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S.I. : HUMAN FACTORS IN A CONTEMPORARY ORGANIZATION

Self-reported fatigue and health complaints of refuse collectors

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Abstract
Working as a refuse collector is a physically strenuous activity. The aim of the investigations in this work was to evaluate the fatigue and subjective complaints of musculoskeletal disorders (MSDs) among refuse collectors. The study involved 27 employees; average age: 32.1 years (SD = 3.15), seniority: 2.67 years (SD = 1.56). To evaluate fatigue a modified 30-piece questionnaire with a Borg scale was used. MSDs were measured by the Nordic Standardized Questionnaire with the Borg scale. After work, the highest rates of fatigue were reported for the symptoms: "feel thirsty," "give a yawn," "want to lie down," "feel strained in the eyes," "feel a pain in the back," "become drowsy," "feel stiff in the shoulders," "feel heavy in the head" and "have a headache." There was a high intensity of MSDs reported for the body segments "shoulders/upper arms," "lower back," "upper back," "hips/upper legs," "head/neck," "elbows/forearms" and "wrists/hands." Complaints regarding limited mobility due to MSDs at work and outside of work have been observed for the "shoulders/upper arms," "lower back" and "upper back." Refuse collectors complained more about "drowsiness and dullness" than the "projection of physical impairment" and "difficulty in concentration." Discomfort occurred primarily in the upper segments of the body and made staff mobility difficult both at work and after work. The test results can be used in the prevention of fatigue and discomfort. It is recommended to conduct training on the correct ways of performing work and resting and the repair or replacement of faulty containers.

Keywords Refuse collectors · Fatigue · Health complaints · MSDs

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1 Introduction

Refuse is collected worldwide. Methods used to collect it include (Poulsen et al. 1995): bags, baskets (110–150 L), drums (110–210 L), two-wheeled containers (80–360 L) and four-wheeled containers (300–1800 L). Working as a refuse collector is a physically demanding occupation. Several studies show that the physical load of refuse collectors can be classified as high (Frings-Dresen et al. 1995; Kemper et al. 1990) and refuse collectors' work can generally be characterized by frequent lifting, carrying, pushing and/or pulling heavy objects. In addition, research on health complaints among refuse collectors has reported that there is a high risk of health complaints (An et al. 1999; Dorevitch and Marder 2001; Ivens et al. 1998; Poulsen et al. 1995; Robazzi et al. 1997; Yang et al. 2001).

On the other hand, the issue of work fatigue is also a growing problem in our society and is related to changes in health and welfare. It is identified as one of the most common problems of developed countries (Lewis and Wessely 1992) and is a common phenomenon among all employees regardless of profession (Lasota 2007, 2009; Lasota and Ścigaj 2009). Fatigue manifests as a decreased efficiency as a result of working for a considerable period of time (Okogbaa et al. 1994) and refers to feelings of fatigue and physical discomfort associated with long-term activity. Long periods of fatigue can lead to sick leave and incapacity to perform work (Beurskens et al. 2000).

Fatigue at work is dependent on the task being performed and is compounded by certain tasks imposed on the worker (Ahsberg 2000). The process of fatigue is gradual and progressive and briefly can be divided into physical and mental fatigue (Leung et al. 2004). Mental fatigue is accompanied by a feeling of weariness, reduced alertness and reduced mental performance. In contrast, physical fatigue is accompanied by a reduction in system performance and a subjective sensation of muscular discomfort in certain areas of the muscle structure which successively lead to weakness and eventually lead to muscles being unable to work (Öberg et al. 1994). Long working hours are one of the main factors for overload, which contributes to fatigue (Iwasaki et al. 1998; Spurgeon and Harrington 1989). The research results demonstrate that fatigue in the population of workers was present in 22% of cases (Huibers et al. 2004). Other studies have reported that the prevalence rate of fatigue varies from 7 to 45%, depending on the measurement tools used and the applied cut-off points (Van Dijk and Swaen 2003). Moreover, the exposure of workers to hot environments is conducive to subjective fatigue and fatigue increases with the level of heat exposure (Chen et al. 2003).

