

Ergonomic Risks at Work and Preventive Measures for Waste Sorting Operators and Garbage Collectors in Waste Sorting Company

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ABSTRACT

The workers who are involved in the collection and sorting of waste are susceptible to a range of occupational hazards, such as musculoskeletal disorders, respiratory issues, physical harm. The aim of the study was to analyze ergonomic risks for waste sorting operators and garbage collectors, in one of the waste processing companies in Latvia and to develop preventive measures. The questionnaire and several ergonomic risk analysis methods were used in order to find out the opinion of workers about ergonomic strain and assess the ergonomics risks at the workplaces. Results show that waste sorting operators and garbage collectors are exposed to a range of ergonomic risks at work during work shifts. The ergonomic risk assessment methods used in the study revealed that both groups are exposed to a moderate workload with an overall risk level of III. This suggests that the occupations studied are subjected to overload at the work and preventive measures have been suggested.

Keywords: Sorters, Collectors, Waste, Ergonomics, Risks

INTRODUCTION

According to a report by the European Environment Agency (Eurostat, 2023), Latvia is one of the leading countries in the European Union (EU) in terms of waste processing. The report states that the proportion of processed waste in Latvia is 61% of the total amount of processed waste, which is comparable to Italy and Belgium. In order to establish an environmentally friendly waste management system, it is essential to have people, consumers of goods and services, sort their waste. The waste is then transported to sorting centers, where it is further sorted based on the type and quality of the material into useful waste, suitable for utilization, and waste for disposal. The useful waste is then sent to factories for recycling, while the unsuitable waste is sent to landfills.

According to Eurostat data, waste repair, reuse and recycling it was established that low wages and labor-intensive jobs prevail among those employed in these industries (Llorente-González and Vence, 2020). These studies also indicate that most of the workers in recycling plants are migrants, and typically paid the minimum wage. The mentioned study confirms that unpaid

and low-paid work has increased significantly. Often health problems caused by ergonomic hazards are related to labor shortages, budget constraints, lack of personal protective equipment (PPE) and low levels of mechanization (Melaku and Tiruneh, 2020). Some studies indicate that workers in waste sorting and recycling basically exposed to two types of tasks: work in standing position and uniform hand movements, facing long hours, few breaks, monotonous tasks in a noisy, smelly and confined environment, facing a conveyor belt running at a high speed (Weghmann, 2017).

The workers involved in waste collection and sorting are prone to various occupational risks, including musculoskeletal disorders, respiratory problems, physical injury, liver disorders, occupational exposure, gastrointestinal issues and skin diseases. Waste sorters and garbage collectors may come into contact with different types of chemicals that have been thrown into the waste (Emmatty and Panicker, 2019; Onoja-Alexander et al., 2020; Bulduk, 2019). In several scientific publications, the authors indicate health problems caused by the ergonomic risks of work, which affect the neck and shoulder girdle, forearm, wrist and lower back (Lim et al., 2011; van Kampen et al., 2020). Health problems caused by ergonomic risks are associated with workload due to lifting, carrying, pushing/pulling of heavy objects and awkward postures in standing or sitting positions (Poole and Basu, 2017; Kalkis et al., 2018). In order to prevent the development of the Work-related Musculoskeletal Disorders (WRMSD) the attention of latest researches is drawn to the assessment of occupational and ergonomic risks, as well as various factors related to ergonomic risks while performing the work task (Andersen et al., 2007; Rose et al., 2020). The literature describes the experience of several EU countries, which basically reflects the fact that these work processes are now robotised and the operator just pushes only buttons in control panels (Weghmann, 2023).

Altogether 20 waste sorting operators (aged 45.30 ± 13.95) and 14 garbage collectors (aged 54.21 ± 12.01) participated in the study, all males. Background factors of the subjects including age and length of service are represented in Table 1. The inclusion criteria were: having discomfort feelings in the region of neck, shoulder, arm, hand, legs after the job; full consent to participate in the study. The exclusion criteria were: acute or chronic pain in the neck, shoulder, arm, hand, legs which were found in the health examination.

Table 1. Background factors of the subjects who participated in the study.

