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Physical load analysis in hotel cleaning work

H. Kalkis[1,2,*], Z. Roja[3] and V. Kalkis[3]

[1]Institute for Occupational Safety and Environmental Health, Riga Stradins University, 16 Dzirciema Street, Riga, LV-1007, Latvia; [*]Correspondence: henrijs.kalkis@rsu.lv
[2]Faculty of Economics and Management, University of Latvia, Aspazijas blvd. 5LV-1050, Riga, Latvia
[3]Ergonomics research Centre, University of Latvia, K. Valdemara 48, LV-1013 Riga, Latvia

Abstract. Hotel cleaning work is one of the physically demanding professions. Employees in hotel cleaning processes are subjected to compulsory work postures, frequent body, arm, and leg movements, awkward turns due to areas of restricted spaces or inappropriate work equipment. Such workload can result in health problems and deteriorate health. Therefore, the aim of the research was to determine the physical load for hotel office cleaning staff. 23 hotel cleaners, all female, participated in the investigation participated. For the physical load analysis, a questionnaire, the Key Indicator Method, the quick exposure check method, and heart rate monitoring were chosen. It was proved in this research that the work of hotel office cleaners corresponds to the category of light and moderate workload despite the fact that hotel office cleaners themselves consider the work process to be very intensive and physically demanding. Further studies are necessary in order to clarify the fatigue level and other social risks that can influence the physical workload of employees.

Key words: hotel cleaners, workload, ergonomics, shift work.

INTRODUCTION

Excessive workload can result in health problems and worsen health in the current changing labour market. In the European Union countries, musculoskeletal disorders (MSD) affect more than 40 million employees, comprising gross domestic product (GDP) costs of 0.5 to 2.0%. Almost 30% of employees in Latvia report an increase in physical workload (Woolfson et al., 2008). Musculoskeletal disorders are the most common form of work related ill health and forms 60–62% of the total number of work related disorders (Fit for Work, 2012). Awkward, extreme, or repetitive working postures have been referred to as the main risk factors of MSD in various industries (Silverstein et al., 1987; Bernard, 1997). Often the cause of MSDs can be not only awkward postures, but also hard manual work, which significantly affects the ability to work and quality of life for employees (Monteiro et. al., 2009; Picavet & Hoeymans, 2004). The problems include backache and slipped discs, upper limb disorders, tenosynovitis, pain, numbness, swelling, and tingling in the hands and wrists. It is known that psychosocial work conditions (i.e. work strain and social support) are

significantly related to discomfort in different body parts after work (Jablonska et.al., 2006).

Hotel cleaning work is one of the physically demanding professions. Cleaners increasingly work under severe time constraints. In the same time, it should be emphasized that hotel cleaning work is very intensive, where employees are subjected to compulsory work postures, frequent body, arm, and leg movements, awkward turns due to areas of restricted space, or inappropriate work equipment. Other risk factors, such as chemicals, etc. are also relevant (Bell & Steele, 2011; Hsieh et al., 2013). This combined effect of risks dramatically increases the likelihood of MSD (EU-OSHA, 2009) that can influence the ability to work and quality of life for workers (Monteiro et al., 2009).

Hence, the aim of the research was to determine the physical load for the hotel office cleaning staff that is employed in office rooms, incl. conference rooms, hallways, shower rooms, toilets, and cloakrooms cleaning processes.

MATERIALS AND METHODS

Participants. Hotel cleaners were recruited from one of the medium-sized hotels in Latvia. 23 hotel cleaners participated in the investigation, all women with the average age of 42.6 ± 7.3 and length of service of 5.2 ± 2.4. The physical workload of hotel cleaning staff was analysed in 8 hour shifts in the following work processes:

- Manual toilet cleaning, using chemical cleaning products and cloths
- Manual shower cleaning, using chemical cleaning products and cloths
- Manual sink washing using chemical cleaning products and cloths
- Manual cloakroom cleaning, including cupboard, wall cleaning, using chemical cleaning products and cloths
- Hall and corridors floor cleaning with vacuum cleaner
- Conference room cleaning, including table, window, door cleaning and work with a vacuum cleaner, also manual cleaning using chemical cleaning supplies and wiping cloths (Fig. 1).

