

Musculoskeletal disorders among municipal solid waste collectors in Mansoura, Egypt: a cross-sectional study

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ABSTRACT

Objective: To assess the percentage of musculoskeletal complaints and their possible risk factors among municipal solid waste (MSW) collectors.

Design: A descriptive cross-sectional study with a comparison group.

Setting: Primary level of care, at the Western Municipality of Mansoura City, Egypt.

Participants: A total of 160 male MSW collectors fulfilled the eligibility criteria and 120 of them participated in the study (response rate of 75%). The inclusion criteria were permanent or temporary solid waste collectors employed for 1 year or more. A comparison group of 110 male service workers at the Faculty of Medicine, Mansoura University, comparable to MSW collectors in most of the variables.

Outcome: The percentage of musculoskeletal disorders (MSDs) among collectors, their risk factors (socio-demographic, psychosocial, physical), and the independent risk factors for having the disorders.

Results: The percentage of musculoskeletal complaints during the past 12 months was higher among MSW collectors (60.8%) than the comparison group (43.6%). Low back was the most frequently affected body region among MSW collectors. The differences in the distribution of musculoskeletal complaints between the two groups were statistically significant for the neck and hip/thigh regions. Logistic regression analysis revealed that the independent risk factors for musculoskeletal symptoms among MSW collectors were the longer duration of employment (OR=0.4, 95% CI=0.1 to 0.9); low decision latitude (OR=0.3, 95% CI=0.1 to 0.7); lifting, pulling; pushing/carrying loads >20 kg (OR=5.5, 95% CI=1.8 to 17.0) and walking for long periods of time (OR=2.6, 95% CI=1.1 to 6.6).

Conclusions: Musculoskeletal complaints are highly prevalent among MSW collectors which require engineering, medical and legislative measures. We suggest further research in the interventions that could reduce the high percentage among collectors.

INTRODUCTION

Human activities create waste, and it is the way this waste is handled, stored, collected

ARTICLE SUMMARY

Article focus

- Manual solid waste collectors are at risk of musculoskeletal disorders (MSDs).
- MSDs are multifactorial in nature.
- Intervention is needed to reduce the risk.

Key messages

- MSDs are highly prevalent among municipal solid waste (MSW) collectors.
- Personal, psychosocial and ergonomic risk factors are implicated.
- Mechanisation of collection minimises the risk.

Strengths and limitations of this study

- The first study to be carried out among this sector.
- Single-centre study with small sample size is the main limitation.

and disposed of, which can pose risks to the environment and to public health.¹ One job that has contributed greatly to human health by reducing the risk of several diseases like typhoid fever or cholera is waste collecting.² For waste collectors, the risk of disease resulting from exposure to various work hazards is high,^{3–5} as is the risk of fatal and non-fatal occupational accidents.⁶

Several studies, were conducted upon municipal solid waste (MSW) collectors to study their health problems, are worldwide accessible and published in peer-reviewed journals.

Association between working environment and musculoskeletal symptoms has been widely reported. Workplace activities such as heavy lifting, manual handling, prolonged sitting and standing, bending and repetitive tasks are known as risk factors for musculoskeletal disorders (MSDs).^{4 7–9}

Refuse collecting is a physically demanding job, which is associated with a high prevalence rate of MSDs.^{3 4 10–12} Moderate evidence is available that waste collecting increases the

risk of respiratory complaints and limited evidence is available for gastrointestinal complaints and hearing loss according to the systematic review by Kuijter *et al.*²

Among waste collectors, non-fatal injuries are mainly musculoskeletal in nature.¹³ In many developing countries, MSW is collected manually and collection of household waste is also a job which requires repeated heavy physical activity such as lifting, carrying, pulling and pushing.¹⁴ A nearly 2 times higher incidence rate of musculoskeletal complaints for refuse collectors was reported in Denmark than for the total Danish workforce.¹² For refuse collectors in Taiwan, the risks for musculoskeletal complaints of the low back and elbow/wrist among refuse collectors were more than two times higher than those of their colleagues that worked in the office.¹⁴

Solid waste management practice in Egypt has been largely focused on the issues of collection and disposal with little or no attention paid to the health status of MSW collectors. The collection methods are based mostly on manual labour, which is less costly than the mechanised collection systems adopted in developed countries. To the authors' best knowledge, no past studies have investigated the actual prevalence of MSDs and their risk factors in MSW collectors in Egypt.

