Musculoskeletal pain and work-related risk factors among waste collectors in Hanoi, Vietnam: A cross-sectional study

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Abstract

Background: Musculoskeletal disorders are prevalent among waste collectors in developing countries. This study aimed to investigate the prevalence of musculoskeletal disorders and risk factors of persistent musculoskeletal disorders among waste collectors in Hanoi, Vietnam. Methods: A cross-sectional survey was utilized to study 331 waste collectors in 2017. The Örebro Musculoskeletal Pain Questionnaire and questionnaires on demographic and working conditions were used to collect data. Descriptive and linear regression analyses were applied at the significant level p<0.05.

Results: Results showed that the prevalence of musculoskeletal disorders among waste collectors in Hanoi was high (100%), multiple-site musculoskeletal disorders (at least two sites) were reported by 81%. Lower back was the most affected site, followed by pain in the neck and shoulders. The risk of persistent musculoskeletal disorders were higher amongst female workers, workers with the neck bent at an angle of 45°, kneeling, repetitive medial rotation while walking, and feeling dissatisfaction with work, stress or anxiety during one week before the survey. Conclusions: Hanoian waste collectors were suffered from musculoskeletal disorders as the results of unfavorable work postures and psychological stress at work. The findings imply the need of mechanical and social support at work for waste collectors to prevent the development of musculoskeletal disorders.

Background

Work-related musculoskeletal disorders (MSDs) are described as wide range of degenerative and inflammatory conditions that affect the supporting blood vessels, peripheral nerves, joints, ligaments, tendons, and muscles in workers (1). MSDs result in impairing body function, affecting the workers’ quality of life and reducing their working capability, which in turn will have significant economic ramifications for the workers (1, 2). A number of studies have identified that workers in occupations with manual/ repetitive work are more likely to suffer from persistent MSDs such as construction, manufacturing (3), physiotherapists (2), lobster catching (4), cattle slaughterers (5), carpet weavers (6), dentists (7). and solid waste collectors (WCs) (8–11).

Globally, in many countries, especially developing countries, MSW is collected manually because of limited resources, inadequate working equipment as well as poor labor conditions. WCs frequently
perform vigorously intense physical activities such as carrying, pushing, pulling or lifting heavy objects (8–10). The working environment is mainly outdoors and on the street. Without access to adequate street shelters for temporary rest, WCs are directly affected by changes in climatic conditions such as rain, sun light, pollution and toxic gases and dusts (8, 9, 12, 13). Some studies have shown that the risk of MSDs in WCs is related to occupational factors (physical stress on musculoskeletal system, harmful physical postures, repetitive physical movements, heavy workload, lack of appropriate labor organization and protection from the government, climatic conditions, and psychological stress); individual and physical factors (for example, age, sex, medical history, weight); and some other factors (such as domestic physical activity, access to health services) (1, 3, 10, 14).

Similar to other developing countries, waste is becoming a social problem, especially in big cities in Vietnam (15). Hanoi is the political, economic, cultural and commercial center of Vietnam, with a highly dense population. WCs have to work continuously to clean the huge amount of waste which is generated daily in the city. The heavy workload, coupled with harsh working conditions such as extreme heat in summer and cold in winter time, in association with lack of support tools for manual work, put the WCs at the high risk of MSDs, particularly persistent pain. The present study was conducted to assess the prevalence of persistent MSDs and identify work-related and personal factors of persistent MSDs among WCs in Hanoi, Vietnam.

Methods

Study design and inclusion criteria of participants

A cross sectional study was conducted in the period of January to October 2017. Selection criteria were having a labor contract, being directly involved in waste collection process, and having 18 months of working experience by the time of recruitment. All eligible WCs (488) from a branch of the urban environmental company in Hanoi, Vietnam, were invited and recruited to partake in the study. A total of 331 completed questionnaires were returned and put into the final analysis (response rate 67.8%).

Data collection

At first we contacted the Personal Department of the company to obtain their permission and the list of eligible WCs. Then data collectors came to the WCs worksite, introduced the study and invited
participants to join with the assistance of the WCs team leaders. In case the WCs were not present at the worksite after three visits, they were not invited to participate into this survey.
Participants were interviewed at their worksites after or before their shift using a structured, personal interview questionnaires. All participants were provided with and signed the consent form upon answering the questionnaires. The survey questionnaires included two parts: (1) The Orebro questionnaire and (2) demographic and working characteristics which were presented in the Appendix 1.