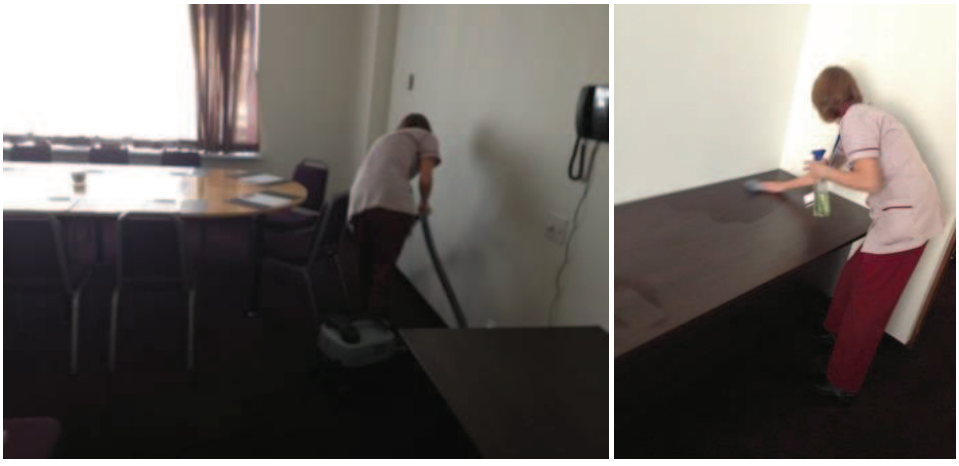

Figure 1. Conference room cleaning operations.

The inclusion criteria were: age, health status after mandatory examination, and full consent to participate in the study. The exclusion criteria were: acute pain in different body parts, cardiovascular diseases, undergone any muscular-skeletal surgery, having not attended the mandatory medical examination. Prior to the study, participants completed a questionnaire to find out the opinion of the workers about the ergonomics risks, work conditions and physical load impact on different body parts.

The Key Indicator Method (Steinberg, 2006; Klussmann et al., 2010) was used for assessment of the lifting, holding, carrying of heavy loads (KIM-LHC) as well as for manual handling operations (KIM-MHO).

The quick exposure check (QEC) method was applied in the research in order to carry out quick identification and assessment of the influence of the workload on the body parts of hotel cleaning staff (Brown, Li, 2003).

Heart rate monitoring (HRM) allowed to estimate the work heaviness degree depending on the workers' physical activity (intensity). The measurement was based on heart rate (HR) variation, which correlates with oxygen consumption and allows to quantify the objective energy expenditure for each work phases including short rest periods (Jackson et al., 1990). HRM was performed using the POLAR S810i™ Heart Rate Monitor device and the data processing software Polar Precision Performance.

Work heaviness in terms of energy expenditure was classified according to the classification scale shown in Table 1.

Table 1. Work heaviness classification in terms of energy expenditure (Mantoe et al., 1996)

Work heaviness category (WHC)		Energy expenditure	
NIOSH (USA) standard, ISO 28996		Male, kcal min^{-1}	Female, Kcal min^{-1}
Light work	I	2.0–4.9	1.5–3.4
Moderate work	II	5.0–7.4	3.5–5.4
Hard work	III	7.5–9.9	5.5–7.4
Very hard work	IV	10.0–12.4	7.5–9.4
Ultimate work	V	more 12.5	more 9.5

RESULTS AND DISCUSSION

The survey results show that employees in the hotel office cleaning work process are subjected to dynamic, static-dynamic work. All hotel cleaning staff (n = 23) noted that they lifted and moved no more than 5 kg heavy burdens in the process, and the frequency of lifting or moving heavy burden was up to 10 times per shift. At the same time, it was noted that everyday work involved chemical substances. In interviews, the hotel cleaning staff (n = 23) complained about intensive hand and leg movements, awkward postures: frequent bending, twisting, reaching, or crouching during the work process. The following main discomfort areas were marked: neck, shoulders, arms and hands, upper back, legs. The hotel cleaning stuff (n = 23) remarked that intensive work only took 3.8 ± 1.3 hours per shift.

