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Measuring Musculoskeletal Disorders with a Modified Version of the Nordic Musculoskeletal Questionnaire and Improving the Work Environment in an Office in Kuwait

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Abstract

Musculoskeletal disorders (MSDs) are conditions that affect the muscles, bones, joints, tendons, and ligaments, often causing pain, discomfort, or impaired movement, typically due to repetitive strain, overuse, or injury. According to the World Health Organization, there are more than 1.7 billion people who suffer from MSDs. In our study, we focused on measuring MSDs with a modified version of the Nordic Musculoskeletal Questionnaire (NMQ) and improving the work environment in an office in Kuwait. The Nordic Musculoskeletal Questionnaire (NMQ), which was developed by The Nordic Council of Ministers, is commonly used for assessing musculoskeletal troubles in nine body parts over the last 12 months and the last 7 days. The original NMQ also evaluates whether the trouble prevented the person from doing his/her normal work (at home or away from home) over the last 12 months, while the modified version that we proposed in this study collects the same information for both the last 12 months and the last 7 days as well. According to the data we collected from 38 participants in the preliminary stage of our study, our modified version of the NMQ collects more information than the original NMQ without increasing the data collection time statistically significantly as the paired t-test resulted in a p-value which is greater than 0.05. Using the modified version of NMQ in an office in Kuwait, we identified the most troublesome body parts of 50 workers—none of them belong to our preliminary study with 38 participants—as neck, shoulders, upper back, and lower back. Based on our results, we provided ergonomic improvement suggestions including lumbar support, neck support, and stretching exercises. We also conducted an ergonomic awareness seminar for the workers and gave them leaflets and posters for stretching and keeping a healthy posture while at work and any other location. MSDs develop over time and, if uncontrolled, worsen as the person ages. We think that the workers that we have contacted will have improved quality of life and less musculoskeletal trouble in the following years of their careers and personal lives. A follow-up study may be conducted after several years to see the improvement if the same workers can be reached at that time.

Keywords
Nordic musculoskeletal questionnaire, ergonomics, office .

1. Introduction

1.1 Musculoskeletal disorders (MSDs)

Musculoskeletal disorders (MSDs) are health conditions, such as discomfort, pain, stiffness, and reduced mobility, that affect muscles, bones, and joints. MSDs can affect people of all ages and can be caused by various factors, including repetitive movements, overexertion, poor posture, trauma, genetic predisposition, and aging. These factors threaten workers' health, and they affect their working abilities.

According to the World Health Organization (2022), around 21% of the world's population, 1.71 billion people, suffer from musculoskeletal disorders (MSDs) and MSDs are the most prevalent cause of disabilities. Factors such as lack of training to meet basic necessary health conditions, insufficient educational facilities, excessive written activities during improper sitting time, and unsuitable table and chair design may all contribute to an increased risk of developing MSDs. It is important to address these issues to prevent the development of MSDs. MSDs are a significant contributor to workplace absenteeism and impose a substantial financial burden on the public health system. Employers can take measures such as providing ergonomic furniture, offering training on proper posture and movement, and encouraging regular breaks to reduce the risk of developing MSDs. (Openshaw, 2006; Kahrizi, 2019; Sjarif and Ferdinand, 2021).

1.2 Measuring the MSDs with a questionnaire: The Nordic Musculoskeletal Questionnaire (NMQ)

The Nordic Council of Ministers developed the Nordic Musculoskeletal Questionnaire (NMQ) to measure the troubles such as aches, pain, and discomfort, that individuals face (Kuorinka et al., 1987; Dickinson et al., 1992; López-Aragón et al., 2017). The NMQ is a standardized tool for assessing musculoskeletal symptoms in nine body parts: the neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet. The NMQ consists of both a general section and a specific section. In our study, we focus on the general section.

For each body part, the NMQ first asks 1) whether the participant has experienced any musculoskeletal symptoms for the past 12 months. If the participant has experienced trouble in a specific body part, then the second and third questions come: 2) "Have you at any time during the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?", and 3) "Have you had trouble at any time during the last 7 days?" The questions in the original questionnaire are dichotomous as they are answered either with a "Yes" or "No".