The objective of this study was to assess the prevalence of musculoskeletal symptoms in a group of MSW collectors in Mansoura city and to identify the possible risk factors contributing to their occurrence.

SUBJECTS AND METHODS

A cross-sectional study with a comparison group was conducted upon solid waste collectors working at the Western Municipality of Mansoura city during the period from 1 January to 31 August 2011.

Study population

The at-risk group (MSW collectors)

The total number of solid waste collectors was 198 and all were men. The inclusion criteria were permanent or temporary solid waste collectors employed for 1 year or more. A total of 160 solid waste collectors fulfilled the eligibility criteria and 120 of them participated in the study (response rate of 75%). The MSW collectors were interviewed and examined at three regional assembly offices according to their geographical distribution at 13:00 where collectors of the morning and evening shift arrive for signing.

Comparison group

The group comprised 110 male service workers at the Faculty of Medicine, Mansoura University, comparable to MSW collectors in most of the variables except for the risk of exposure to MSW.

The comparison group was interviewed and examined at the Department of Public Health and Community Medicine during the work day.

Ethical consideration

Approval of the Western Municipality and Faculty of Medicine authorities was obtained. An informed verbal consent of study subjects to participate in the study was obtained with assurance of confidentiality and anonymity of the data. Subjects participated voluntarily with a full right to withdraw from the study. There is no Research Ethics Committee at the moment.

Study tools

Each participant was subjected to the following:

1. Interview: A questionnaire was used to collect the following data:
 - A. Socio-demographic and occupational profile of workers.
 - B. Physical work demands using the Dutch Musculoskeletal Questionnaire.¹⁵
 - C. Musculoskeletal symptoms (pain or discomfort or ache) by body region using Standardised Nordic questionnaire for the analysis of musculoskeletal symptoms.¹⁶ Risk factors for work-related MSDs were classified into several physical, psychosocial and individual factors according to the results of various epidemiological studies and literature reviews.^{17–19}
 - D. Job strain was measured using job strain index.²⁰ Psychological job demands were measured using five items with four response alternatives each, forming a four-point ordinal scale. An index of psychological job demands was formed by the sum of scores for these items, with 5 as the minimum and 20 as the maximum score for the index. In a corresponding way, decision latitude was measured by an index based on six items, with 6 as the minimum and 24 as the maximum. Decision latitude and psychological job demands were dichotomised into 'high' and 'low', using the median score as the cut-off point (18 for decision latitude and 13 for job demands).

2. Clinical examination.
3. Anthropometric measurements: weight and height were measured, and body mass index (BMI) was calculated. Obesity was defined as BMI ≥ 30.00 kg/m².²¹

Data analysis

Data were entered, cleaned and statistically analysed using the SPSS V.16.

Qualitative variables were described as numbers and percentages. χ^2 and Fisher's exact test were used for comparison between groups; as appropriate. Quantitative variables were described as mean (\pm SD) and median. They were tested for normality by Kolmogorov-Smirnov test. In the normally distributed variables, independent sample t test was used; while in non-normally distributed variables, Mann-Whitney test was used for comparison between groups.

Binary stepwise logistic regression analysis was used for prediction of independent variables. Significant predictors for MSDs in the bivariate analysis were entered into the regression model. ORs and their 95% CI were calculated. A $p \leq 0.05$ was considered to be statistically significant.

RESULTS

Socio-demographic characteristics

Table 1 shows that MSW collectors were comparable with the comparison group in most of the socio-demographic characteristics except for the family size and residence. The majority of both MSW collectors and comparison group (78.3% and 68.2%, respectively) were above the age of 40. Most of the MSW collectors (89.2%) were illiterate/read and write compared to 82.7% of the comparison group. The percentage of obesity was 16.7% in the MSW collectors compared to 25.5% of the comparison group ($p > 0.05$).

Operational definition

Enough means that their income meets their daily needs; while *indebt* means that their income is not satisfactory.

