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The Reliability of the Discomfort Survey Component Within the Discomfort Survey and Postural Assessment (DiSPA) Tool Applied on Road Construction Workers

Uchenna Okoro, Kenneth Lawani, and Billy Hare

Glasgow Caledonian University, Glasgow, G4 0BA, United Kingdom

ABSTRACT

There is a high prevalence of musculoskeletal disorders (MSDs) among road construction workers with attendant consequences. Although several tools have been developed in the past to assess MSD risk factors for MSD prevention, the Discomfort Survey and Postural Assessment Tool (DiSPA) has been designed to accommodate more MSD risk factors, combine a discomfort survey with postural assessment and assess the entire body. The reliability of the Postural Assessment component of DiSPA has been tested previously in a pilot test. This paper aims to present and discuss the pilot study results of the reliability test for the Discomfort Survey component of DiSPA. Features of the Discomfort Survey include a body map with a body segment graph, risk matrix and a rating table. A test-retest test is conducted to check the reliability of the Discomfort Survey section of the DiSPA tool. 10 construction workers from different trades are assessed using the discomfort survey arm of DiSPA. The results show good reliability of the tool. Insights and findings from the study are presented. The reliability test disagreements and agreements are discussed for further improvement of the tool.

Keywords: Construction industry, Health and well-being, Musculoskeletal disorders, Assessment tools, Whole-body assessment, Reliability test, Discomfort survey

INTRODUCTION

Musculoskeletal Disorders (MSDs) are soft-tissue injuries caused by sudden or sustained exposure to repetitive motion, force, vibration, and awkward positions (NIOSH, 2022). Work-related musculoskeletal disorders (WMSDs) are simply MSDs developed or exacerbated by work (Egwuonwu et al., 2016). The adverse effects of musculoskeletal disorders on workers are pain and discomfort with significant consequences, including absenteeism from work, reduced productivity, job dissatisfaction, poor life quality, threats of legal actions and disability (Lamester et al., 2006; EU-OSHA, 2015). A research by Egwuonwu et al. (2016) is evident of a prevalence of MSDs among road construction workers. The cost associated with MSDs is enormous, as revealed in data provided within the past 10 years. For example, Public Health England in a publication (Ali et al., 2019) stated that annually,

the NHS spends over £5 billion in treating and managing musculoskeletal conditions. Belgium in 2018 recorded direct and indirect costs of MSDs to be £2.5 billion and £1.7 billion respectively (Gorasso et al., 2023) while the USA in 2016 spent over £308 billion in the treatment of MSDs (Dieleman et al., 2020).

MSD assessment tools have been developed over the years for the assessment of MSD risk factors during work. Assessment of risk factors is critical in the efforts towards preventing musculoskeletal disorders. Examples of MSD assessment tools include Ovako Working Posture Analysing System (OWAS), Rapid Entire Body Assessment (REBA), Nordic Musculoskeletal Questionnaire (NMQ), Quick Exposure Check (QEC), Workplace Ergonomic Risk Assessment (WERA) (Karhu et al., 1977; Mcatamney & Hignett, 1995; Kuorinka et al., 1987; David et al., 2008; Rahman et al., 2011). Each of these tools were developed with uniqueness and key strengths but not without limitations (David, 2005). Some tools could assess only a region of the body, while others are limited in the risk factors they assess. Also, these tools may be designed for discomfort survey purposes or for postural assessment.

Recently, the Discomfort Survey and Postural Assessment (DiSPA) tool was developed to address the common limitations found in most existing MSD assessment tools (Okoro et al., 2025). DiSPA comprises of a discomfort survey component (DiS) and a postural assessment component (PA). It includes features such as a body map, risk matrix, self-reporting and observational questionnaire, schematic images, scoring system with action levels to advise interventions. DiSPA assesses a range of MSD risk factors eg. vibration, environmental factors, recovery/rest time, grip, psychosocial factors, work stress, posture, frequency, weight/force and duration (Okoro et al., 2025). It is designed for whole-body assessment including the back, shoulder, wrist/hand, neck, leg/knee and feet/ankle. DiSPA is a pen-and-paper assessment tool. It is cost effective, quick and easy to use with little training.