2. Methods

2.1 Our modified version of the NMQ

In our study, we modified the questions of the original NMQ to collect the same data and more. As can be seen in Figure 1, we combined the first two dichotomous questions of the original NMQ into a single question with three possible answers:

1. Not at all: No trouble experienced at all. It corresponds to a "No" to the first question of the original NMQ.
2. Moderate: The trouble is noticeable, but it didn't interfere with my normal work (at home or away from home). It corresponds to a "Yes" to the first question of the original NMQ followed by a "No" to the second one.
3. Very Severe: The trouble prevented me from doing my normal work (at home or away from home). It corresponds to a "Yes" to the first question of the original NMQ followed by a "Yes" to the second one.

In the third question of the original NMQ, only the existence of trouble in the last 7 days was asked, but its severity was not measured. In our modified version of the questionnaire, we also measured the severity of the MSDs in the last 7 days with the same scale that we provided above.

In the original NMQ, there are 3 dichotomous questions, whereas, in our modified version, there are 2 questions with each having 3 possible answers. In addition to the information collected with the original questionnaire, the modified version collects information about the severity of the trouble in the last 7 days. One may argue that completing the modified version should take more time than the original version as it collects more data and its questions have more options to choose from. However, the number of questions in our modified version is fewer, which may lead to a shorter time to collect the data. To compare the time required to complete the two versions of the questionnaire, an experiment was conducted with 38 participants.

2.2 Comparing the time taken to complete the two versions of the NMQ

Thirty-eight people were recruited to complete the modified and original versions of the NMQ to draw a comparison between the completion times of the two versions. Each participant completed both surveys one after the other. Half

of them started with the original version and the other half started with the modified version. The time taken to complete each questionnaire was recorded. For comparison purposes, a paired t-test was performed with a significance level of 5%.

Have you at any time during the **last 12 months** had trouble (i.e., ache, pain, discomfort) in the following body parts?	Have you at any time during the **last 7 days** had trouble (i.e., ache, pain, discomfort) in the following body parts?
Neck Not at all ☐ Moderate ☐ Very Severe ☐	**Neck** Not at all ☐ Moderate ☐ Very Severe ☐
Shoulders Right shoulder: Not at all ☐ Moderate ☐ Very Severe ☐ Left shoulder: Not at all ☐ Moderate ☐ Very Severe ☐	**Shoulders** Right shoulder: Not at all ☐ Moderate ☐ Very Severe ☐ Left shoulder: Not at all ☐ Moderate ☐ Very Severe ☐
Elbows Right elbow: Not at all ☐ Moderate ☐ Very Severe ☐ Left elbow: Not at all ☐ Moderate ☐ Very Severe ☐	**Elbows** Right elbow: Not at all ☐ Moderate ☐ Very Severe ☐ Left elbow: Not at all ☐ Moderate ☐ Very Severe ☐
Wrists/hands Right wrist/hand: Not at all ☐ Moderate ☐ Very Severe ☐ Left wrist/hand: Not at all ☐ Moderate ☐ Very Severe ☐	**Wrists/hands** Right wrist/hand: Not at all ☐ Moderate ☐ Very Severe ☐ Left wrist/hand: Not at all ☐ Moderate ☐ Very Severe ☐
Upper back Not at all ☐ Moderate ☐ Very Severe ☐	**Upper back** Not at all ☐ Moderate ☐ Very Severe ☐
Low back (small of the back) Not at all ☐ Moderate ☐ Very Severe ☐	**Low back (small of the back)** Not at all ☐ Moderate ☐ Very Severe ☐
One or both hips/thighs Not at all ☐ Moderate ☐ Very Severe ☐	**One or both hips/thighs** Not at all ☐ Moderate ☐ Very Severe ☐
One or both knees Not at all ☐ Moderate ☐ Very Severe ☐	**One or both knees** Not at all ☐ Moderate ☐ Very Severe ☐
One or both ankles/feet Not at all ☐ Moderate ☐ Very Severe ☐	**One or both ankles/feet** Not at all ☐ Moderate ☐ Very Severe ☐

Figure 1. Modified version of the NMQ. "Not at all" means *"no trouble experienced at all"*. "Moderate" means *"the trouble is noticeable, but it didn't interfere with my normal work (at home or away from home)"*. "Very Severe" means *"the trouble prevented me from doing my normal work (at home or away from home)"*.

