

Factors Related with Musculoskeletal Disorders on Garbage Carrier Workers

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Submitted:04/03/2025 **Revised:** 20/03/2025 **Accepted:** 12/04/2025 **Published online:** 28/04/2025

doi:<https://doi.org/10.35308/j-kemas.v12i1.11632> **How to cite this article:** Annisa, YZ., Firdani, F., Fitriyani. 2025. Factors Related with Musculoskeletal Disorders on Garbage Carrier Workers. *J-Kesmas: Jurnal Fakultas Kesehatan Masyarakat (The Indonesian Journal of Public Health)*. 12 (1): 14-24

Abstract

Garbage collectors carry out manual work that requires physical strength when lifting and moving rubbish, which puts them at risk of experiencing Musculoskeletal Disorders complaints. Based on preliminary studies, 70% of waste collection officers in Padang City 2023 will experience serious MSD complaints. This research aims to determine the factors related to MSD complaints among waste collection officers in Padang City. This research used a cross-sectional design conducted from January to July 2023 with a population of 131 people and a sample of 62 people selected using Accidental Sampling. The dependent variable musculoskeletal disorder complaints and independent variables (age, BMI, years of service, work posture, physical workload, repetitive movements). Data analysis techniques use univariate analysis, bivariate analysis (chi-square) with 95% CI ($\alpha=0,05$), and multivariate (multiple logistic regression). 61.3% of workers experienced complaints of severe MSDs, 61.3% had age at risk, 32.2% had abnormal BMI, 54.8% had long working periods, 79% had unergonomic working postures, and 53.2% had moderate physical workload. Variables related to MSDs were age ($p=0.000$) with OR 10,7, years of work ($p=0.000$) with OR 8,4, work posture ($p=0.004$) with OR 8,3, and physical workload ($p=0.026$) with OR 3,8. Variables unrelated to MSD complaints were ($p=0.893$) and repetitive movements ($p=0.448$). The most dominant variable related to MSD complaints was length of service ($p=0.008$). There is a relationship between age, years of work, work posture, and physical workload with MSD complaints. The working period is the most dominant variable related to MSD complaints. We hope that workers carry out routine muscle stretching before work and provide education on ergonomic working methods for garbage carrier workers.

Keywords: garbage carrier workers; MSD

Introduction

Musculoskeletal disorders (MSD) are disorders of the skeletal muscles that are felt gradually from very mild complaints to very painful. Complaints include damage to joints, ligaments, and tendons due to forces receiving repeated static loads over a long period (Tarwaka, 2015). Complaints that are felt

can interfere with work activities, resulting in discomfort at work resulting in a decrease in a person's work productivity. Work activities involving pushing, moving, lifting, and activities that require human power and are carried out for a long duration will increase the risk of MSD complaints (Faisal et al., 2022).

The 2019 Global Burden of Disease (GBD) data shows that 1.71 billion people experienced musculoskeletal complaints, and 150.08 million experienced disability and death caused by MSD worldwide (Golden Burden of Disease, 2019). Based on Riskesdas in 2018, the prevalence of musculoskeletal complaints in Indonesia was 7.30%. In West Sumatra province, it was 7.21%, and in Padang City, it was 5.25%. The data states the prevalence of musculoskeletal complaints based on job characteristics, namely, farmers/farm laborers (8.25%), civil servants/TNI/Polri/BUMN (7.71%), and laborers/drivers (6.12%) (Kementerian Kesehatan RI, 2019).

Several factors, including individual factors, work factors, and environmental factors, can cause MSD complaints experienced by workers. Individual elements include age, gender, smoking habits, exercise habits, BMI, and years of work. Job factors consist of work posture, workload, work duration, repetitive movements, and Manual Material Handling (MMH) (Rahmah & Herbawani, 2021). Environmental factors consist of vibration, pressure, temperature, and humidity (Tarwaka, 2015). One of the jobs that poses a risk of ergonomic dangers and MSD complaints is waste collection officers. Waste transport officers carry out waste transportation to the Final Disposal Site (TPA) manually and mechanically. Filling containers is done manually by officers while transporting containers onto trucks is done mechanically (load haul) (Menteri Pekerjaan Umum Republik Indonesia, 2013). Manually transporting waste requires physical strength, requiring workers to stand, bend, and lift repeatedly and continuously. These activities can cause discomfort in the body parts, which can trigger MSD complaints (Rimantho, 2016).