The aim of the study was to evaluate subjective fatigue among refuse collectors, investigate complaints of musculoskeletal disorders (MSDs) and assess the impact of discomfort on reduced mobility at work and elsewhere.

Fig. 1 Emptying the trash—containers with a capacity of 120 L

2 Methods and subjects

2.1 Research subjects

The study group consisted of 27 employees. The mean age was 32.1 years with a standard deviation SD = 3.15. Seniority in the profession was 2.67 years (SD = 1.56). Employees worked from about 5.00 A.M. and the average weekly working time was 42.1 h (SD = 2.57). The tasks of the employees included taking full containers of garbage from the premises, attaching them to the refuse truck by way of container attachment hooks and emptying them (Figs. 1, 2). The empty container was then returned to its place. Containers with a capacity of 120 L and 240 L (Fig. 3) were moved by one employee while containers with a capacity of 1200 L (Fig. 4) were moved by two employees. Studies were conducted in Poland.

2.2 Assessment questionnaires

To evaluate fatigue, a modified 30-piece questionnaire developed by the Research Committee on Industrial Fatigue of Japan Society for Occupational Health and proposed by Yoshitake (1978) was used in the form of a Polish version proposed by Paluch (1985), which assesses subjective symptoms of fatigue. In the questionnaire, 30 symptoms were classified in three areas of fatigue. The first 10 questions relate to the syndrome of "drowsiness and dullness," the second 10 questions to the syndrome of "difficulty in concentration," and the last 10 questions to the syndrome of "projection of physical impairment." Respondents were asked to answer each question by selecting the intensity of fatigue. The fatigue strength indicator for a particular symptom

Fig. 2 Emptying the trash—containers with a capacity of 1200 L

Fig. 3 Container with a capacity of 120 L

Fig. 4 Container with a capacity of 1200 L

of fatigue has been designated as the average value of all values possible. The fatigue strength indicator for each of the areas of fatigue (T_I, T_{II}, T_{III}) is the corresponding average rate of the 10 symptoms of fatigue. Job type is classified into three types: i.e., general, mentally or physically demanding, based on the intensity ratio of fatigue after working in every area of fatigue. The employee is assigned to a general type if their T_I is the greatest and T_{II} the smallest (i.e., $T_I > T_{III} > T_{II}$). Mental type is assigned to an employee when T_{II} is the largest and the T_{III} smallest (i.e., $T_{II} > T_I > T_{III}$). In contrast,

the physical type is assigned when T_{III} is the largest and T_{II} the smallest (i.e., $T_{III} > T_I > T_{II}$). To assess the degree of severity of the symptoms of fatigue the Borg scale is used (1998).

Complaints of musculoskeletal disorders and limited mobility at work and outside of work due to discomfort were assessed using a questionnaire developed on the basis of the Standardized Nordic Questionnaire (Kuorinka et al. 1987) The survey sheet contained a profile of a man with selected segments of the body. Nine body segments are distinguished (head/neck, upper back, lower back, shoulders/upper arms, elbows/forearms, wrists/hands, hips/upper legs, knees, ankles/feet). To assess the degree of severity of the discomfort in the individual body segments the Borg scale was used (1998).

2.3 Research procedure

Employees were informed about the study and participated in it as volunteers. Fatigue evaluation questionnaires were distributed before work and after work, which the workers were asked to complete. Workers responded to the question "How do you feel now?" by checking the box corresponding to the intensity of the symptom. Health complaint assessment questionnaires were distributed after work with a request to fill them in. Respondents were asked to indicate the perceived intensity of discomfort in certain segments of the body and to answer "yes" or "no"; whether the discomfort limited their mobility at work and beyond.

2.4 Statistical analysis

Statistical analysis was performed using STATISTICA (data analysis software system), version 10.0 StatSoft Inc. The significance of differences in strengths of symptoms of fatigue before work and after work and the intensity of discomfort were assessed using t test. Significant differences were adopted at the level of 5% probability ($p < 0.05$).

