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Italian version of the cornell musculoskeletal discomfort questionnaire (CMDQ-I): Translation, cultural adaptation and validation

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Abstract.
BACKGROUND: Almost 25% of workers in the European Union suffer from back pain, and 23% complain of muscle pain. Sixty-two percent of workers carry out repetitive operations with their hands or arms, 46% work in painful or tired positions and 35% carry or handle loads.
OBJECTIVE: This study aimed to translate, culturally adapt and validate the Italian version of the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ-I).
METHODS: Translation and cultural adaptation procedures followed international guidelines. Participants were recruited from among the personnel components of the Italian Air Force, who were between 18 and 65 years old. Cronbach's alpha and the intraclass correlation coefficient (ICC) were calculated to assess internal consistency and stability, respectively. The CDMQ-I was administered together with the Visual Analogic Scale (VAS), and the validity was evaluated using Pearson's correlation coefficient.
RESULTS: All CDMQ-I items were either identical or similar in meaning to the original version's items. The scale was administered twice with a retest after seven to 10 days to 66 participants. Cronbach's alpha was higher than 0.761, and the ICC ranged between 0.737 and 0.952. Pearson's correlation coefficient showed positive and significant correlations ($p > 0.01$).
CONCLUSIONS: The study produced an Italian version of the CMDQ with good reliability and validity. This scale is a useful tool to investigate the frequency and intensity of musculoskeletal disorders in various categories of workers.

Keywords: Assessment, prevention, scale, validity, work interference, arthropatries, muscle diseases, bones

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1. Introduction

Musculoskeletal discomforts include all disorders of muscles, tendons, ligaments, tendon sheets, peripheral nerve and junctures as the result of repeated trauma over time or functional overload. They usually affect body districts, such as the back, neck and upper limbs, but they can also affect lower limbs. They normally do not have a single cause but are often caused by a combination of different factors [1].

Musculoskeletal disorders are one of the most frequent work-related disorders, and some studies have shown that they are the most frequent cause of loss of time in work and increased costs [2]. Moreover, they are the most common health problems in the working environment, representing 48% of the total illnesses caused by work according to a survey conducted by the World Health Organization (WHO) [3]. Physical causes and risk factors related to work include loads mobilization, assumptions of incorrect posture, repetitive movements and efforts, intense rhythms of work and prolonged maintenance of standing or sitting positions [4]. Almost 25% of workers in the European Union suffer from back pain, and 23% complain of muscle pain. Sixty-two percent of workers carry out repetitive operations with their hands or arms, 46% work in painful or tired positions and 35% carry or handle loads [5].

The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was developed in 1999 by Alan Hedge and ergonomic graduate students in the Human Factors and Ergonomics Laboratory at Cornell University [6, 7]. It is a data collection tool based on previous studies of musculoskeletal discomfort developed to assess musculoskeletal discomfort among English-speaking workers.

The CMDQ was validated into Turkish in 2011 [8], into German in 2016 [9] and into Malay in 2016 [10]. To validate the CMDQ into Italian, the researchers of the current study chose to administer the scale to a group of Italian Air Force personnel. This population was chosen so as to have a homogeneous group of subjects, as members of the air force the wear a uniform and, therefore, clothing and footwear considerations are the same for all. They also live in the same context: same working environment, employment and routine. Both office staff (sedentary) and troop staff (standing) are subject to the prolonged maintenance of uncomfortable positions that could predispose then to the onset of musculoskeletal disorders.

This study aimed to translate and culturally adapt the CMDQ into Italian. It also sought to verify the validity and reliability of the Italian version (CDMQ-I) among a group of Italian Air Force personnel.

2. Methods

Once the consent of the developers of the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was received, the original tool was translated from English to Italian, following the "Translation and Cultural Adaptation of Patient-Reported Outcomes Measures – Principles of Good Practice" guidelines [11].

The CDMQ investigates the frequency, intensity and interference of discomfort in various body parts with the ability to work. More specifically, there are two versions of the questionnaire: one for sedentary workers and one for standing workers. Both versions feature either a male figure or a female figure, for men and women respectively. The two versions differ only in the number of body districts examined: in the version for sedentary workers, participants are asked to answer questions about 18 body parts, while in the version for standing workers, questions address about 20 body parts (i.e., feet are included).