Waste transport officers play a role in transporting waste to the landfill so that waste can be managed properly and correctly and does not pose a risk of causing health problems (Gulo et al., 2022). The increase in population, accompanied by increasing levels of public consumption, causes an increase in the amount of waste produced, increasing waste transporters' work capacity, which requires muscle strength in work activities (Rimantho, 2016). The increase in waste generated can impact the workload and energy required to carry out the activity of lifting debris into garbage trucks. As a result, energy transfer from the muscles to the skeletal system is not optimal (Tarwaka, 2015). Based on data from the National Waste Management Information System in 2022, the amount of waste generated in Indonesia reached 18.32 million tons per year, or 51,763 tons per day (*Capaian Kinerja Pengelolaan Sampah*, n.d., 2023). The amount of waste generation in West Sumatra is in 10th place with the highest waste generation in Indonesia, reaching 785,934.41 tons/year, and the city producing the most waste is Padang City (*Capaian Kinerja Pengelolaan Sampah*, n.d.). Padang City is one of the cities in Indonesia with an area of 694.96 km² with a population of 909,040 people (Badan Pusat Statistik Kota Padang, 2021;

BPS, 2020). Waste generation in Padang City has increased from year to year. In 2020, the waste produced was 232,259 tons. In 2021, it was 233,385 tons. In 2022, it was 234,973 tons.

Based on a preliminary survey conducted on 10 waste transport officers in Padang City using the Nordic Body Map questionnaire, the results showed that 3 workers with a high-risk level and 4 workers with a medium-risk level experienced complaints of musculoskeletal disorders. Many waste haulers' complaints are that 80% experience pain in the back, 70% experience pain in the waist, 70% experience pain in the left and right calves, and 60% experience pain in the upper right arm. Officers who carry out waste transportation with unergonomic body positions that are carried out continuously can result in injuries to the musculoskeletal system. Based on this background, it is necessary to research the factors related to MSD complaints to waste collection officers in Padang City.

Methods

This quantitative study uses a cross-sectional design with independent variables (age, BMI, length of service, work posture, physical workload, repetitive movements) and the dependent variable, namely MSD complaints. The measurement results are musculoskeletal disorders complaints, high complaints if they have a score of ≥ 42 and low complaints if they have a score of < 42 , Age, at risky if age ≥ 35 years and no risk if age < 35 years, years of work, long > 5 years and new ≤ 5 years, work posture, not ergonomic if score ≥ 4 and ergonomic if score < 4 , BMI, abnormal if BMI < 18.5 and > 25.0 and normal if BMI $18.5-25.0$, physical workload, middle ≥ 100 beats/minute and low < 100 beats/minute, and repetitive movement, At risky if > 4 times/minute and no risk if ≤ 4 times/minute. This research was conducted in January-July 2023 with a population of 131 waste collection officers in Padang City, with a sample of 62 people selected using accidental sampling techniques. The data source comes from primary data from observations and interviews using the REBA questionnaire to assess work posture and the NBM questionnaire to determine the level of MSD complaints (Tarwaka, 2015). The secondary data is data on the number of workers, TPS locations, and waste transportation routes from the Padang City Environmental Service. Data analysis used univariate, bivariate (chi-square) with 95% CI ($\alpha=0,05$), and multivariate (multiple logistic regression). This research has received information about passing ethical review from the Research Ethics Commission Team of the Faculty of Public Health, Andalas University No: 28/UN16.12/KEP-FKM/2023.

Results

Overview of Research Locations

Conducted this research at TPS locations and waste transportation routes in Padang City, spread across 137 sites and 30 waste transportation routes. The waste transportation work area in Padang City starts from the Mega Permai TPS to the Teluk Kabung Tengah TPS. Garbage collection officers work every day (Monday-Sunday) for 6 hours per day consisting of dump truck officers transporting waste directly from the roadside and arm roll officers transporting waste that has been collected at the TPS

with the same work activities, namely, picking up and loading rubbish on the truck, sweeping up the remaining debris at the transport location, and arranging the garbage on the truck for transport to the Aie Winter Landfill.