Variables

Dependent variable: Persistent MSDs based on ÖMPQ score
The Örebro Musculoskeletal Pain Questionnaire (ÖMPQ) was utilized to identify the sites of MSDs, and to assess the impacts of persistent MSDs on various bodily functions, daily activities and working ability (16–20). The score of the questionnaire was the sum of 21 individual scores, corresponding to 21 questions. The total score ranged from 3–210 points. The higher the overall score, the greater the risk of persistent MSDs and impacts of musculoskeletal pain on bodily functions, daily activities and labor (20). A cut-off score of 105 has been used to indicated low risk of persistent MSDs (20). In this study, the English version of ÖMPQ was translated, tested and revised before the actual survey. The Cronbach’s alpha of the Vietnamese ÖMPQ was 0.76 which indicated the acceptable reliability (21).

Independent variables: Demographic and work characteristics
Two groups of factors were collected and analyzed for their potential relationships with the persistent MSDs (1, 3, 10).

The demographic questions included age, sex, education and work seniority. Age and work seniority were categorized into two groups (≥39 versus less than 39 years old and ≥15 versus less than 15 working years, respectively). Sex included male and female groups and education was classified into primary and high school group and above high school group.

Questions regarding working conditions included four groups of variables, namely work organization, exposure to physical occupational hazards, unfavorable working postures and psychological stress at work. Work organization variables included the number of working hours per shift (≤8 versus over 8 hours/shift) and shift work in the last three months (Shift 1 from 5 a.m to 1 p.m; Shift 2 from 1 p.m to 8 p.m; Shift 3 from 6 p.m to 2 a.m and Frequently changed shift). Physical occupational hazards contained the self-perceived frequency of exposure to sunlight, hot/cold/wet weather conditions (frequent exposure and seasonal to none exposure). Unfavorable working postures were expressed by time spent performing twelve specific postures which were common among WC (≥2 versus less than 2 hours per shift, see Illustration in Appendix 1). Experience of psychological stress at work included level of anxiety and stress during the previous week (high versus acceptable), level of satisfaction about working condition during the last week (unsatisfied versus acceptable), experience of threat of
physical and psychological violence at work (yes versus never).

**Statistical analysis**

The collected data were analysed using SPSS Version 22.0. Descriptive analysis was done to assess the prevalence, site and severity of MSDs. Mean Orebro score, which indicated the level of MSDs, was compared across WC groups with different demographic characteristics and working conditions using Linear regression analysis at the significant level of p < 0.05.

**Results**

The response rate of this study was 67.8%. Among 488 eligible WCs who were invited to join the project, 331 WCs agreed to provide information. We could not approach the other 157 WCs because they were on sick leave (21), maternity leave (15), absent at the worksite when data collectors visited (10), and refused to join (111).

**Situation of musculoskeletal disorders**

All 331 waste workers reported MSDs in at least one body site (100%). The prevalence of pain at the lower back was the highest (62.5%), followed by pain at the neck (58.3%), shoulders (55.9%) and forearm (55%) (Figure 1). 19% WCs reported pain in only one body site and about 12% had pain in all studied body sites (Figure 2). The proportion of waste collectors with lower risk of persistent MSDs (Orebro mean score < 105) was 63.4% (210 workers). The Orebro mean score and standard deviation of the whole sample were 97.5±20.9, respectively (Table 1).

**Factors related to musculoskeletal disorders**

Four groups of variables were put into the linear regression analysis to identify the association between personal and work-related characteristics and the risk of persistent MSDs. These groups included (1) personal and work organization variables; (2) exposure to occupational hazards, (3) duration performing unfavorable working postures; and (4) experience of psychological stress at work. The results in Table 1 showed that female workers, workers in day shift or frequently changed shift reported significantly higher Orebro’s mean score in comparison with their counterparts. Workers with the neck bent for a prolonged duration at an angle of over 45° without supportive equipment and medial rotation while walking for more than 2 hours during their shift had higher score than those who had these postures less than 2 hours at the significant level p = 0.01. Kneeling was not a common posture with majority of workers having this posture less than 2 hours per shift, but they reported higher Orebro’s mean score than those having this posture more than 2 hours. Workers who felt highly anxious, stressed or unsatisfied during one week before the survey also reported...
significantly higher score than those who rated these psychological conditions as “acceptable” (p<0.01).