Subjects and length of service	n	Age (average \pm standard deviation)	Range
Waste sorters	20	45.30 ± 13.95	23-68
(0-5 years)	12	42.92 ± 12.94	23-63
(6-15 years)	7	47.43 ± 16.16	28-68
(> 16 years)	1	59	59
Garbage collectors	14	54.21 ± 12.01	34-69
(0-5 years)	5	45.80 ± 11.58	34-60
(6-15 years)	6	56.50 ± 10.45	42-69
(> 16 years)	3	63.67 ± 8.39	54-69

The aim of the study was to analyze ergonomic risks for waste sorting operators and garbage collectors, in one of the waste processing companies in Latvia and to develop preventive measures. The study has been approved by Ethics committee of University of Latvia.

METHODS

The questionnaire was used to identify the categories of workers, who are most exposed to intensive hand movements, work organisational risks, working time. In the questionnaire, participants indicated their age, length of service in the profession, level of education, information on physical activity, and which parts of the body experience discomfort or pain after work. In the research such methods for evaluation of ergonomics risks were utilized.

- Key Item method (KIM) (Steinberg, 2012). The Key Indicator Method for Manual Handling Operations (KIM-MHO) is a tool used to assess work activities that involve exposure to the finger-hand-arm area in manual work operations.
- Rapid Upper Limb Assessment (RULA) (McAtamney and Corlett, 1993). Method enables quick evaluation of posture and categorization of risk factors by assigning a score. Based on the score, a certain level of action is established to indicate whether the posture is acceptable or if changes are necessary.
- Rapid Entire Body Assessment (REBA) (Hignett and McAtamney, 2000). Method is a tool used to evaluate the risk of musculoskeletal disorders (MSDs) associated with specific job tasks. It is a whole-body screening method with assessment of biomechanical and postural load on the body.
- Quick Exposure Check (QEC), (David et al., 2005). Method is used to assess exposure to risk factors for WRMSDs and helps to develop ergonomic interventions at the workplaces.

RESULTS AND DISCUSSION

Survey Results

The survey data showed that the average age of waste sorters and garbage collectors ranged from 23 to 69 years and the average length of service in the profession from 0 to 19 years. Of the 20 waste sorters, 12 had between 0 and 5 years of experience (length of service) in the profession and 7 had between 6 and 15 years. It should be noted that the employees were in different age groups. This shows that waste sorters are not interested in working in the company for a long period. It is due to such factors as hard manual work and the low salary. Studies by other authors prove similar findings (Llorente-González and Vence, 2020). The majority of garbage collectors (6 employees) have 6 to 15 years of experience in the occupation in the age group 42–69 and 5 have 0 to 5 years in the age group 34–60. For both occupations, 94.25% of the employees indicated that they had an elementary school education. None of the waste sorters and collectors engage in physical activities during and

outside working hours. Essentially to mention that the employees smoke and consume alcohol in their free time.

The survey data showed that workers have strain on their shoulders, neck, arms, legs and back during the work process, which is also in line with studies by other authors (Lim et al., 2011). Employees in the age group 18–30 years complained more about discomfort in legs and back (100%) and they were mainly waste sorters, in the age group 31–50 years. Workers complained more about discomfort in back and shoulders (100%), in legs (73.3%), neck area (66.6%) - similar in both the groups studied. In the age group 51–69 years, discomfort in the arms (93.7%), neck area and shoulder girdle (87.5% and 81.2%, respectively), less in the back and legs (see Table 2) was noted. In author's opinion, this could be explained by the fact that elderly workers have adapted to their work and working conditions over time, learning more comfortable working techniques.

Table 2. Employees' opinion on stressed body parts during work.

Age groups	Body parts	Count (n)	%
18–30 (n = 3)	Neck	0	0
	Legs	3	100
	Back	3	100
	Shoulder	0	0
	Arm/hand	0	0
31–50 (n = 15)	Neck	10	66.6
	Legs	11	73.3
	Back	15	100
	Shoulder	15	100
	Arm/hand	13	86.6
51–69 (n = 16)	Neck	14	87.5
	Legs	7	43.7
	Back	12	75.0
	Shoulder	13	81.2
	Arm/hand	15	93.7

Results of Ergonomic Load Analysis of Waste Sorting Operators

The work is organized in shifts of 12 hours. The employees work two consecutive days and then have two days off. There are 8 to 10 employees per shift every day. Waste sorting operator sorts waste sliding along a conveyor belt by throwing it to the right or left into separate compartments. The conveyor belt speed is adjustable and the height is 1.0 m. The height of the compartments is 1.0 m, the width is 45 cm and the length is 1.4 m. The width of each workstation is 1.5 m. An emergency stop switch (tensioned metal cable) is located perpendicularly, 15 cm above floor level, under the conveyor belt on both sides, and another one is located perpendicularly to the conveyor at the top. The workers clean the work area themselves. During one shift, the workers sort about 27 t of waste material. White paper is placed in separate bags. The bags weight approximately 20 kg each, which must be lifted and

dropped into the waste compartment in height of the 1.0 m. The waste sorters are exposed to load on shoulders, arms, legs during the work process.