3 Results

3.1 Subjective fatigue

Table 1 shows the intensity of subjective symptoms of fatigue before and after work among the employees surveyed. In the research sample the group of symptoms "drowsiness and dullness" reached the highest values before work, with symptoms: "give a yawn," "become drowsy" and "want to lie down" (4.6, 3.3 and 2.5 respectively). The intensity of the other symptoms was at a lower level, from 0.6 to 2.2. After work, the intensity of all symptoms increased significantly, along with the addition of "feel unsteady in standing." The highest values were recorded for "give a yawn" (5.8), "want to lie down" (5.1), "feel strained in the eyes" (4.5), "become drowsy" (4.3), "feel heavy in the head" (3.9), "get tired over the whole body" (3.6), "get tired in the legs" (3.6), "become rigid or clumsy in motion" (3.6). The intensity of the other

Table 1 Intensity of symptoms of fatigue before work and after work

Symptoms	Intensity		
	Before work	After work	*p* value
Group I Drowsiness and dullness			
Feel heavy in the head	2.2	3.9	0.0000[d]
Get tired over the whole body	1.9	3.6	0.0007[d]
Get tired in the leg	1.7	3.6	0.0001[d]
Give a yawn	4.6	5.8	0.0086[b]
Feel the brain hot or muddled	1.1	2.4	0.0082[b]
Become drowsy	3.3	4.3	0.0053[b]
Feel strained in the eyes	1.4	4.5	0.0000[d]
Become rigid or clumsy in motion	1.7	3.6	0.0004[d]
Feel unsteady in standing	0.6	1.0	0.1372
Want to lie down	2.5	5.1	0.0006[d]
Group II Difficulty in concentration			
Feel difficulty in thinking	0.9	1.2	0.5152
Become weary of talking	0.4	0.9	0.1394
Become nervous	0.2	1.2	0.0456[a]
Unable to concentrate attention	0.4	1.0	0.0463[a]
Unable to take interest in things	0.7	1.3	0.1039
Become apt to forget things	0.0	1.7	0.0027[c]
Lack of self confidence	0.5	1.4	0.0339[a]
Anxious about things	0.2	0.8	0.2460
Unable to straighten my posture	0.9	1.1	0.5505
Lack patience	0.4	1.1	0.0388[a]
Group III Projection of physical impairment			
Have a headache	1.7	3.9	0.0000[d]
Feel stiff in the shoulders	1.7	4.3	0.0000[d]
Feel a pain in the back	2.1	4.5	0.0001[d]
Feel oppressed in breathing	0.0	0.6	0.0271[a]
Feel thirsty	2.6	6.3	0.0001[d]
Have a husky voice	0.7	0.9	0.5997
Feel dizzy	0.2	1.6	0.0215[a]
Have spasms of the eyelids	0.0	0.3	0.0819
Have a tremor in the limbs	0.1	0.4	0.2657
Feel ill	1.3	2.8	0.0000[d]

[a] $p < 0.05$
[b] $p < 0.01$
[c] $p < 0.005$
[d] $p < 0.001$

Table 2 The intensity of fatigue, by field

Groups	Intensity		
	Before work	After work	*p* value
Drowsiness and dullness	2.5	3.8	0.0000[d]
Difficulty in concentration	0.5	1.2	0.0000[d]
Projection of physical impairment	1.0	2.6	0.0000[d]
	$T_I > T_{III} > T_{II}$		

[a] $p < 0.05$
[b] $p < 0.01$
[c] $p < 0.005$
[d] $p < 0.001$

symptoms did not exceed 2.4. However, in the case of the group of symptoms "difficulty in concentration" the intensity level for all symptoms did not exceed the level of 0.9 before work. After work, the intensity of symptoms did not exceed a value of 1.7. In the group of symptoms "projection of physical impairment," before work the intensity of the symptoms was low and did not exceed the level of 2.6. After work a high intensity was observed for the physical fatigue symptoms of "feel thirsty" (6.3), "feel a pain in the back" (4.5), "feel stiff in the shoulders" (4.3), "have a headache" (3.9) and "feel ill" (2.8). In contrast, the intensity of the other symptoms did not exceed the level of 1.6.