2.3 Office workers in Kuwait

We chose an office in Kuwait to evaluate the musculoskeletal troubles of the workers. A total of 50 workers participated in our study, none of whom were a part of our preliminary test. We used a simplified version of the modified version of the NMQ that we explained in the section "2.1 Our modified version of the NMQ" to collect data in this workplace. To simplify the data collection process, we asked one question for each of the following body parts: shoulders, elbows, wrists/arms; as opposed to two questions; i.e. one for the right and one for the left side. We also interviewed the workers to see their awareness of musculoskeletal issues.

Demographic data including the participant's gender, age, job title, and weekly exercise hours were also collected.

2.4 Data analysis methods

The raw data collected with the modified NMQ are ordinal. The categories, Not at all, Moderate, and Very Severe correspond to the MSD scores of 1, 2, and 3 respectively. Each participant gives 9 answers for the last 12 months (and also for the last 7 days) in the simplified modified NMQ. In this paper, we will refer to the average of these 9 values as the "average MSD score" whereas the phrase "mean MSD score" is reserved for the average of the MSD scores of different individuals. It may be safe to perform parametric analysis on the average MSD scores according to the literature (Norman, 2010; Meek et al., 2007; Boone & Boone, 2012; Sullivan & Artino, 2013, Mircioiu & Atkinson, 2017). It is important to note that a person who gives the answer "1. Not at all" to all of the questions will have the lowest possible average MSD score, which is 1.0, whereas a person who reports some trouble in some body parts will receive a bigger average MSD score with a maximum of 3.0. An average MSD score of 3.0 means that the participant gives the answer of "3. Very severe" to all of the questions; therefore it is unlikely to encounter a person with a large average MSD score close to 3.0 continuing to work. We used SAS Studio, Excel, and Minitab for the data analysis.

3. Results and Discussion

3.1 Findings of the preliminary study with 38 participants

As the participants were allowed to correct their answers anytime before the data collection was over, the results of the original NMQ and the modified version were almost perfectly consistent. Out of 912 pairs of answers (38 participants * (9+3) (for 9 body parts, 3 of which have right and left repetition) * 2 periods of time), 909 pairs were consistent, which corresponds to 99.7% consistent answer pairs among all. The mean time to complete the original NMQ was 202.8 seconds, whereas it took 226.7 seconds to complete the modified version. This corresponds to a percent difference of 11.8%. The paired t-test results showed that this difference is not statistically significant ($p>0.05$).

Among the 38 participants of our preliminary data collection phase, the most troubled body parts were the lower back, neck, and upper back with mean MSD scores of 2.00, 1.82, and 1.76 for the last 12 months; and lower back, right wrist, and upper back with mean MSD scores of 1.58, 1.42, and 1.37 for the last 7 days respectively. The mean of the individual average MSD scores for the last 12 months and last 7 days were 1.54 and 1.25 respectively.

3.2 Numerical findings of the study with 50 office workers

As there was no statistically significant difference between the time taken to complete the two versions of the NMQ and our modified version collects more data, we used the simplified modified version to collect data from the office workers. Table 1 shows the mean MSD scores for each body part for the 50 office workers over the last 12 months and last 7 days. The most troublesome body parts are the neck, shoulders, lower back, and upper back with mean MSD scores of 1.86, 1.84, 1.80, 1.74 for the last 12 months and 1.78, 1.70, 1.70, 1.64 for the last 7 days respectively.

A general linear model analysis was performed using the individual average MSD scores, for both the last 12 months and last 7 days, of the 50 office workers as the dependent variables; and gender, age, job title, and weekly exercise hours as the independent variables. Age and weekly exercise hours didn't show any significant effect on the average MSD scores ($p>0.05$) whereas gender and, to some extent job title, did ($p<0.05$).

It is known that MSDs increase over time. However, age didn't show up as a significant factor in our study. The reason for that may be the fact that most of our participants had ages close to one another—90% of these office workers were aged between 25 and 45.