The workload severity risk range for the activities involving lifting, holding, and carrying analysed for the hotel cleaning staff with the KIM-LHC method are summarised in Table 2.

Table 2. KIM-LHC method risk scores (RS), standard deviation (SD), risk range (R) for hotel cleaning staff (n = 23)

Work process	RS±SD	R I – V
Manual toilet cleaning using chemical cleaning products and cloths	4.3 ± 1.6	I
Manual shower cleaning using chemical cleaning products and cloths	4.5 ± 1.1	I
Manual sink washing using chemical cleaning products and cloths	5.2 ± 1.4	I
Manual cloakroom cleaning, including cupboard, wall cleaning using chemical cleaning products and cloths	4.9 ± 1.0	I
Hall and corridors floor cleaning with vacuum cleaner	8.7 ± 1.3	I
Conference room cleaning, including table, window, door cleaning and work with a vacuum cleaner, also manual cleaning using chemical cleaning supplies and wiping cloths	10.2 ± 1.3	II

The results in Table 2 shows that in various work processes, the workload for hotel cleaning staff is minimal and corresponds to risk degree I, since the maximum weight being lifted and carried is only 5 kg and the frequency does not exceed 10 times per shift. In the process of cleaning conference rooms, the risk degree corresponds to risk degree II (increased physical workload). That can be explained with more intensive work with vacuum cleaner, frequent arm movements, and it is in accordance with other authors' investigations (Bell & Steele, 2011). According to this method, the work hardness categories (or risk range) are: I – light work or low load situation ($RS < 10$); II – moderate work or increased load situation ($RS = 10…25$). If the risk range is II, physical overload is possible for persons older than 40 or younger than 21 years, newcomers in the job, or people suffering from illness.

The workload severity risk ranges R for manual handling activities analysed for hotel cleaning staff with the KIM-MHO method are summarized in Table 3.

Table 3. KIM-MHO method risk scores (RS), standard deviation (SD), risk range (R) for hotel cleaning staff (n = 23)

Work process	RS±SD	R I – V
Manual toilet cleaning using chemical cleaning products and cloths	8.1 ± 1.6	**I**
Manual shower cleaning using chemical cleaning products and cloths	7.4 ± 1.3	**I**
Manual sink washing using chemical cleaning products and cloths	7.9 ± 1.4	**I**
Manual cloakroom cleaning, including cupboard, wall cleaning using chemical cleaning products and cloths	8.2 ± 1.1	**I**
Hall and corridors floor cleaning with vacuum cleaner	8.6 ± 1.2	**I**
Conference room cleaning, including table, window, door cleaning and work with a vacuum cleaner, also manual cleaning using chemical cleaning supplies and wiping cloths	8.5 ± 1.7	**I**

After the assessment of manual handling activities, it can be concluded that in spite of frequent, repetitive hand movements in various operations, hotel cleaning stuff is subjected to risk range I (low workload) according to the KIM-MHO method results. Such result can be explained by the fact that each cleaning operation takes no longer than 15 minutes and rest time between operations is 15–30 minutes, sometimes even 45 minutes. It depends on the intensity of the office and conference events at the hotel.

The assessment of the influence of workload on body parts using the QEC method showed that the results do not coincide with survey results and other authors' investigations (Bell, Steele, 2011). The QEC exposure scores for the back, shoulder/arm, wrist/hand, neck have been categorised into 4 exposure categories: low, moderate, high, or very high (see Table 4).