Earlier, a pilot study was carried out and a reliability test was conducted only for the PA section of the DiSPA tool (Okoro et al., 2025). This paper aims at presenting and discussing the results of the reliability test conducted for the DiS section of DiSPA.

SELF-REPORTING QUESTIONNAIRE/SURVEYS

Body discomfort survey or self-reporting questionnaire is one among the risk assessment methods for musculoskeletal disorders. Other risk assessment methods include observational, direct measurement and remote-sensing methods (Wang et al., 2015). These surveys have been used in epidemiological research and ergonomic studies for data collection, pain assessment or risk assessment (Gambatese and Jin, 2021; Funabashi et al., 2022; Brauer et al., 2003; Hedge et al., 1999).

The Nordic Musculoskeletal Questionnaire (Kuorinka et al., 1987) is an example of a widely used questionnaire that has been applied in various work circumstances (Kakaraparthi et al., 2023). Some other dominant questionnaires include the Cornell Discomfort Musculoskeletal

Questionnaire (Hedge et al., 1999), the Dutch Musculoskeletal Questionnaire (Hildebrandt et al., 2001) and the Worker Discomfort Survey (University of Western Ontario, 2011). Several authors have criticized the self-reporting assessment method based on its subjectivity, imprecision, worker literacy effect and the fact that work has to be interrupted for the worker to self-report (David, 2005; Tang, 2020). However, its strengths which include: simplicity of use, cost effectiveness, applicability to a wide range of work situation, suitability for large survey population, workers participation and ability to report health problems that may not be observable except by direct medical examination (David, 2005; Wang et al., 2015), has continued to promote its wide application.

The discomfort survey component of DiSPA is concise, unique and easy to use. It can be administered by self or by interview. The questionnaire incorporates a varied set of information related to musculoskeletal pain of different body parts (back, shoulder, wrist/hand, neck, leg/knee and feet/ankle) in a single page. The survey begins with a 3 month retrospective assessment of pain. Brauer et al. (2002) agrees that subjects will accurately recall the intensity of musculoskeletal pain for a 3 month period. 3 months allows reasonable time for changes in task, work environment, tools etc. at the same time guarantees that the workers are able to recall any pain due to work with its intensity within the period. Next is a body map with a segment graph. The graph divides the various body parts and collects data on musculoskeletal pain for the left and right body regions and also the upper and lower body parts. Data collected for various body segments include information on pain severity with work interference (how uncomfortable) and information on pain likelihood (how often). The data is analyzed using a risk matrix to ascertain the risk rating (low, medium or high) for each body part and noted in a risk rating table.

Despite the risk rating, a detailed whole-body assessment is encouraged using the postural assessment component of DiSPA. However, when whole-body assessment isn't required, the already established risk rating using the risk matrix in the DiS will guide the selection of body parts for evaluation. The discomfort survey component is designed to align and harmonize with the postural assessment component of the DiSPA tool. The body anatomical regions considered, the categorization of elements (3 categories) and the rating system for both DiSPA components are in agreement.

METHODS

In order to achieve the aim of this study, the DiS component of DiSPA was applied in a pilot study to a group of 10 construction workers of 3 different trades performing activities in a road construction site located in Port-hacourt city, Nigeria. The instrument is outlined in appendix 1. The trades involved were Iron working (4 workers), Masonry (3 workers) and Carpentry (3 workers). The workers were aged between 26 and 55 years. A test-retest test was conducted with 10 days interval to check for the reliability of the tool. Test-retest refers to the characteristics of measurement tools assessed on two separate occasions over time (Berchtold, 2016). It is applied

to examine psychometric properties of new measurement tools. The tool was administered by interview. The interviewers are 2 facilitators with a background in construction health and safety who had undertaken a 1hr training on the application of the Discomfort Survey component of DiSPA.