2.1. Translation and cultural adaptation

The original English version of the CMDQ was translated into Italian by two independent Italian physiotherapists familiar with English. The results were then synthesized, and no necessary changes or issues were identified. Afterwards, two English translators translated the questionnaire back to English. The original version and the back-translated version of the tool were then compared. Finally, the translated version was checked by two physiotherapists familiar with English to make cultural adaptations and correct any remaining spelling, diacritical, grammatical, or other errors.

2.2. Participants and procedures

According to previous validations of the CMDQ [8–10], age of participants had to be 18 to 65, and no pathological amounts were to be presented to musculoskeletal and nervous system (for example arthritis, neurodegenerative diseases, autoimmune diseases). Participation was voluntary, and participants gave written consent before being included. The CMDQ is

a questionnaire structured as a table in which 20 body districts are indicated. The subject is asked to indicate whether in the last week he/she has experienced discomforts to these districts, of what intensity and how much they have interfered with the ability to work. The CMDQ-I was administered twice within 7–10 days by the same physiotherapist. Together with the questionnaire was also administered the Visual Analogic Scale (VAS). The VAS [12] is a visual scale of the intensity of pain that has as extremes on one side the absence of pain and on the other the maximum pain imaginable. To validate both versions of the CMDQ, the questionnaire was administered to two different groups: a group of sedentary workers (sedentary version) and one of standing workers (dynamic version).

For the score's calculation, a value is assigned to each response. With regard to the frequency of disturbances, ranges from a minimum of 0 ("never") to a maximum of 10 ("several times a day"), passing through an intermediate scores of 1.5 ("1-2 times/week"), 3.5 ("3-4 times/week") and 5 ("every day"). The discomfort score is a severity of discomfort, then we can have the following scores: 1 ("mild intensity"), 2 ("moderate intensity") or 3 ("high intensity"). The interference score takes values of 1 ("not at all"), 2 ("not much") or 3 ("highly").

Scores can be analyzed in 4 ways: by simply counting the number of symptoms per person; by summing the rating values for each person; by weighting the rating scores to more easily identify the most serious problems; by multiplying the above frequency score (0,1.5, 3.5, 5, 10) by the discomfort score (1, 2, 3) by the interference score (1,2,3). The last one allows better to detect which people have the most problems, and is the one we choose for out study.

Missing values can be considered 0 for the computational analysis, but if the missing value is in the discomfort or frequency score it must be considered as missing and assign the score relative to the frequency as total.

2.3. Reliability and validity

Following the "Consensus-Based Standards for the Selection of Health Status Measurement Instrument" (COSMIN) checklist [13], the reliability and validity of the culturally adapted scale were assessed. The CMDQ-I was administered to the participants by a physiotherapist. Test–retest reliability and internal consistency were evaluated. Cronbach's alpha, which should be at least 0.7 as an indicator of the satisfactory homogeneity of the items within the total scale, was calculated to verify the internal consistency. The CMDQ-I was administered twice within seven to 10 days by the same physiotherapist to evaluate the test–retest reliability by calculating the interclass correlation coefficient (ICC), which should be less than 0.7.

To assess the validity of the CMDQ-I, participants also filled out the VAS together with the questionnaire. Pearson's correlation coefficients were calculated to establish the correlation between the VAS score and the CMDQ-I severity scores. The significance level was set for p-values less than or equal to 0.05. All statistical analyses were performed using IBM-SPSS version 23.00.

3. Results

3.1. Translation and cultural adaptation

Translation and cultural adaptation were made following guidelines and all the items corresponded consistently to the original version. Italian versions for women standing and sedentary and for men standing and sedentary are reported in Appendix 1–4, respectively, women and men's versions differs only for tools layout.

3.2. Participants

Participants were recruited from among the members of the Air Force. Thirty-nine participants were selected for the sedentary version of the questionnaire: 23 males (59%) and 16 females (41%). Their age ranged from 18 to 65 years with a mean age of 39.51 (± 13.49) years. For the dynamic version, 40 participants were recruited: 30 males (75%) and 10 females (25%) with a mean age of 23.64 (± 3.1) years. All of them met the inclusion criteria and agreed to participate in the study. All were included. The Italian version of the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ-I) was administered from April 2019 to July 2019. Table 1 shows the demographic characteristics of the participants.