Occupational profile of the study groups

Table 2 shows that the majority of both MSW collectors (71.7%) and the comparison group (79.1%) were

temporary workers. MSW collectors were employed for longer duration than the comparison group (15 vs 11 years). Most of the MSW collectors (81.7%) collected waste using a local collection unit (offa) with a median weight of 20 kg and 33.6% of the comparison group used baskets with a median weight of 6 kg. MSW collectors collected waste from all sources using mainly tractors and trucks. However, the comparison group collected waste mainly from commercial and institutional sources using tractors and vehicles with mobile bins. The differences between both groups regarding the collection vehicle, weight of the collection unit and sources of collected waste were statistically significant. Most of MSW collectors (96.7%) and 70.9% of the comparison group had high job demands with statistically significant difference.

Percentage and anatomical distribution of musculoskeletal complaints

Table 3 reveals that the percentage of musculoskeletal complaints during the past 12 months was significantly higher among MSW collectors (60.8%) compared to 43.6% of the comparison group ($p \leq 0.01$).

The anatomical distribution of musculoskeletal complaints among MSW collectors showed that: the most frequently affected body regions were low back (22.5%); then shoulders (15.8%); neck (7.5%); knee (6.7%) and hips/thighs and elbows (5.8% each). However, among

Table 1 Socio-demographic profile of the study groups

	MSW collectors n=120 n (%)	Comparison group n=110 n (%)	Test of significance
Age (years)			
<40	26 (21.7)	35 (31.8)	$\chi^2=3.03, p > 0.05$
≥ 40	94 (78.3)	75 (68.2)	
Mean \pm SD	47.4 \pm 9.7 ys	45.5 \pm 7.5ys	t=1.7, $p > 0.05$
Level of education			
Illiterate/read and write	107 (89.2)	91 (82.7)	$\chi^2=1.9, p > 0.05$
Primary and others	13 (10.8)	19 (17.3)	
Marital status			
Unmarried	2 (1.7)	6 (5.5)	$\chi^2=2.5, p > 0.05$
Married	118 (98.3)	104 (94.5)	
Family size			
<5 persons	22 (18.3)	71 (64.5)	$\chi^2=50.9, p \leq 0.001$
≥ 5 persons	98 (81.7)	39 (35.5)	
Family income per month*			
Enough	57 (47.5)	66 (60.0)	$\chi^2=3.6, p > 0.05$
Indebt	63 (52.5)	44 (40.0)	
Residence			
Rural	114 (95.0)	84 (76.4)	$\chi^2=16.6, p \leq 0.001$
Urban	6 (5.0)	26 (23.6)	
BMI groups			
Underweight	4 (3.3)	2 (1.8)	Non-obese versus obese
Normal weight	67 (55.8)	54 (49.1)	
Overweight	29 (24.2)	26 (23.6)	
Obese	20 (16.7)	28 (25.5)	

*It is based on subjective term.

Table 2 Occupational profile of the study groups

	MSW collectors n=120 n (%)	Comparison group n=110 n (%)	Test of significance
Type of contract			
Temporary	86 (71.7)	87 (79.1)	$\chi^2=1.7, p>0.05$
Permanent	34 (28.3)	23 (20.9)	
Duration of employment (years)			
Median (min–max)	15 (1–36) years	11 (1–31) ys	Z=1.8, p>0.05
Sources of collected waste*			
Residential	111 (92.5)	0 (0.0)	$\chi^2=196.7, p\leq 0.001$
Commercial	109 (90.8)	76 (69.1)	$\chi^2=17.2, p\leq 0.001$
Industrial	105 (87.5)	0 (0.0)	$\chi^2=177.1, p\leq 0.001$
Institutional	105 (87.5)	74 (67.3)	$\chi^2=13.6, p\leq 0.001$
Biomedical	105 (87.5)	7 (6.4)	$\chi^2=151.2, p\leq 0.001$
Collection vehicle‡			
Tractor	64 (53.3)	56 (50.9)	Tractor versus others
Trolley	5 (4.2)	1 (0.9)	
Truck	35 (29.2)	0 (0.0)	$\chi^2=7.4, p\leq 0.01$
Vehicle with mobile bin	16 (13.3)	20 (18.2)	
Collection unit‡			
Waste basket	2 (1.7)	37 (33.6)	Non-wheeled versus wheeled containers†
Waste bag	6 (5)	24 (21.8)	
Offa (a local collection bag)	98 (81.7)	0 (0.0)	$\chi^2=3.02, p>0.05$
Two-wheeled container	14 (11.7)	4 (3.6)	
Four-wheeled container	0 (0.0)	12 (10.9)	
Weight of collection unit in kg (Median (min–max))	20 (7–70)	6 (1–50)	Z=7.3, p<0.001
Job demands			
High (≤ 13)	116 (96.7)	78 (70.9)	$\chi^2=28.8, p\leq 0.001$
Low (>13)	4 (3.3)	32 (29.1)	
Decision latitude			
High (≤ 18)	68 (56.7)	76 (69.1)	$\chi^2=3.8, p>0.05$
Low (>18)	52 (43.3)	34 (30.9)	