Univariate Analysis

Based on the univariate analysis in Table 1 found that 61.3% of waste transport officers in Padang City experienced serious MSD complaints, 61.3% of waste transport officers in Padang City were of risky age, 32.3% of waste transport workers with abnormal BMI, as many as 54.8% of workers waste transporters in Padang City with long working periods, as many as 79% of waste transport officers in Padang City with unergonomic working postures, as many as 53.2% of waste transport officers in the City with a medium workload category, as many as 58.1% of waste transport officers in Padang City carry out risky repetition movements.

Table 1. Frequency Distribution of MSD complaints, Age, BMI, Years of Work, Work Posture, Physical Workload, and Repetitive Movements among Garbage Carrier Workers

Variable	Frequency (f)	Percentage (%)
MSD complaints		
High	38	61,3
Low	24	38,7
Age		
Risky	38	61,3
No Risk	24	38,7
BMI		
Abnormal	20	32,3
Normal	42	67,7
Years of Work		
Long (> 5 years)	34	54,8
Short (\leq 5 years)	28	45,2
Work Posture		
Not Ergonomic	49	79
Ergonomic	13	21
Physical Workload		
Middle	33	53,2
Low	29	46,8
Repetitive Movements		
Risky	36	58,1
No Risk	26	41,9

Bivariate Analysis

The results of the bivariate analysis show that there is a relationship between the variables age (p-value = 0.000), years of work (p-value = 0.000), work posture (p-value = 0.004), and physical workload (p-value = 0.026) with MSD complaints to waste collection officers in Padang City. There was no relationship between BMI (p-value = 0.893) and repetitive movements (p-value = 0.448) with MSD complaints

Table 2. Relationship between Age, BMI, Years of Work, Work Posture, Physical Workload, Repetitive Movements with MSDs Complaints in Garbage Carriers Workers

Variable	MSD complaints				Total		OR	p-value
	High		Low					
	f	%	f	%	f	%		
Age								
Risky	31	81,6	7	18,4	28	100	10,755	0,000
No Risk	7	29,2	17	70,8	24	100		
BMI								
Abnormal	13	65	7	35	20	100	-	0,893
Normal	25	59,5	17	40,5	42	100		
Years of Work								
Long (> 5 years)	28	82,4	6	17,6	34	100	8,400	0,000
Short (≤ 5 years)	10	35,7	18	64,3	28	100		
Work Posture								
Not Ergonomic	35	71,4	14	28,6	49	100	8,333	0,004
Ergonomic	3	23,1	10	76,9	13	100		
Physical Workload								
Middle	25	75,8	8	24,2	33	100	3,846	0,026
Low	13	44,8	16	55,2	29	100		
Repetitive Movements								
Risky	24	66,7	12	33,3	36	100	-	0,448
No Risk	14	53,8	12	46,2	26	100		

Multivariate Analysis

Based on Table 3, the selection of variables for candidates for multivariate analysis is carried out by looking at the bivariate analysis results. Variables that have a p-value <0.25 are considered candidates to be included in the multivariate analysis. Candidate variables for multivariate analysis include age (p-value = 0.000), length of service (p-value = 0.000), work posture (p-value = 0.004), and physical workload (p-value = 0.026).

Table 3. Multivariate Analysis Results

Variable	B	Wald	p-value	OR	95% CI	
					Lower	Upper
Age	1,603	5,271	0,022	4,967	4,967	19,511
Years of Work	1,727	5,562	0,018	5,626	5,626	23,641
Work Posture	1,203	1,886	0,170	3,329	3,329	18,524
Physical Workload	1,079	2,165	0,141	2,942	2,942	12,387

-2 Log likelihood = 53,526

Nagelkerke R Square= 0,510

The results of the multivariate analysis show that the length of service variable is the most dominant variable related to MSD complaints seen from the OR value (5.626) and the B coefficient value (1.727). Based on Nagelkerke R Square is 51%, meaning the ability of the independent variable to explain the dependent variable is 51%, while the remaining 49% is determined by other factors not included in the model. The Exp value (B) or OR value of work experience is 5.626, meaning that the more respondents with long work periods, the higher the risk of someone experiencing MSD complaints compared to respondents with new work periods.