Table 1
Demographic characteristics for the participants divided into dynamic and sedentary workers

	Dynamic ($n = 40$)	Sedentary ($n = 39$)
Females number (%)	10 (± 25)	16 (± 41)
Age mean (standard deviation)	23.64 (± 3.1)	39.51 (± 13.49)

Table 2
Internal consistency: Cronbach's alpha values of the Cornell Musculoskeletal Discomfort Questionnaire

	Dynamic (40)			Sedentary (39)		
	Frequency	Severity	Interference in work	Frequency	Severity	Interference in work
NECK	0.825	0.816	0.813	0.736	0.745	0.795
SHOULDER (right)	0.819	0.808	0.796	0.753	0.761	0.809
SHOULDER (left)	0.817	0.812	0.799	0.725	0.738	0.794
DORSAL	0.816	0.794	0.775	0.748	0.748	0.795
ARM (right)	0.828	0.814	0.803	0.767	0.754	0.808
ARM (left)	0.827	0.813	0.802	0.754	0.744	0.793
LUMBAR	0.825	0.807	0.798	0.743	0.736	0.797
FOREARM (right)	0.828	0.814	0.804	0.765	0.756	0.806
FOREARM (left)	0.828	0.814	0.804	0.761	0.750	0.800
WRIST (right)	0.845	0.825	0.818	0.758	0.750	0.790
WRIST (left)	0.842	0.821	0.808	0.764	0.759	0.802
GLUTEUS/HIPS	0.817	0.804	0.786	0.751	0.752	0.795
THIGH (right)	0.842	0.814	0.795	0.769	0.758	0.811
THIGH (left)	0.840	0.811	0.791	0.768	0.762	0.809
KNEE (right)	0.841	0.811	0.803	0.764	0.747	0.799
KNEE (left)	0.839	0.811	0.804	0.761	0.742	0.792
LEG (right)	0.834	0.797	0.791	0.758	0.750	0.794
LEG (left)	0.834	0.799	0.784	0.760	0.755	0.800
FOOT (right)	0.844	0.798	0.773	-	-	-
FOOT (left)	0.832	0.790	0.792	-	-	-
TOTAL ALPHA	0.839	0.817	0.806	0.767	0.761	0.809

As shown in Table 2, the Cronbach's alpha value is >0.7 for all subscales, demonstrating that the CMDQ-I has a very good internal consistency, that is, a very good interrelationship between the items. Moreover, the table reveals that all the items are relevant because if any items were deleted, the alpha's value would decrease, consequently decreasing the internal consistency.

Table 3
Stability

	Dynamic				Sedentary			
	Mean (standard deviation) T0	Mean (standard deviation) T1	Intraclass Correlation Coefficient	Confidence interval 95% [lower limit-upper limit]	Mean (standard deviation) T0	Mean (standard deviation) T1	Intraclass correlation coefficient	Confidence interval 95% [lower limit-upper limit]
Frequency	12.59 (± 16.89)	10.61 (± 10.39)	0.737	0.42–0.88	17.78 (± 17.21)	14.11 (± 10.39)	0.854	0.72–0.92
Severity	7.11 (± 6.91)	6.04 (± 5.77)	0.900	0.781–0.94	7.39 (± 5.84)	6.95 (± 5.33)	0.952	0.91–0.97
Interference in work	7.88 (± 7.58)	7.55 (± 6.84)	0.902	0.78–0.956	7.32 (± 6.22)	6.68 (± 5.45)	0.928	0.86–0.96

As shown in Table 3, the value of the interclass correlation coefficient appears to be >0.7, demonstrating a good stability of the instrument. The analysis demonstrated that, after repeated administration to the same participant seven to 10 days apart, the instrument remains stable.

3.3. Reliability

A good internal consistency resulted in Cronbach's alphas of 0.767, 0.761 and 0.809 for the frequency, severity and work interference scale of the sedentary version, respectively. Cronbach's alphas of 0.839, 0.817, 0.806 were identified for the dynamic version. The Cronbach's alpha if an item is deleted is reported in Table 2.