*Categories are not mutually exclusive.

†Non-wheeled containers include waste basket, bag and offa; wheeled containers include two-wheeled and four-wheeled containers.

‡Only 77 of the comparison group collect waste.

the comparison group, the most frequently affected body region was low back (19.1%); then shoulders (8.2%); upper back (7.3%) and knee and elbows (4.5% each).

Risk factors for musculoskeletal symptoms

Table 4 shows that, the difference between MSW collectors with musculoskeletal symptoms and those free of symptoms was statistically significant ($p\leq 0.01$) regarding

Table 3 Anatomical distribution of musculoskeletal complaints among the study groups in the past 12 months

	MSW collectors n=120 n (%)	Comparison group n=110 n (%)	Test of significance
No complaint	47 (39.2)	62 (56.4)	$\chi^2=6.8, p\leq 0.01$
One or more complaints	73 (60.8)	48 (43.6)	
Neck	9 (7.5)	2 (1.8)	$\chi^2=4.1, p\leq 0.05$
Shoulders	19 (15.8)	9 (8.2)	$\chi^2=3.1, p>0.05$
Elbow	7 (5.8)	5 (4.5)	$\chi^2=0.19, p>0.05$
Wrists/hands	2 (1.7)	2 (1.8)	Fisher's exact, p>0.05
Upper back	4 (3.3)	8 (7.3)	$\chi^2=1.8, p>0.05$
Low back	27 (22.5)	21 (19.1)	$\chi^2=0.4, p>0.05$
Hips/thighs	7 (5.8)	0 (0.0)	Fisher's exact, p<0.01
Knee	8 (6.7)	5 (4.5)	$\chi^2=0.5, p>0.05$
Ankles/feet	4 (3.3)	1 (0.9)	Fisher's exact, p>0.05