Table 2 shows the intensity of the symptoms of fatigue of workers in each group before and after work. In the case of the areas "drowsiness and dullness", the average value of the intensity of symptoms before work was at 2.5, and after work—3.8 ($p \ll 0.001$). In the area of "difficulty in concentration," the average value of the intensity of symptoms was 0.5 before work, after work—1.2 ($p \ll 0.001$). Finally, in the area "projection of physical impairment" before work the intensity level was 1.0; after work it rose to the level of 2.6 ($p \ll 0.001$).

3.2 Health complaints

Table 3 shows the intensity of discomfort in the surveyed body segments and subjective feelings of limited mobility at work and elsewhere. Figure 5 also shows the intensity of discomfort in the surveyed body segments sorted from highest to lowest values. There was a high level of intensity of discomfort for: "shoulders/upper arms" (8.4), "lower back" (8.2), "upper back" (8.0), "hips/upper legs" (7.7), "head/neck" (7.0) "elbows/forearms" (6.9) "wrists/hands" (4.3). Moreover, refuse collectors complained of limited mobility because of discomfort especially in the case of "shoulders/upper arms" (83.3%—at work, 75.0%—outside of work), "lower back" (83.3%, 66.7%, respectively), "upper back" (75%, 75%, respectively), and "hips/upper legs" and "head/neck" nearly at 50% at work and beyond.

Table 3 Current discomfort and restricted mobility in different parts of the body

	Body parts	Intensity	Restricted mobility (%)	
			Before work	After work
1	Head/neck	7.0	50.0	41.7
2	Shoulders/upper arms	8.4	83.3	75.0
3	Upper back	8.0	75.0	75.0
4	Elbows/forearms	6.9	25.0	25.0
5	Lower back	8.2	83.3	66.7
6	Wrists/hands	4.3	8.3	8.3
7	Hips/upper legs	7.7	50.0	50.0
8	Knees	3.0	0.0	0.0
9	Ankles/feet	2.1	8.3	8.3

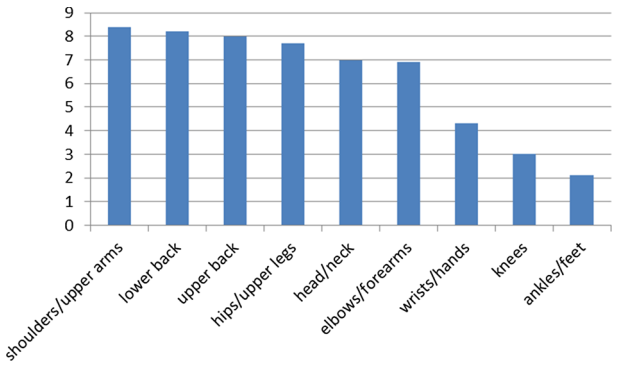

Fig. 5 Intensity of discomfort in the surveyed body segments

4 Discussion

The results of this work show that prior to work, significant values for fatigue were recorded for the symptoms "give a yawn" (4.6) and "become drowsy" (3.3). This could be a result of fewer hours of sleep, as employees work began about 5:00 in the morning. Both symptoms may have an impact on "the desire to position themselves to lie down" (2.5). In turn, the operation led to a statistically significant increase in the intensity of 22 symptoms, but only in 13 cases is the measured intensity higher than the value of 2.5. The symptoms "give a yawn" and "become drowsy" increased ($p < 0.01$, $p < 0.01$, respectively) which could give rise to "want to lie down" ($p < 0.001$). Moreover, these symptoms also have a high intensity before work. It has been reported in this paper that there was also a significant increase in "feel strained in the eyes" ($p < 0.001$), which could be caused by exposure to toxic substances (Park et al. 2011), as operators work in conditions of high-risk biological (micro-organisms) and chemical agents (Ivens et al. 1997; Poulsen et al. 1995; Sigsgaard et al. 1994). Also, refuse collectors are exposed to physical factors such as noise and vibration due to traffic, the

moving refuse truck: sitting in the cab or standing on the riding steps at the back of the car, handling equipment for emptying garbage containers and crushing and being in the vicinity of such activities. These factors may also cause an increase in intensity in "feel unsteady in standing" ($p < 0.001$ as well as "feel the hot or muddled brain" ($p < 0.01$) or "have a headache" ($p \ll 0.001$).