Discussion

MSD Complaints

Based on the results of research on 62 waste transport officers in Padang City, it was found that 38 (61.3%) experienced serious MSD complaints. The most common complaints were severe pain in the waist (58.1%), back (37.1%), right shoulder (35.5%), left and right calf (27.4%). Garbage collectors work in a bent position and twist their bodies to pick up and arrange rubbish, hands raised above their shoulders to throw trash, and jogging to pick up garbage, which is done repeatedly. This working position causes complaints of pain in the waste collection officers' waist, back, shoulders, and calves in Padang City. Based on Peter Vi's theory in Tarwaka (2015), MSD complaints are caused by excessive muscle stretching, repetitive activities, and unnatural work postures. Task demands, work tools, abilities and limitations of workers generally cause this (Tarwaka, 2015). The results of this research align with research by Zakaria (2017) on municipal solid waste collectors in areas near the East Coast of Malaysia. It was found that the complaints most often felt by workers were the waist (54.5%), back (27.7%), shoulders (22.7%), knee (22.7%) (Fac & Nfm, 2017).

Age

A total of 38 (61.2%) Padang City waste collection officers are at risk. Musculoskeletal complaints are usually experienced by people aged 24 – 65 years. The first complaint is experienced at the age of 35 years, and the level of complaints will increase with age. Increasing age is associated with decreased physical capacity because muscle strength decreases (Tarwaka, 2015). This study's results align with research by Bonini-Rocha (2021) on 70% of waste material scavengers from structural city dumps in Brasília, Brazil. Workers aged 36-45 years are workers at risk.

The analysis of the relationship between age and MSD complaints among Padang City waste collection officers shows a significant relationship between age and MSD complaints with a p-value of 0.000. Complaints of serious MSDs were higher in respondents aged at risk (81.6%) compared to those aged not at risk (29.2%). From the statistical test, it was found that the OR value was 10.755, meaning that officers of at-risk age had a 10.7 times risk of experiencing MSD complaints compared to officers of non-risk age. The age at risk of experiencing more severe MSD complaints is because a person's physical condition will decline as they get older. The results of this research are in line with research by Bonini-Rocha (2021), showing that there is a significant relationship between age and MSD complaints among solid waste scavengers in Brasilia, Brazil, with a p-value of 0.002 (Bonini-Rocha et al., 2021).

Body Mass Index (BMI)

Based on the research results, most waste collection officers (67.7%) in Padang City have a normal body mass index (BMI). Based on Tarwaka's (2015) theory, BMI is one of the factors causing MSD complaints, although its influence is relatively small. MSD complaints related to body mass are more caused by the balance condition of the skeletal structure in receiving loads (Tarwaka, 2015). Workers with abnormal BMI doing work with physical strength continuously will cause pressure on the spinal cord so that they risk causing complaints of MSDs (Tarwaka, 2015). This research is also in line with

research by Astuti et al. (2019), showing that of the 52 waste collection officers in Bandung Wetan District, 52 officers (62%) were in the normal BMI category, 15 officers (18%) were in the underweight category, and 17 officers (20%) were in the overweight category. The similarity with this research is that most waste haulers have normal body mass, and their work activities are carried out by manual lifting and are carried out repeatedly and continuously (Astuti, Rosady, et al., 2019).

The analysis of the relationship between BMI and MSD complaints among Padang City waste collection officers shows no significant relationship between BMI and MSD complaints, with a p-value of 0.893. Complaints of severe MSDs were higher in officers with abnormal BMI (65%) compared to those with normal BMI (59.5%). There is no relationship in this study. Because the distribution of BMI groups is uneven, most respondents have a normal BMI. The results of this study are in line with research by Astuti et al. (2019), which shows that there is no significant relationship between BMI and complaints of lower back pain among waste collectors in Bandung Wetan District with a p-value of 0.735 (Astuti, Rosady, et al., 2019).

Years of Work

A total of 34 (54.8%) had long service periods. Continuously carrying out work activities can result in pain or aches, which accumulate in the emergence of injuries, which risk giving rise to MSD complaints. Working periods that are too long cause fatigue in muscles and bones' physical and psychological endurance. The results of this research are in line with research by Dewi et al. (2023) on scavengers in the RDF TPST environment in Cilacap Regency, which stated that 35 respondents (61.4%) had long working periods (≥ 5 years), and 22 respondents (38.6%) had a new job (Dewi et al., 2023).