Table 4 Risk factors for musculoskeletal symptoms in MSW collectors

	Musculoskeletal symptoms		Test of significance
	Present n=73 n (%)	Absent n=47 n (%)	
I. Socio-demographic factors			
Age (years)			
<40	14 (19.2)	12 (25.5)	$\chi^2=0.7$, p>0.05 OR 0.69 (0.3, 1.8)
≥40 (r)	59 (80.8)	35 (74.5)	
Duration of employment in years			
<15	26 (35.6)	27 (57.4)	$\chi^2=5.5$, p≤0.01 OR 0.4 (0.2, 0.9)
≥15 (r)	47 (64.4)	20 (42.6)	
BMI			
Non-obese	58 (79.5)	42 (89.4)	$\chi^2=2$, p>0.05 OR 0.5 (0.1, 1.5)
Obese (r)	15 (20.5)	5 (10.6)	
II. Psychosocial factors:			
Job demands			
High (≤13)	71 (97.3)	45 (95.7)	Fisher's exact, p>0.05 OR 1.6 (0.2, 16.4)
Low (>13) (r)	2 (2.7)	2 (4.3)	
Decision latitude			
High (≤18)	32 (43.8)	36 (76.6)	$\chi^2=12.5$, p≤0.001 OR 0.2 (0.1, 0.6)
Low (>18) (r)	41 (56.2)	11 (23.4)	
III. Physical work demands:			
Lift, push, pull or carry loads >5 kg	57 (78.0)	32 (68.0)	$\chi^2=1.5$, p>0.05 OR 1.7 (0.7, 4.1)
Lift, pull, push or carry loads >20 kg	56 (76.7)	26 (55.3)	
Exert great force on tools	2 (2.7)	2 (4.3)	Fisher's exact, p>0.05 OR 0.6 (0.1, 6.6)
Bent or twist with trunk	58 (79.5)	32 (68.0)	
Bent or twist with neck	55 (75.3)	30 (63.8)	$\chi^2=1.9$, p>0.05 OR 1.8 (0.7, 4.5)
Bent or twist with wrists/hands	57 (78.0)	33 (70.2)	
Bent, or twisted posture for long periods of time with trunk	51 (69.9)	31 (66.0)	$\chi^2=1.8$, p>0.05 OR 1.7 (0.7, 4.2)
Bent, or twisted posture for long periods of time with neck	46 (63.0)	30 (63.8)	
Bent, or twisted posture for long periods of time with wrists	44 (60.3)	31 (66.0)	$\chi^2=0.9$, p>0.05 OR 1.5 (0.6, 3.8)
Make short repetitive movements with trunk	8 (11.0)	0 (0.0)	
Make short repetitive movements with neck	6 (8.2)	0 (0.0)	$\chi^2=0.2$, p>0.05 OR 1.2 (0.5, 2.8)
Make short repetitive movements with wrists	12 (16.4)	0 (0.0)	
Reach with arms or hands	4 (5.5)	0 (0.0)	$\chi^2=0.01$, p>0.05 OR 0.9 (0.4, 2.2)
Hold arms at or above shoulder level	24 (32.9)	16 (34.0)	
Work in uncomfortable postures	37 (50.7)	25 (53.2)	$\chi^2=0.4$, p>0.05 OR 0.8 (0.3, 1.8)
Work in the same posture for long periods of time	49 (67.0)	36 (76.6)	
Make frequent repetitive movements with arms, hands or fingers	29 (39.7)	27 (57.4)	Fisher's exact, p≤0.01 Fisher's exact, p≤0.05 Fisher's exact, p≤0.001
Stand for long periods of time	46 (63.0)	32 (68.0)	
Sit for long periods of time	1 (1.4)	6 (12.8)	Fisher's exact, p>0.05 OR 0.5 (0.2–1.1)
Walk for long periods of time	65 (89.0)	30 (63.8)	
			$\chi^2=3.6$, p≤0.05 OR 0.2 (0.1, 0.6)
			$\chi^2=0.3$, p>0.05 OR 0.8 (0.3–1.8)
			Fisher's exact, p≤0.01 OR 0.1 (0.0, 0.8)
			$\chi^2=11$, p≤0.001 OR 4.6 (1.6, 13.2)

BMI, body mass index; r, reference category.

the duration of employment. Most of MSW collectors without musculoskeletal symptoms (76.6%) had significantly high decision latitude compared to only 43.8% of those with symptoms ($p \leq 0.001$). The difference between both groups was statistically significant regarding lift, pull, push or carry loads >20 kg; make short repetitive movements with trunk; neck; wrists; and arms, hands or fingers; sit and walk for long periods of time.

Independent risk factors for musculoskeletal symptoms

Logistic regression analysis showed that the short duration of employment as waste collector and the high decision latitude were associated with low risk of MSDs (OR=0.4 and 0.3, respectively). On the other hand, lifting, pulling, pushing or carrying loads >20 kg, and walking for long periods of time were independently associated with the likelihood of having musculoskeletal symptoms (OR=5.5 and 2.6, respectively) (table 5).

DISCUSSION

Prevalence and risk factors

The results of the present study showed that a high percentage of musculoskeletal complaints (60.8%) was detected among MSW collectors and the low back was the most frequently affected body region. The independent risk factors for musculoskeletal symptoms among MSW collectors were the duration of employment; decision latitude; lifting, pulling; pushing/carrying loads >20 kg and walking for long periods of time.