Table 4. QEC method exposure scores (Brown & Li, 2003)

	Exposure level			
Score	Low	Moderate	High	Very high
Back (moving)	10–20	21–30	31–40	41–56
Shoulder/arm	10–20	21–30	31–40	41–56
Wrist/hand	10–20	21–30	31–40	41–46
Neck	4–6	8–10	12–14	16–18
Work pace	1	4	9	–
Stress	1	4	9	16

In the research, the highest exposure scores have been categorized into moderate exposure level for back (16.3 ± 1.9), shoulder/arm (18.1 ± 2.4), work pace (4.0 ± 1.1) and stress (4.0 ± 0.9). The wrist/hand movements were assessed as low exposure (14.2 ± 0.6) that is in accordance with the KIM-MHO results. The exposure scores investigated by the QEC are shown in Table 5.

Table 5. QEC method exposure scores for the hotel cleaning staff (n = 23) body areas

	Toilet cleaning	Shower cleaning	Sink washing	Cloakroom cleaning	Hall and corridors floor cleaning	Conference room cleaning
Back (moving)	18	18	18	18	18	18
Shoulder/ arm	18	22	18	22	18	18
Wrist/ hand	14	14	14	14	18	18
Neck	6	6	6	6	6	6
Work pace	1	1	1	1	1	1
Stress	1	1	1	1	1	1
Total score	66	70	66	70	70	70
Exposure level	Low	Low	Low	Low	Low	Low

In order to justify the results of the quantitative methods, the objective heart rate monitoring method was applied. The heart rates of the studied hotel cleaning staff was observed after 15 minutes of intensive work which comprised of several work cycles: lifting and moving weights, unsuitable work heights, bending, twisting, reaching or crouching, repetitive movements, rapid hand movements.

The calculation of the measurement revealed that the average hotel cleaner energy consumption was 3.2 ± 1.4 kcal min^{-1}. Hence, the level of work heaviness of the employees according to the work heaviness classification data corresponds to the risk level I (light work category). Hence, the HRM analysis confirmed the work heaviness categories according to the KIM, QEC methods. Table 6 summarises the results of heart rate monitoring and the indices of energy consumption.

Table 6. Hotel cleaning stuff heart rate (HR), Pearson's correlation (r), energy expenditure (E), work heaviness category (WHC)

Occupation	Heart rate monitoring			Average	WHC
	Average HR ± SD, beats/min	Range HR, beats/min	r	E ± SD, kcal/min	
Hotel cleaners (n = 23)	82 ± 9.1	79–93	0.95	3.0 ± 0.6	Light work

Determining the differences of all hotel cleaners, it can be concluded that the heart rate increased only in case of elderly cleaners (n = 7; 45.2 ± 2.6), but not significantly during the conference rooms cleaning process when the conference breaks take place (10 –15 minutes). The average energy expenditure increased by approximately 1.2 ± 0.5 kcal min^{-1}, therefore increasing the work heaviness category but not higher than category II – moderate work (3.5–5.4 kcal min^{-1} for females). After taking the rest break, the heart rate returned to the normal level (60–70 beats min^{-1}).

In this investigation, it was proved that the work of hotel office cleaners corresponds to the light and moderate workload category despite the fact that hotel office cleaners themselves consider the work process to be very intensive and physically demanding. These results were based on mathematical calculations (KIM, QEC methods) and objective measurements (HRM), but are not completely in accordance with findings of other authors, where cleaning work is characterised by working under time pressure, poor work organisation, and high psychosocial risks (Woods et al., 1999; Bohle et al., 2004). It could be explained by the fact that the research was only oriented to investigating the workload of office cleaners, but not of hotel room cleaners whose workload is characterised by more compulsory work positions and movements (Hsieh et al., 2013). In such investigations, it is suggested to analyse the impact of physical load in combination with other work environment risks (chemicals, noise, vibration, ventilation, fatigue, etc.) that can worsen the influence of the physical workload on hotel cleaning stuff.

CONCLUSIONS

The quantitative and objective physical load analysis methods for hotel cleaning staff confirmed that the workload of hotel cleaning staff is only increased during the conference breaks when the job is most intensive. Further studies are necessary in order to clarify the fatigue level and other social risks (work organization, lifestyle, habits, etc.) that can influence hotel cleaners` physical workload and wellbeing.

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