The analysis of the relationship between years of work and MSD complaints among Padang City waste collection officers shows a significant relationship between years of work and MSD complaints with a p-value of 0.000. Serious MSD complaints were experienced more frequently by officers with long service periods (82.4%) than those with new service periods (35.7%). The statistical test results showed that the OR value was 8.400, indicating that officers with a long service period had an 8.4 times greater risk of experiencing MSD complaints than officers with a new service period. This is because waste haulers use muscle strength, reducing muscle performance. After all, this pressure will accumulate every day, causing persistent and chronic complaints. The results of this research are in line with research by Dewi (2023), which shows that there is a significant relationship between years of work and MSD complaints among scavenger workers in the RDF TPST Cilacap Regency environment with a p-value of 0.06 (Dewi et al., 2023).

Work Posture

As many as 49 (79%) with unergonomic working postures. Based on observations made on waste collection officers in the city of Padang, it is known that unnatural working positions occur when officers bend down when picking up and arranging waste, have their hands raised above their shoulders when throwing rubbish, and unstable parts when throwing garbage. Unergonomic working positions with body positions that deviate from the average direction when doing work can cause local mechanical

stress on the part of muscles, ligaments, and joints (Tarwaka, 2015). The results of this research align with Sinaga's (2020) research on Medan City Waste Transport Officers, showing that out of 74 people with high work postures, 57 people (77%) complained of lower back pain, which is one type of MSD complaint (Sinaga, 2020).

The analysis of the relationship between work posture and MSD complaints among waste collection officers in Padang City shows a significant relationship between work posture and MSD complaints with a p-value of 0.004. Complaints about severe MSDs were more common among officers with unergonomic working postures (71.4%) compared to those with ergonomic working postures (23.1%). The statistical test results showed that the POR value was 8.333, indicating that officers with unergonomic working postures had an 8.3 times greater risk of experiencing MSD complaints than officers with ergonomic working postures. Unergonomic work postures are caused by repetitive lifting activities, bending and twisting the body to pick up rubbish, and raising the hands above the shoulders when lifting weights. This research is in line with research by Sinaga (2020), showing that there is a significant relationship between work posture and MSD complaints among Medan City waste collection officers with a p-value of 0.026 (Sinaga, 2020).

Physical Workload

As many as 33 (53.2%) were in the moderate physical workload category. Based on research results, the physical workload is felt to be heavier for dump truck officers because of activities such as throwing rubbish, arranging rubbish, going back and forth across the road to pick up garbage, and jogging to the next rubbish collection point. Meanwhile, arm roll officers only work at one TPS point by cleaning up the rubbish around it and arranging it in containers to be lifted onto trucks. When carrying out work, arm roll officers have longer breaks to rest than dump truck officers. Dump truck officers pick up trash directly from the side of the road until the truck is full, without stopping until the final transportation location. Excessive physical workload can be a risk factor for MSD complaints because it can cause extreme muscle stretching and the risk of causing muscle pain (Tarwaka, 2015). The results of this research align with research by Alfaridz (2023) on street sweepers in the Medan Johor District. There were 20 respondents (60.6%) with heavy workloads and 13 (39.4%) with medium workloads, indicating more workers with heavy workloads (Alfaridz & Harahap, 2023).

The analysis of the relationship between physical workload and MSD complaints among waste collection officers in Padang City shows a significant relationship between the physical workload variable and MSD complaints with p-value = 0.026. Complaints about severe MSDs were more common among respondents with moderate workloads (75.8%) compared to those with light workloads (44.8%). The statistical test results showed that the POR value was 3.846, which shows that officers with a moderate physical workload have a 3.8 times greater risk of experiencing MSD complaints than officers with a light physical workload. Workers ignore rest periods and muscle stretching before physical activities such as bending, carrying, and moving loads while doing work, resulting in the possibility of MSD complaints among workers. Excessive physical workload can be a risk factor for MSD complaints

because it causes extreme muscle stretching, causing muscle pain (Khofiyya et al., 2019). The results of this research align with research by Alfaridz (2023), showing a relationship between workload and MSD complaints among street sweepers in Kec. Medan Johor with a p-value of 0.000 (Alfaridz & Harahap, 2023).