The most frequently affected body regions among MSW collectors were low back (22.5%); then shoulders (15.8%); neck (7.5%); knee (6.7%) and hips/thighs and elbows (5.8% each). The differences in the distribution of musculoskeletal complaints between MSW

collectors and the comparison group were statistically significant for the neck and hips/thighs regions.

In Egypt, collectors suffer from MSDs because of the large volume of waste they have to pack manually. Ergonomic risk factors are contributing factors. The illiterate collectors may be unaware about the proper safety techniques during waste collection.

In Palestine, 45.7% of surveyed waste collectors have suffered from backache, 34.1% of waste collectors have suffered from twisted ankle, 22.1% have suffered from muscle tear, 8.7% have suffered from joint pain. Regarding the cause of the injured part of the body in the last 12 months, 61.1% of waste collectors have been hit by any hard or sharp objects, 37.4% have lifted more than their capacity, 35.6% have fallen down while pulling or pushing the waste trolley, and 21.6% of waste collectors have been stuck with hard object. Nearly half of the waste collectors (44%) were satisfied with their job and 21.1% were very satisfied with their work, while 17.7% and 14.8% of domestic waste collectors surveyed were not satisfied to absolutely not satisfied, respectively.²²

In Nigeria, 171 workers representing 61.3% of the sampled solid waste collectors had suffered from musculoskeletal injuries on the job. Solid waste collectors in Port Harcourt municipality suffered from musculoskeletal injuries because of the large volume of wastes they have to pack manually in contrast to the use of hydraulic lifts.²³

In Iran, prevalence of musculoskeletal symptoms, among MSW workers in Tehran, in low back, knees, shoulders, upper back and neck were 45%, 29%, 24%, 23% and 22%, respectively. The study found that solid waste workers had more MSDs than the general population. The risk of disease was increased with the increasing years of working as solid waste worker and smoking. There was no relationship between MSDs and education or marriage status of workers.²⁴

High prevalence of MSDs among refuse collectors was reported in Brazil,²⁵ Denmark,¹² Taiwan,¹⁴ USA¹³ and the Netherlands.²⁸

In developed countries, automated trucks are used using hydraulic lift to pick up and dump trash containers.²³ In Egypt, the reverse is the case. In many developing countries, MSW is collected manually and collection of household waste is also a job which requires repeated heavy physical activity such as lifting, carrying, pulling and pushing.¹⁴

MSW collectors and the comparison group were of low socioeconomic status as the majority of them had low educational levels, insufficient family income with large family size and were rural residents. In Egypt, waste collectors are subject to social stigma, they are likely to be from marginalised groups. Manual waste collection is easily learned and usually does not require literacy or vocational training. This job provides a source of livelihood to extremely poor people. MSW collectors are considered the poorest of the poor. Many people view waste collectors as a nuisance or source of shame.

Table 5 Logistic regression analysis of independent risk factors for musculoskeletal symptoms among MSW collectors

	β	p Value	OR (95% CI)
Duration of employment (years)			
<15	-1.01	$p \leq 0.05$	0.4 (0.1 to 0.9)
≥ 15 (r)			
Decision latitude			
High	1.3	$p \leq 0.01$	0.3 (0.1 to 0.7)
Low (r)			
Lift, pull, push or carry loads >20 kg			
Yes	1.7	$p \leq 0.01$	5.5 (1.8 to 17.0)
No (r)			
Walk for long periods of time			
Yes	0.97	$p \leq 0.05$	2.6 (1.1 to 6.6)
No (r)			
Constant	-0.3		
Model χ^2	32.0,	$p \leq 0.001$	
Percentage correctly predicted	70		

r, reference group.

In India, it was concluded that the social stigma of waste pickers remains a problematic issue.²⁹ It was commented that the socioeconomic status of the waste collectors is low, and their working conditions are unfavourable.³⁰ Even in Japan, the discrimination against waste management workers still exists.³¹ The lower socioeconomic status of MSW collectors was reported in Palestine²² and Nigeria as most of the workers admitted to doing it as a last resort in the absence of better alternative.²³

All of MSW collectors were men and the majority of both groups were in the middle-age groups. The same findings were reported from Palestine and Nigeria.^{22 23} It was concluded that formal waste collection is mainly performed by male employees.⁶ Waste collection in Egypt uses old and traditional equipment and depends on the physical power of the collectors.