**INSERT TABLE 1 HERE**

**Discussion**

This study results reveals an extremely high prevalence of MSDs amongst WCs in Hanoi, the capital of Vietnam. Significant related factors include work shift, several work posture and psychological condition one week before the survey.

**Situation of MSDs**

In this study, 100% participated WCs experienced MSDs in at least one body region by the time of the survey, which is a higher percentage than what several previous studies among WCs concluded (43.2–92.5%) (8-11). The difference in the findings of this study compared to previous studies might be attributable to the heterogeneity in the characteristics of study participants, working conditions, climatic condition of Vietnam compared to those in other countries, especially the proportion of gender age and years of work experience (8, 9). This could be explained by the higher number of female participants (89.7%) since they experience a higher prevalence of MSDs compared with their male counterparts (Orebro mean score: 98.5 in women versus 88.5 in men) in this study. Studies had showed that being a female is often described as a “risk factor” for many musculoskeletal disorders with higher prevalence of MSDs among women compared to men (14) because of different physical strength in musculoskeletal system. In addition, age and years of working experience played an important roles in the elevated risk of MSDs in this study because these conditions increased the effects of cumulative exposure of occupational hazards, resulting in higher prevalence of MSDs among older workers (14). This results imply the need of support at work for female waste collectors, workers in their older age or with longer years of work experience to prevent the risk of persistent MSDs, protect workers’ health and reduce any compensated cost MSDs might cause. The MSD prevalence in this study was even higher than that of studies in other occupations such as lobster catching (82.3%) (4), physiotherapists (89%)(2), cattle slaughterers (88.2%) (5), carpet weavers (87.6%) (6) and dentists (69%) (7). This indicated that the waste collection job might result in higher
risk of MSDs among WC workers in comparison with other occupations. Lower back, neck, shoulder, forearm and upper back were the most frequently affected body sites in this study. Other authors also reported that MSDs most occurred in the lower back (7, 9, 10), upper limbs (9, 11) and shoulder (10). However, the prevalence of MSDs in the lower extremity in this study was lower than that of the study among Iranian waste collectors (7, 10). The manual waste collection process involved most body regions. Lower back however, bears the highest amount of impact (1), which explains the high prevalence of low-back pain. Moreover, waste collecting job required workers to frequently change their posture (standing, moving, twisting the body, and sweeping) which mainly affected the back, legs and hands, resulting in high risk of MSDs for said body parts. This also explained the high prevalence of MSDs at multi-body sites (81%). When compared to studies among workers in different occupations, the prevalence of multi-site MSDs among WCs in this study were also higher (2, 4, 7, 8, 10).

Factors related to persistent MSDs

Regarding MSD related factors, the severity level of MSDs were higher among female compared to male workers (p<0.05). This might be explained by the biological differences between men and women. The negative impact of the same act of physical labor is generally greater on females than males, which has been discussed above. The difference in the prevalence of MSDs between males and females was consistent across different occupations (3, 4, 6). Among demographic and work organization characteristics, no significant association between education level, age, years of service, working hours and MSDs were found, excluding the significant association between the working shift during the last three months and the Orebro mean score (p <0.01). Among WCs, night shift was rated as the most strenuous work. At night, WCs were exposed to higher level of psychological stress, harsher climatic conditions (e.g. too wet or too cold) and fatigue. Moreover, their working hours during night shift only ends when all the garbage of the city has been collected and transported to the processing plant. Hence, sometimes it exceeds the regulation of 8 working hours per shift. In this study, WCs with higher level of MSDs might be scheduled to day shift since their physical health conditions were not suitable for night shift by the time of the survey. Future longitudinal studies
should be conducted to better identify the association between risk factors and risk of MSDs.