Repetitive Movement

A total of 36 (58.1%) had risky repetition movements. Repetitive movement positions carried out by waste collection workers, such as bending, lifting, and moving waste, are repeated >4 times per minute, and workers ignore rest periods and muscle stretching before work, which can cause MSD complaints among workers. In line with Tarwaka's theory (2015), if muscles receive static loads repeatedly for a long time, it can result in complaints of MSD (Tarwaka, 2015). The results of this research are in line with research by Faisal et al. (2022) regarding the risk of MSD complaints among waste sorting workers at the Talang Tuo Jambi Waste Management UPTD, workers perform the most minor repetitive movements/minute and the most repetitive movements are 29 movements/minute. Shows that repetitive motions are included in the risk category (Faisal et al., 2022).

The analysis of the relationship between repetition movements and MSD complaints among waste transport officers in Padang City shows no significant relationship, with a p-value of 0.448. Complaints of severe MSDs were more common among respondents with risky repetitive movements (66.7%) compared to non-risky repetitive movements (53.8%). More repetitive movements are carried out by officers who arrange rubbish on trucks than officers who throw trash and jog to pick up garbage, so more repetitive movements are carried out by officers with lighter workloads. This is what makes it possible for the results of this research to show no relationship between repetition movements and MSD complaints from waste collection officers in Padang City. The results of this research are not in line with research by Faisal et al. (2022), which shows that there is a relationship between repetition movements and MSD complaints among waste sorting workers at the Talang Gulo Jambi Waste Management UPTD with a p-value of 0.007 (Faisal et al., 2022).

Work Period The Most Dominant Variable Associated with MSDs Complaints

The work period variable is the most dominant variable related to MSD complaints (p-value = 0.018), as seen from the OR value (5.626) and the B coefficient value (1.727). The substantial influence value (β) of supervision is 5.626, meaning that the risky work period causes the respondent's risk of experiencing MSD complaints to be 5.626 times higher compared to respondents with a new work period controlled by age, work posture, and physical workload variables. Based on Nagelkerke, R Square is 51%, meaning the ability of the independent variable to explain the dependent variable is 51%. In comparison, the remaining 49% is determined by other factors not included in the model.

The work carried out by waste haulers is done manually. It requires physical strength, such as lifting, bending, and moving loads transported using manual handling with the same activities every day. This work is carried out by dump trucks and arm roll waste haulers from Monday to Sunday without any time off. Continuously carrying out work activities can result in pain or aches due to fatigue in the physical

and psychological endurance of muscles and bones, which risks causing MSD complaints.

The results of the multivariate analysis show that the length of service variable is the most dominant variable related to MSD complaints seen from the OR value (5.626) and the B coefficient value (1.727). Based on Nagelkerke R Square is 51%, meaning the ability of the independent variable to explain the dependent variable is 51%, while the remaining 49% is determined by other factors not included in the model. The Exp value (B) or OR value of work experience is 5.626, meaning that the more respondents with long work periods, the higher the risk of someone experiencing MSD complaints compared to respondents with new work periods.

Conclusion

Based on the research results, it is known that 61.3% of workers experienced severe MSD complaints, 61.3% of workers in the risk age category, 67.7% of workers with an average body mass index, 54.8% of workers with long service periods, 79% of workers with work posture is not ergonomic, 53.2% of workers in the medium workload category, and 58.1% of workers with repetitive movements are at risk. There is a relationship between age, length of service, work posture, and physical workload with MSD complaints. There is no relationship between BMI repetition movements and MSD complaints. The most dominant variable related to MSD complaints is the work period variable. It is hoped that Padang City waste collectors can improve their work posture by not bending over when picking up rubbish but by kneeling with their spine straight and stretching their muscles before working. It is hoped that DLH Padang City can collaborate with DKK Padang to provide training regarding ergonomic working positions, manual lifting methods, and information regarding the risk of musculoskeletal complaints for workers' health.