In this study, also found was an increase in intensity for "get tired over the whole body" ($p < 0.001$, "become rigid or clumsy in motion" ($p < 0.001$ and "get tired in the leg" ($p < 0.001$. These symptoms indicate an increase in physical fatigue, which could be related to the physical nature of the work and ultimately result in increased feelings of "want to lie down" ($p \ll 0.001$ in refuse collectors. Furthermore, the loading work requires a lot of physical effort associated with frequent lifting, pushing or pulling of the containers of garbage and long walks (Jóźwiak et al. 2013). Increased physical activity could result in increased feelings of physical fatigue after work, such as "feel stiff in the shoulders" ($p \ll 0.001$), "feel a pain in the back" ($p \ll 0.001$, which could have contributed to an increase in the intensity of the symptom "feel thirsty" ($p \ll 0.001$, which also could be caused by sweating and failure to consume adequate amounts of fluids.

The dependence of the intensity of fatigue took the form of $T_I > T_{III} > T_{II}$, which suggests that the work of refuse collectors is of the generally-demanding type. The same type of work is characteristic of electricians, plumbers and concreters (Chang et al. 2009), as opposed to jobs such as construction workers (Hsu et al. 2008), scaffolders, steel fixers and farm workers, whose work is the physically-demanding type (Chang et al. 2009).

Based on an interview with employees, it became evident that not all containers were equipped with wheels or not all wheels were technically sound, which greatly hampered the transport of the container to the truck. In addition, loaders faced many other obstacles or impediments in the form of: unpaved, uneven surfaces, protruding curbs, distance from location of containers. In such cases, an increased difficulty is experienced in operating the container, and more force is necessary for pushing, pulling and carrying the container. Workers are often bent forward while hauling containers, especially in cases where the container movement is difficult. These factors may bring about the appearance of a high intensity of discomfort in the body segments "shoulders/upper arms" (8.4), "lower back" (8.2), "upper back" (8.0), "hips/upper legs" (7.7), "head/neck" (7.0) and "elbows/forearms" (6.9). The level is, however, slightly lower for "wrists/hands" (4.3). The works of other authors report that pushing and pulling tasks are associated with low-back and shoulder complaints (Hoozemans et al. 1998, 2002). In addition, the high prevalence of MSDs among refuse collectors has also been reported in other studies (An et al. 1999; Ivens et al. 1998; Poulsen et al. 1995). Moreover, the results of this work show that the intensity of the discomfort felt by workers limited their mobility both at and after work in the segments: "shoulders/upper arms" (83.3%—at work, 75.0%—outside of work), "lower back" (83.3%, 66.7%), "upper back" (75%, 75%) and "hips/upper legs" and "head/neck" nearly 50% at work and beyond. Difficulties relate primarily to those body segments that have experienced a significant volume of MSDs.

5 Conclusions

The results of the study indicate that most refuse collectors complained about "drowsiness and dullness" rather than the "projection of physical impairment" and the "difficulty in concentration". It was the presence of a high intensity of discomfort primarily in the upper body segments which made worker mobility difficult during both operation and after work.

It should be mentioned that during the research described above, many observations have been made, which indicate that at work there are unusual additional stress situations. These loads result from damage to containers, their incorrect filling, as well as the loading of large containers by one person instead of a two-person team.

The results of this study can be used in the prevention of fatigue and discomfort. It is recommended to conduct training on correct working practices (e.g. posture during operation) and rest and the repair or replacement of faulty containers (e.g. those without wheels).

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