Although the workers had different job titles, the nature of their work was very similar to one another as most of them were sedentary office workers. This may be the reason why the mean MSD scores for workers with different job titles were very close to one another. The job title didn't show up as a significant factor for average MSD scores for the last 7 days ($p>0.05$), although it was barely significant for the average MSD scores for the last 12 months ($p=0.043$).

Gender showed a significant effect on the average MSD scores for the last 12 months ($p=0.008$) and barely significant effect for the last 7 days ($p=0.048$). For both time periods, the females suffer more MSDs compared to males as can be seen in Figures 2a and 2b. As the boxplot doesn't show much difference between mean MSD scores of males and females for the last 7 days, some researchers may deem a p-value of 0.048 as coincidentally less than the significance level that was chosen at the beginning of our study as 5%. However, for the last 12 months, the p-value is 0.008, which requires careful consideration.

A meta-study (Treaster and Burr, 2011) analyzed 56 articles on the effect of gender on MSDs and concluded that MSDs are more prevalent for females compared to males. The results of our study also confirm their findings.
One underlying reason for females tending to have more MSD than males may be that hand tools and workplace layouts are frequently based on anthropometric data of males. In addition, non-occupational factors like leisure activities, household work hours, and roles at home may impact the gender-specific association between occupational exposures and MSDs.

Table 1. Mean MSD scores for each body part for the 50 office workers over the last 12 months and last 7 days

	Mean MSD Scores	
Body Part	**Last 12 Months**	**Last 7 Days**
Neck	1.86	1.78
One or both shoulders	1.84	1.70
One or both elbows	1.52	1.34
One or both wrists/hands	1.46	1.28
Upper back	1.74	1.64
Low back (small of the back)	1.80	1.70
One or both hips/thighs	1.50	1.44
One or both knees	1.44	1.34
One or both ankles/feet	1.48	1.38

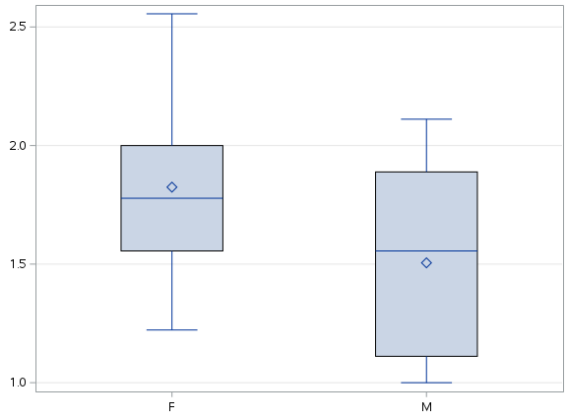

Figure 2a: Individual average MSD scores of females (F) and males (M) for the last 12 months

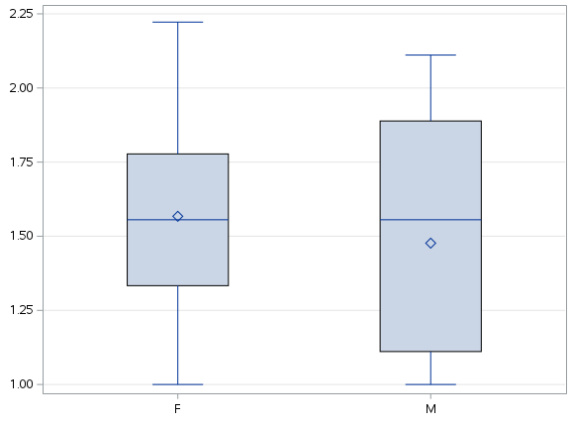

Figure 2b: Individual average MSD scores of females (F) and males (M) for the last 12 months

3.3 Improving the workplace

The existing chairs in the office were padded and supported with armrests, but they didn't have a lumbar support or a headrest. Sitting on such a chair for an extended period in an uncomfortable posture can cause MSDs. In addition, prolonged use of keyboards and computers can hurt the musculoskeletal system. Stretching and doing physical exercises can reduce the risk of work-related MSDs. At the workplace, the workers were allowed rest time. However, they didn't use this time for stretching or exercising.