The KIM-MHO method analysis results show that waste sorters are at the high risk level of III category. This means that there is a significant increase in physical stress on the arms and shoulders and measures are needed to reduce the risk regarding work related muscular diseases. It corresponds to the worker's opinion expressed in the questionnaire. The results of the QEC method were evaluated and a risk level of III was obtained. The work activity has an increased load on the shoulders, arms and joints, as well as on the back. See Table 3 for representation of QEC scores for waste sorting operators.

The REBA method results for whole-body workload analysis gives a score of 5, corresponding to a risk level of III. This means that an increased risk has been identified. The RULA method results score for upper limb strain is also 5, corresponding to a risk level of III. This means that the risk is medium in accordance with the methodology.

Table 3. QEC scores for waste sorting operators.

Back	Shoulders/ Arms	Hands/ Wrists	Neck	Pace of work	Stress	Total	Risk degree
22	28	36	6	4	4	100	III

Overall, the ergonomic assessment results show a risk level of III. This means that the workers have a significantly increased physical strain on the whole body and that the muscles and joints of the back, shoulders, lumbar spine, forearms and wrists are found to be overloaded during the work process. It corresponds to the questionnaire results where workers complain about the discomfort in the back and shoulders, wrists and finger joints.

Results of Ergonomic Load Analysis of Garbage Collectors

Working hours for garbage collectors are 8 hours per working day. The garbage collectors push the waste container to the back of the car, then places the container in its designated place. He has to pick up any rubbish that has fallen out during the collection process. Basically, the collector can do this job without the help of others, but in winter, when the snow is not cleared, a waste collector car driver is needed to push the container to the waste truck. The garbage collector is basically exposed to a dynamic type of work (frequent pushing, pulling movements involving the muscles of the legs, arms, back) which causes strain on the muscles, resulting in discomfort or even pain.

The assessment using the KIM-MHO indicates that lifting and handling of heavy loads and assessment of frequent manual handling is at risk level III. This indicates that there is an increased physical strain in whole body for garbage collectors. The assessment of the QEC method for individual body part strain results in a risk level of III. Especially the increased workload is on shoulders, arms and the back. See Table 4 for representation of QEC scores for garbage collectors. The REBA method results for whole-body

workload analysis for garbage collectors shows a score of 4, corresponding to a risk level of III. This means that an increased risk has been identified and it aligns with the RULA method results where score for upper limb strain is 6, corresponding to a risk level of III. This means that the risk is medium in accordance with the RULA methodology.

Table 4. QEC scores for garbage collectors.

Back	Shoulders /Arms	Hands /Wrists	Neck	Pace of work	Stress	Total	Risk degree
22	24	30	6	4	4	90	III

Overall, the results of ergonomic risk analysis show a total risk level of III. This means that the workers have a significantly increased physical strain on the whole body and during the work operations garbage collectors are exposed to physical overload. Such overload results of workers who are exposed to physical load can be found also in other researchers (Roja et al., 2017a; Roja et al., 2017b). During the survey, workers complained of back and shoulder pain, as well as wrist and finger pain, which can be attributed to the workload. The results are consistent with other studies (Kong et al., 2011), for example given that workers often work in a flexed posture and that the arms, shoulder girdle and back are primarily loaded during work. And in such situation subjective discomfort scores increase with increasing back and shoulder flexion angles. Future research will not only focus more on the calculations and impact of ergonomic load, but will also compare workers' subjective views with objective measures such as heart rate, muscle fatigue, etc.

CONCLUSION

Waste sorting operators and garbage collectors are exposed to various ergonomic risks at work, as shown by the results of the ergonomic risk assessment methods used in the study. For both groups, the assessment of ergonomic strain resulted in the overall risk level III, indicating that the occupations studied are exposed to moderate workload. Preventive measures have been developed taking into account the financial and technological capacity of the organization to modernize, automate or robotize the waste sorting and garbage collecting work operations.

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