On the first day, the workers were interviewed in turns during their break. A facilitator spent an average of 10 minutes on each worker. The facilitator asked questions based on the outline in the assessment tool, beginning with an inquiry on musculoskeletal pain. The workers were asked if they had experienced musculoskeletal pain in any of the presented body parts within the last 3 months. The responses of pain with severity (interference with work) and likelihood on each body part were recorded for the worker. When a worker has responded to all questions in the sheet, he leaves, and the next available worker is invited. A repeat of the procedure was undertaken 10 days later for the re-test. Some workers who were present at the first test but absent on the second day for the re-test were excluded from the analysis. Also, workers who were present at both first test and retest but were not consistent in reporting at least 1 same body part where they experienced pain were excluded. Out of the 10 workers, only 5 met the screening criteria. There were 3 Iron workers and 2 Carpenters. 1 worker, a Mason, reported 'no pain experience' on the 2 occasions.

The risk ratings of the body regions were recorded to be either low, medium or high as designed by DiSPA. These ratings were further coded to allow for matching, comparison and use in an Excel sheet. Low rating was coded as 1, Medium coded as 2, and High coded as 3. Where the comparison of the 2 codes representing the ratings on the first test (T1) and second test (T2) matched, the number 1 was noted, and where there was a mismatch, 0 was noted. Where there was no rating for either of T1 or T2 or both, a null position was assigned and so did not count in the totals. The percentage of matched ratings to the total record for each worker was used to establish the reliability of the tool. The data from the pilot study and results of the test-retest reliability are presented in Table 1 and Table 2, respectively.

Table 1: Data from pilot study test (T1) – re-test (T2).

Iron worker 1	**Back**	**Shoulder/Arm**	**Wrist/Hand**	**Neck**	**Leg/Knee**	**Feet/Ankle**
T1 - Risk Rating	Low	Low	-	Low	-	-
T2 - Risk Rating	Low	-	Medium	Medium	Low	-
Iron worker 2	Back	Shoulder/Arm	Wrist/Hand	Neck	Leg/Knee	Feet/Ankle
T1 - Risk Rating	Low	-	-	-	-	-
T2 Risk Rating	Low	-	-	-	-	-
Iron worker 3	Back	Shoulder/Arm	Wrist/Hand	Neck	Leg/Knee	Feet/Ankle
T1 - Risk Rating	-	Low	-	-	-	-
T2 - Risk Rating	Low	Low	-	-	-	-
Carpenter 1	Back	Shoulder/Arm	Wrist/Hand	Neck	Leg/Knee	Feet/Ankle
T1 - Risk Rating	Low	-	-	-	-	-
T2 - Risk Rating	Low	Low	-	-	-	-
Carpenter 2	Back	Shoulder/Arm	Wrist/Hand	Neck	Leg/Knee	Feet/Ankle
T1 - Risk Rating	Low	-	-	-	-	-
T2 - Risk Rating	Low	-	-	-	-	-
Mason	Back	Shoulder/Arm	Wrist/Hand	Neck	Leg/Knee	Feet/Ankle
T1 - Risk Rating	-	-	-	-	-	-
T2 - Risk Rating	-	-	-	-	-	-

Table 2: Test re-test reliability result (T1 & T2).

	Iron Worker 1			Iron Worker 2			Iron Worker 3			Carpenter 1			Carpenter 2		
Body Region	**T1**	**T2**		**T1**	**T2**		**T1**	**T2**		**T1**	**T2**		**T1**	**T2**	
Back	1	1	1	1	1	1	-	1	-	1	1	1	1	1	1
Shoulder/Arm	1	-	-	-	-	-	1	1	1	-	1	-	-	-	-
Wrist/Hand	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Neck	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-
Leg/Knee	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Feet/Ankle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Match			1			1			1			1			1
Total			2			1			1			1			1
Reliability			**50%**			**100%**			**100%**			**100%**			**100%**

FINDINGS

The results of the test show a high Test-retest reliability. Most of the workers were able to reproduce the same results in the 2-day interview test using the Discomfort Survey component of DiSPA. Aside from Iron Worker 1, every other worker who met the screening criteria recorded a 100% reliability. The 50% reliability from Iron worker 1 was a result of his response to the question on pain likelihood, 'how often do you experience pain in the neck'. The workers' response of '1-2 days a week' on the first test and 'pain daily' on the retest resulted in the disagreement. However, his response to the pain experience for the back was consistent. Since the worker identified only 2 body parts for pain experience (back and neck), the result of the matched response (1) against the total body parts identified with pain (2) produced a 50% reliability. The difference in the Iron worker 1's response during the test-retest (low and medium) could be that the pain he experienced had exacerbated within the 10 day interval. A 24-hour–72-hour interval test-retest as applied in the reliability test of the extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E) (Dawson et al., 2009) is suggested for subsequent and related tests.

