributed to the methodological design and to the interpretation of the results, and provided critical revision of the manuscript, including refinement of its scope. VOD supervised the project and drafted the manuscript. All authors read and approved the final manuscript.

Authors' information

Not applicable.

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Author Contribution

TA and VOD conceived and designed the study. TA conducted the cross-cultural adaptation, data collection, and analysis under the supervision of VOD. JRANJ contributed to the statistical analysis and interpretation of the data. GEvK and HGR contributed to the study design and to the interpretation of the results. PGO and JBW contributed to the methodological design and to the interpretation of the results, and provided critical revision of the manuscript, including refinement of its scope. VOD supervised the project and drafted the manuscript. All authors read and approved the final manuscript.

Acknowledgements

The authors thank the expert panel and the military pilots who participated voluntarily in this study.

Data Availability

The datasets generated and/or analysed during the current study are not publicly available owing to institutional and privacy restrictions applying to serving military personnel, but are available from the corresponding author on reasonable request. The final adapted instrument is provided as supplementary material.

References

1. Gomes SRA, et al. Factors associated with low back pain in air force fighter pilots: a cross-sectional study. BMJ Mil Health. 2022;168(4):299–302.
2. Yang Y, et al. Prevalence and potential risk factors for occupational low back pain among male military pilots: a study based on questionnaire and physical function assessment. Front Public Health. 2021;9:744601.
3. Russomano T, Castro JC. Fisiologia Aeroespacial: Conhecimentos Essenciais Para Voar Com Segurança. Porto Alegre: EDIPUCRS; 2012.
4. Mendes PRF, et al. Core stabilisation exercises reduce chronic low back pain in Air Force fighter pilots: a randomised controlled trial. BMJ Mil Health. 2022;170(1):31–6.
5. Mastalerz A, et al. Pain in the cervical and lumbar spine as a result of high G-force values in military pilots—a systematic review and meta-analysis. Int J Environ Res Public Health. 2022;19(20):13413.
6. Rhon DI, et al. Much work remains to reach consensus on musculoskeletal injury risk in military service members: a systematic review with meta-analysis. Eur J Sport Sci. 2022;22(1):16–34.
7. Brandt Y, et al. A randomised controlled trial of core strengthening exercises in helicopter crewmembers with low back pain. Aerosp Med Hum Perform. 2015;86(10):889–94.
8. Shiri R, Frilander H, Sainio M, Karvala K, Sovelius R, Vehmas T, et al. Cervical and lumbar pain and radiological degeneration among fighter pilots: a systematic review and meta-analysis. Occup Environ Med. 2015;72(2):145–50.
9. Keskimölö T, Pernu J, Karppinen J, Niinimäki J, Oura P, Leino T, et al. Degenerative cervical spine changes among early career fighter pilots: a 5-year follow-up. BMJ Mil Health. 2023;169(4):291–6.
10. Ang B, Linder J, Harms-Ringdahl K. Neck strength and myoelectric fatigue in fighter and helicopter pilots with a history of neck pain. Aviat Space Environ Med. 2005;76(4):375–80.
11. Nindl BC, et al. Human performance optimisation metrics: consensus findings, gaps, and recommendations for future research. J Strength Cond Res. 2015;29(Suppl 11):S221–45.
12. Ciena AP, et al. Influência da intensidade da dor sobre as respostas nas escalas unidimensionais de mensuração da dor em uma população de idosos e de adultos jovens. Semina Cienc Biol Saude. 2008;29(2):201–12.
13. Wallace J, et al. A validated injury surveillance and monitoring tool for fast jet aircrew: translating sports medicine paradigms to a military population. Sports Med Open. 2022;8(1):92.
14. Wallace JB, Newman PM, McGarvey A, Osmotherly PG, Spratford W, Gabbett TJ. Factors associated with neck pain in fighter aircrew: a systematic review and meta-analysis. Occup Environ Med. 2021;78(12):900–12.
15. Batistuta Manzi-Oliveira A, et al. Adaptação transcultural de instrumentos de avaliação psicológica: levantamento dos estudos realizados no Brasil de 2000 a 2010. Psico-USF. 2011;16(3):367–81.
16. Beaton DE, et al. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine (Phila Pa 1976). 2000;25(24):3186–91.

17. Semage SN et al. Cross-cultural and factorial validity of the PTSD Checklist–Military version (PCL-M) in Sinhalese language. Eur J Psychotraumatol. 2013;4.
18. Reichenheim ME, Moraes CL. Operationalizing the cross-cultural adaptation of epidemiological measurement instruments. Rev Saude Publica. 2007;41(4):665–73.
19. Almanasreh E, Moles R, Chen TF. Evaluation of methods used for estimating content validity. Res Social Adm Pharm. 2019;15(2):214–21.
20. Polit DF, Beck CT. The content validity index: are you sure you know what's being reported? Critique and recommendations. Res Nurs Health. 2006;29(5):489–97.
21. Polit DF, Beck CT, Owen SV. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Res Nurs Health. 2007;30(4):459–67.
22. Souza AC, Alexandre NMC, Guirardello EB. Propriedades psicométricas na avaliação de instrumentos: avaliação da confiabilidade e da validade. Epidemiol Serv Saude. 2017;26:649–59.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Tables.docx
- Suplementarymaterial.docx