Test–retest reliability, reported in Table 3, was good with interclass correlation coefficients (ICCs) of 0.854, 0.952 and 0.928 for the frequency, severity and work interference of the sedentary scale, respectively. In comparison, ICCs of 0.737, 0.900 and 0.902 were identified for the dynamic version.

3.4. Validity

Participants filled out a Visual Analogic Scale (VAS) to assess the validity of the questionnaire. The correlation between the VAS scores and CMDQ-I, reported in Table 4, was evaluated by calculating Pearson's correlation coefficients that were significant ($p < 0.01$) both for the frequency and the severity

Table 4
Validity: Pearson's correlation coefficient between the Cornell Musculoskeletal Discomfort Questionnaire and the visual analogical scale

	Dynamic	Sedentary
	VAS	
Frequency	0.582**	0.421**
Severity	0.639**	0.533**

**Significant correlation $p < 0.01$ (two tailed). As shown in Table 4, the CMDQ-I is correlated with the VAS scale, showing all significant correlations.

of the sedentary version (0.421 and 0.533, respectively) and the dynamic version (0.582 and 0.639, respectively).

4. Discussion

This study aimed to produce an Italian version of the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ-I) with good validity and reliability. The CMDQ is a good data collection tool to investigate musculoskeletal discomfort in all body districts briefly. The translation and cultural adaptation produced a clear and coherent Italian version of the questionnaire: the CMDQ-I.

As in previous reviewed validations in other languages, the internal consistency was assessed by calculating Cronbach's alpha. The results are comparable with the published data of other validations in foreign languages. The values are generally higher than the German validation, but lower than the Turkish one, in which Cronbach's alpha values ranged from 0.88 to 0.89. In the CMDQ-I, Cronbach's alpha values are higher in the dynamic version of the questionnaire, while the values of the ICC between the VAS values and the CMDQ-I values are more significant in the sedentary version.

Studies results are representative of the population included in the study. Sedentary workers were older (mean age 39.51 ± 13.49) than the standing workers (mean age 23.64 ± 3.1). This means they were at higher risk for musculoskeletal disorders related to structural degeneration. In comparison, standing workers were more prone to develop functional overload because of their duties.

To evaluate the current validity of the CMDQ-I, all participants filled out a VAS of 100 mm along with the questionnaire. The agreement between the responses given on the VAS and the CMDQ-I was measured using Pearson's correlation coefficient, showing all significant correlations. This study found that the application of the CMDQ-I may be helpful in several areas.

First, in the specific population considered, the questionnaire can be a useful tool for the detection and prevention of musculoskeletal disorders that could become a cause of physical unfitness to work overtime. Second, musculoskeletal disorders are often caused by functional overload and repeated movement due to work tasks; avoiding the onset of such disorders can reduce legal disputes between employees and institutions, thus reducing costs. From this perspective, the application of this evaluation tool within companies can help shape company prevention policies, such as introducing ergonomic office furniture like chairs, desks and screens.

Moreover, the CMDQ-I may be used along with the CMDQ, the T-CMDQ [8], the D-CMDQ [9] and the CMDQ-M [10] to compare musculoskeletal symptoms in the same categories of workers in different countries and analyse which cultural aspects may affect the onset of musculoskeletal work-related disorders.

5. Conclusions

This study was conducted by a research group composed of medical doctors and rehabilitation professionals from the Sapienza University of Rome and the Rehabilitation and Outcome Measure Assessment (ROMA) Association. In the last few years, the ROMA Association has dealt with the validation of many outcome measures in Italy [14–25].

This study consisted of the translation and cultural adaptation of the Cornell Musculoskeletal Discomfort Questionnaire. The research produced an Italian version of the CMDQ with good psychometric properties. The questionnaire is intuitive and easy to understand and to administer. The study showed that it is an excellent tool for the assessment of musculoskeletal disorders of different intensity and in different body parts. Moreover, all categories of workers can be submitted to a general screening of musculoskeletal disorders through the questionnaire.

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Conflict of interest

The authors declare the absence of any conflict of interest with the information contained in this study.

Ethical approval

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Declaration of Helsinki of 1975, as revised in 2008.

Informed consent

All participants included in the study provided written consent.

Supplementary data

The Appendices are available from https://dx.doi.org/10.3233/WOR-213462.

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