In our study, no significant association was found between exposure to physical working environment and MSDs. This result was different from findings of other studies. Magnavita et al. (13) reported that exposure to temperature and light increased the risk of MSDs in the upper limbs (OR 1.92 and 1.68, respectively). That study also found that temperature elevated the risk of MSDs in the lower back (OR 1.31) (13).

Among all investigated unfavorable postures and tasks, this study found the significant association between the duration of the neck bent for a prolonged duration at an angle of over 45° without supportive equipment, kneeling, and medial rotation while walking, and the Orebro mean score, indicating that longer duration of unfavorable postures would elevate the risk of persistent MSDs. This results were consistent with other studies which reported that several other factors including remaining in harmful postures for a prolonged duration, quick motion and continuous bending or twisting while carrying or lifting heavy objects also increased risk of MSDs (1, 6, 10, 22).

Psychological stress was also found to be one the risk factors of MSDs. Mental stress diverts resources spent on attention, and can lead to fatigue and injury (1, 13). Various studies suggest that the prevalence of depression, sleep disorders and occupational accidents were higher among workers who had MSDs compared to those who did not (23). It seems increasingly evident that addressing psychological factors impacting workers, is crucial for prevention of MSDs.

Limitations of this study

We recognize that limitations of self-reported health conditions and working conditions could create a certain level of bias on the prevalence and level of MSDs among the investigated participants. In addition, it is not possible to create the causal relationship between demographic and working conditions and the persistent MSD with the cross-sectional study design in this paper. Hence, future studies should consider more robust study design such as cohort or randomized control trial to evaluate the impact of working conditions on MSD among waste collectors in particular and different groups of occupation in general. However, this is the first paper to describe the situation of persistent MSDs among waste collectors in Vietnam, using the ÖMPQ.
Conclusions
This study showed that the prevalence of MSDs among WCs in Hanoi was high (100%), multiple-site MSDs (at least two sites) were reported by 81%. Lower back was the most affected site, and accounted for 62.5% of the responses, followed by pain in the neck (58.3%) and shoulders (55.9%).
The risk of persistent MSDs were higher amongst female workers. Other risk factors of persistent MSDs included the neck bent at an angle of 45°, kneeling, repetitive medial rotation, feeling dissatisfaction with work, stress or anxiety during one week before the survey (p<0.05)..<br>• The high prevalence of MSDs and risk factors of persistent MSDs as unfavorable work postures and psychological stress at work imply the need of mechanical and social support at work for waste collectors to prevent the development of MSDs. The application of machine on the job will be useful in several work tasks such as lifting/ carrying heavy objects or sweeping the street to replace the current manual operation. Social support might include better rewarding methods, coworker support, provision of adequate personal protective equipment and timely provision of medical treatment for occupational injuries and other health problems.

Abbreviations
MSD: Musculoskeletal disorder
ÖMPQ: Örebro Musculoskeletal pain questionnaire
OR: Odd ratio
WC: Waste collector

Declarations
Ethics approval and consent to participate
The study was approved by the ethics committee of biomedical research at the School of Public Health, Hanoi, under Decision No. 46/2017/YTCC-HDD3, dated 15/02/2017. The participation in the study was completely voluntary and written consent forms were obtained upon data collection.
Consent for publication: Not applicable
Availability of data and materials
Additional data and materials are available upon requests sent to the corresponding author.
Competing interests
The authors declare that they have no competing interests

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Authors’ contributions

NVB and TTTTT analyzed data and prepared the drafted manuscript, TTTT and NTQ coordinated the survey to collect data. NTQ and NNB commented on the manuscript. TTTT finalized the manuscript and submitted it.

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Figures
**Figure 1**

Prevalence of MSDs by body sites

| Body Site | Prevalence (%) |
|-----------|----------------|
| Lower back| 62.5           |
| Neck      | 58.3           |
| Shoulder  | 55.9           |
| Forearm   | 55             |
| Upper back| 39.3           |
| Leg       | 37.2           |
| Hand      | 35.6           |
| Foot      | 30.5           |
| Hip       | 26             |
| Thigh     | 24.5           |
Figure 2

Prevalence of MSDs by number of affected sites

Supplementary Files

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STROBE_checklist_cross-sectional.doc
Supplement materials appendix 1.docx