References

- Alfaridz, M., & Harahap, R. A. (2023). Hubungan Beban Kerja dengan Keluhan Musculoskeletal Disorders pada Petugas Penyapu Jalan Kecamatan Medan Johor. *Jurnal Mahasiswa Kesehatan Masyarakat*, 6(1), 32–36. <https://doi.org/10.32832/pro>
- Astuti, I., Rosady, D. S., Romadhona, N., Achmad, S., & Kusmiati, M. (2019). Nyeri Punggung Bawah serta Kebiasaan Merokok, Indeks Massa Tubuh, Masa Kerja, dan Beban Kerja pada Pengumpul Sampah. *Jurnal Integrasi Kesehatan & Sains*, 1(1), 74–78. <https://doi.org/10.29313/jiks.v1i1.4326>
- Astuti, I., Septriana Dony, Romadhona, N., Achmad, S., & Kusmiati, M. (2019). Nyeri Punggung Bawah serta Kebiasaan Merokok, Indeks Massa Tubuh, Masa Kerja, dan Beban Kerja pada Pengumpul Sampah. *Jurnal Integrasi Kesehatan & Sains (JIKS)*, 1(1).
- Badan Pusat Statistik Kota Padang. (2021). Luas Daerah Kota Padang tahun 2021. <https://Padangkota.Bps.Go.Id/Indicator/153/34/1/Luas-Daerah.Html>.

- Bonini-Rocha, A. C., de Oliveira, R. A. C., Bashash, M., do Couto Machado, G., & Cruvinel, V. R. N. (2021). Prevalence of musculoskeletal disorders and risk factors in recyclable material waste pickers from the dump of the structural city in Brasília, Brazil. *Waste Management*, 125, 98–102. <https://doi.org/10.1016/j.wasman.2021.02.018>
- BPS. (2020). *Jumlah Penduduk Menurut Jenis Kelamin (Jiwa)*.
Capaian Kinerja Pengelolaan Sampah. (n.d.).
- Dewi, P. N., Rakhmawati, N. S., Kartika, E., & Saputro, D. H. (2023). Faktor Yang Berhubungan Dengan Keluhan Nyeri Otot Rangka Pada Pemulung Di Lingkungan TPST RDF Kabupaten Cilacap. *Sanitasi: Jurnal Kesehatan Lingkungan*, 16(1).
- Fac, O., & Nfm, S. (2017). Musculoskeletal Disorder among Municipal Solid Waste Collectors. *Asia Pacific Environmental and Occupational Health Journal*, 3(1), 28–32.
- Faisal, R., Marisdayana, R., & Kurniawati, E. (2022). Faktor Risiko Muskuloskeletal Disorders (MSDs) Pada Pekerja Penyortir Sampah Di UPTD Pengelolaan Sampah Talang Gulo. *Jurnal Inovasi Penelitian*, 2(12).
- Golden Burden of Disease. (2019). *Disease burden from non-communicable diseases, World, 1990 to 2019*.
- Gulo, C. E., Dian, R., Hadi, K., Td, J., No, P., & Utara, S. (2022). Kajian Sistem Pelayanan Persampahan di Kota Medan (Studi Kasus Kecamatan Medan Kota). *Jurnal Ruang Luar Dan Dalam FTSP*, 04(02), 110–124.
- Kementerian Kesehatan RI. (2019). Laporan Nasional RISKESDAS. In *Kementerian Kesehatan RI* (Vol. 1, Issue 1).
- Khofiyya, A. N., Suwondo, A., & Jayanti, S. (2019). Hubungan Beban Kerja, Iklim Kerja, dan Postur Kerja terhadap Keluhan Musculoskeletal pada Pekerja Baggage Handling Service Bandara. *Jurnal Kesehatan Masyarakat*, 7(4), 619–625.
- Menteri Pekerjaan Umum Republik Indonesia. (2013). *Permen PU Republik Indonesia Nomor 03/PRT/M/2013*.
- Rahmah, S., & Herbawani, C. K. (2021). Faktor Risiko Penyebab Keluhan Musculoskeletal Disorders (MSDs) pada Pekerja: Tinjauan Literatur. *Prepotif: Jurnal Kesehatan Masyarakat*, 6(1), 1–14. <https://doi.org/10.31004/prepotif.v6i1.2909>
- Rimantho, D. (2016). *Identifikasi Keselamatan Kerja pada Pekerja Pengumpul Sampah Manual di Jakarta Selatan*.
- Sinaga, S. N. (2020). Hubungan Postur Kerja dengan Keluhan Nyeri Punggung Bawah pada Petugas Pengangkut Sampah Kota Medan. *Fakultas Kesehatan Masyarakat Universitas Islam Negeri Sumatera Utara*.
- Tarwaka. (2015). *Ergonomi Industri Dasar-Dasar Pengetahuan Ergonomi dan Aplikasi di Tempat Kerja* (Edisi II R). Harapan Press Solo.