Most of MSW collectors had high job demands and about half of them (56.7%) had high latitude. This could be attributed to nature of their contract. The majority of both groups were temporary workers. Temporary collectors are excluded from the social and health insurance. The daily paid labourers have no benefits or job security. Thus, they are under physical and psychological demands with lack of job satisfaction. Work satisfaction is an important parameter to do a perfect job.

The work of waste collectors is characterised by an abundance of heavy lifting as well as pulling and pushing of containers and carts. In addition, the work of waste collectors may contain work above shoulder level, frequent exertion of force, static contractions and extreme joint positions which are occupational risk factors for MSDs of the neck, shoulders and arms.^{32–34}

Measures to prevent MSDs

The following measures to prevent MSDs among refuse collectors have been evaluated and seem to be effective:

- Job-specific guideline for refuse collectors regarding maximum production limits (maximum amount of waste (or a maximum number of bags/containers) and a maximum number of hours that waste collecting tasks may be performed during an 8 h working day).¹¹
- Job rotation between collecting bags, sweeping streets and driving a sweeping machine.³⁵
- Job rotation between collecting two-wheeled containers and driving a refuse truck.²⁸

A major economic benefit of job rotation is the increase in flexibility. Several studies have indicated possible ergonomic benefits of job rotation in reducing the risk of musculoskeletal complaints.^{36 37}

Kuijer *et al.*³⁵ conducted a study at a refuse collecting company, the introduction of job rotation among collecting bags, sweeping streets and driving a small cleansing machine seemed to result in a marked reduction in physical workload. Kuijer and Frings-Dresen⁶ showed that the introduction of job rotation between collecting two-wheeled containers and driving the refuse truck resulted in a decrease of the physical work demands and physical workload of refuse collecting.

- Replacement of bags and bins with wheeled containers.^{4 10}
- Removing obstacles at places where wheeled containers are collected.³⁸
- Transferring a four-wheeled container by two persons instead of one.¹⁰
- At least a 10 min rest break per hour while collecting four-wheeled containers.³⁹
- Collectors should briefly test the weight of each container before lifting, to prepare for the load and they should not mount trucks while moving.⁴⁰
- Develop training materials on occupational and environmental health and injury issues relating to solid waste management for staff at all levels.⁴¹
- Incentives for safety compliance should be maintained and advertised and compensation should be evaluated relative to disease frequency.⁴⁰

These measures could be applied to reduce MSDs among MSW collectors; they are applicable and to some extent affordable.

Role of physicians in the prevention and control of MSDs

Physicians could have a role in the prevention and control of MSDs among MSW collectors which could be achieved through health education of workers about early signs of MSDs and when to seek medical advice, provide training to improve the workers' ability to avoid musculoskeletal problems, assist in consultation when planning for new work activities, and implementation of the occupational health programme for their prevention.

Study limitations: This is a single-centre study that included a small number of MSW collectors with relatively low response rate (75%). Because of the small size of the study sample, the results cannot be generalised to the total population of MSW collectors.

In conclusion, MSW collectors are among the most highly exposed occupational groups with respect to MSDs. The higher percentage of musculoskeletal symptoms among MSW collectors could be attributed to the long duration of employment, the low job control and the nature of their job which is physically demanding and involves lifting, pulling, pushing heavy loads and walking for long distances during their daily work along the designated routes. Also the less educated collectors seem to be less aware of the potential hazards and health impacts related to the collection methods. The unfavourable working conditions of MSW collectors could be ameliorated through engineering, medical and legislative measures. Provision of trucks with hydraulic lifts for packing of refuse will ease the job for the workers and reduces the incidence of musculoskeletal pains. Refuse collectors should undergo periodic health examination since occupational demands are still present in their jobs. The pace of work and opportunities for rest and recovery should be considered when assessing the risk of MSDs. There is a need for safety training and education of collectors on safe handling and lifting

techniques. Awareness campaigns may change the social aspects of waste collectors.

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