Amick III et al. (2003) reported that an ergonomics training can reduce pain levels although it is not as effective as ergonomic furniture in reducing the growth of symptoms within a day. We first focused on increasing the ergonomics awareness among the workers and then made recommendations to the management about ergonomic furniture. Based on the recommendations from the literature (ISO, 2021; CDC, 2024; Mahmud, et al., 2011; Taifa & Desai, 2017; Shikdar & Al-Kindi, 2007) we conducted an office ergonomics training for all workers, beginning with an explanation of how Musculoskeletal Disorders (MSDs) are developed and how to avoid them. We emphasized the importance of maintaining a proper sitting posture to prevent back pain and other musculoskeletal issues. Key points included avoiding posterior pelvic tilt by sitting as far back in the chair as possible, yet still ensuring the back of the knees doesn't touch the seat rest, removing armrests if they prevent the chair from moving under the desk, and adjusting the seat height with the help of a cushion so that forearms can rest on the desk with elbows at 90 degrees. We highlighted the importance of keeping knees at a right angle and heels touching the ground when ankles are at 90 degrees, suggesting a footrest if feet don't reach the ground. To avoid shoulder tension and forward head posture, we recommended placing the keyboard and mouse close enough to keep elbows beside the body. We also discussed the importance of keeping wrists straight in line with the forearm and supporting the wrist with something soft at the base of the palm. We also discussed that the screen should be at arm's length distance and the top of the screen at eye level to avoid eye strain and neck issues. We also recommended elevating laptops with a stand or books and installing a phone app to remind about posture checks and breaks for exercises.

We also advised the workers to focus on good nutrition, adequate sleep, hydration, avoiding smoking, and maintaining a healthy weight; as well as keeping the work environment clean and conducive to worker health. These tips may effectively help improve overall health and may have a good effect on their work productivity.

As the old Chinese proverb goes "The faintest ink is better than the strongest memory", we gave each worker a booklet with advice on how to reduce musculoskeletal pain through exercise at work or home. We also made a poster with quick muscle-stretching exercises they could perform during breaks. By following these guidelines, workers can improve their posture and reduce the risk of developing MSDs, leading to a more comfortable and productive work environment.

Other than these general tips that apply to most office workers, we also made recommendations based on the results of the simplified modified NMQ. As mentioned in section 3.2 of this paper, the body parts that were reported to have musculoskeletal trouble most among the 50 workers in this office were the neck, shoulders, lower back, and upper back. The first idea that came to our mind was to recommend replacing the existing chairs in the office with fully ergonomic chairs. However, considering the budget of the office and the environmental impact of discarding 50 chairs, we recommended improving the existing chairs by adding lumbar support, neck support, adjustable elbow rests, and an option to adjust the height of the seat. The office management appreciated our efforts and implemented the lumbar support immediately. However, for the other improvement suggestions, they preferred to bide their time and see the effect of the ergonomic training first. We hope that our positive impact will make the workers in this workplace healthy and set an example for other workplaces to follow.

4. Conclusion

In this study, we proposed a modified version of the Nordic Musculoskeletal Questionnaire (NMQ) and showed that it can help collect more data without increasing the data collection time statistically significantly.

We also improved the work environment in an office in Kuwait by addressing Musculoskeletal Disorders (MSDs) among office workers. Using the modified NMQ, we collected data from 50 office workers and identified the most common areas of pain. Our findings suggest that the design of the workstation (e.g. chairs without lumbar support), and the lack of exercise and stretching during working hours are significant factors contributing to MSDs. We provided ergonomic improvement suggestions, including neck support, lumbar support, and stretching exercises. Additionally,

we conducted an ergonomic awareness seminar for the workers, emphasizing the importance of maintaining a proper sitting posture to prevent back pain and other musculoskeletal issues. By following the ergonomic guidelines we provided, workers can improve their posture and reduce the risk of developing MSDs, leading to a more comfortable and productive work environment.

A follow-up study may be conducted in the future to assess the long-term impact of our ergonomic interventions on the musculoskeletal health and the overall quality of life of the workers.

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