Iron worker 2, Iron worker 3, Carpenter 1 and Carpenter 2 all recorded a 100% reliability. Though the sample size for the pilot study may have had an impact in the outcome, the result shows a great consistency in the responses given by the workers, implying that the Discomfort Survey section of DiSPA can retrieve reliable information on musculoskeletal pain. The study further revealed that only 1 out of all interviewed workers declared 'no pain'. This revelation corroborates the prevalence of musculoskeletal symptoms among construction workers (Egwuonwu et al., 2016), though most of the pain experience recorded in this study was rated low. The back was the most prominent body part with pain experience, while the feet/ankle had no record of pain experience from the workers. The general pain experience was not age dependant as it cut across most of the workers who were aged between 26 to 55 years.

CONCLUSION

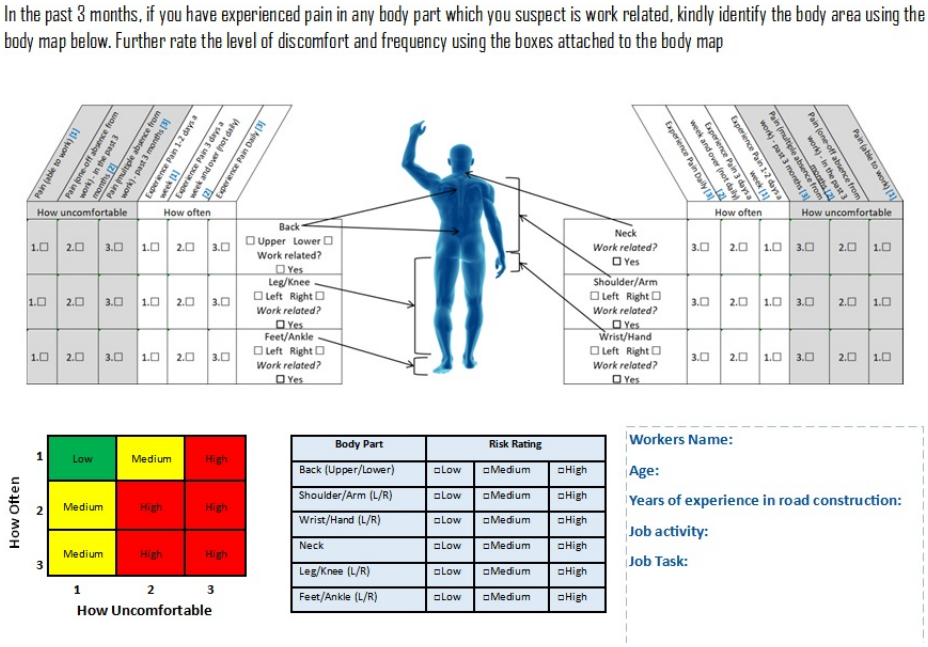
The Discomfort Survey section of the DiSPA tool has been designed to collect data on musculoskeletal pain, which could support epidemiological

studies, highlighting body regions that may be susceptible to musculoskeletal disorders as a result of work. The results of the pilot study show that DiS of DiSPA is able to produce reliable data on musculoskeletal pain. Insights have been obtained based on the disagreement in the reliability test. The entire DiSPA tool is still undergoing refinement at the present and the results of this pilot test will guide the development of the final version. This study forms part of a wider thesis on the assessment of musculoskeletal disorders among road construction workers.

APPENDIX 1

The Discomfort Survey component of the Discomfort Survey and Postural Assessment (DiSPA) Tool.

Please note: This is not the final version of the Discomfort Survey component of DiSPA. The entire DiSPA tool is still undergoing refinements at the time of writing this paper.



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