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Analysis of Work Posture with Complaints of Musculoskeletal Disorder on Stack Emission Sampling Activities

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Objective and Background: The process of sampling the air quality of chimney emissions is a job that has the risk of causing work-related disorders and diseases. This study examines the relationship between the risk of ergonomics in work postures with material safety data sheet complaints on sampling activities.
Methods: Analytical observational method with cross sectional approach. using the Nordic Body Map questionnaire and the Rapid Entire Body Assessment (REBA) assessment sheet. Primary data and secondary data were analyzed using Rank Spearman statistical test.
Results: The level of risk of ergonomics in work postures at each stage of activity varies from low risk (value 2-3), medium (value is 4-7), and high (value 8 -10). Meanwhile, the level of MSDscomplaints was low (score 28-49) 11.1%, moderate complaints (score 50-70) were 44.4% and high complaints (score 71-91) were 44.4%. The results of the analysis test showed that there was a relationship between the level of ergonomics risk of working postures at 6 stages of activity, namely pre sampling, side preparation, climbing stairs, raising equipment, lowering equipment, and descending stairs (p-value < 0.05).

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Conclusion: Based on the other 4 stages of activity, namely sampling with a probe, sampling with a gas analyzer, measuring water content, and measuring particulate levels, there is no relationship between the level of ergonomics in work posture and complaints of MSDs, to reduce the risk of M.S.D.s complaints, efforts can be made through redesigning work stations that are not ergonomic with the use of tools to reduce workload.

Keywords: Work posture; musculoskeletal disorder; rapid entire body assessment (REBA); nordic body map; musculoskeletal disorders (MSDs); stack emission air quality sampling.

1. INTRODUCTION

Occupational diseases are various hazard factors that can be found easily in every workplace, impacting the health status of workers with the emergence of health problems related to work [1]. Data from the Social Security Administrator for Health, the total work accident cases throughout 2019 reached 155,237 cases. Meanwhile, for 2020 there was a slight decrease with a total of 153,044 cases. There are still few cases of occupational diseases reported, in 2018, the number of occupational diseases reported was 30 cases, and in 2020, the number reached almost 100 cases. [2] Musculoskeletal disorders *MSDs*are one of the symptoms that are often felt by someone who is closely related to work activities. This complaint usually attacks the skeletal muscles from mild to severe symptoms [3]. The presence of repeated static loading over a long period can result in joint disorders. Some of the causes of *MSDs*complaints include repetitive activities, sudden and excessive stretching of muscle mass, non-natural work postures, secondary causes, and combination causes [4]. Musculoskeletal complaints related to the work position. Jobs that force workers to be in non-ergonomic positions will cause fatigue effects and increase additional workload. Complaints about musculoskeletal often occurs in skeletal muscles, including the lower muscles, back, waist, arms, shoulders, and neck muscles [5]. Various studies on ergonomics have been carried out, but research analyzing the relationship between the level of ergonomics risk has not shown a relevant consistency. The results of the REBA Worksheet assessment for manual handling work in the CEVA Michelin division are unloading, put away stack, loading, and converting shows a value of 5-13, which means that implementation is needed for improvement efforts [6]. Musculoskeletal disorders of workers in the manufacturing sector shows a significant relationship between complaints of musculoskeletal disorders and work posture [7]. However, a study conducted in 2018 on computer operators in government organizations in the city of Kerman, Iran concluded that there was no significant relationship between musculoskeletal complaints and work posture [8].

The Central Java Provincial Work Safety Center is the Technical Implementation Unit of the Central Java Province Manpower and Transmigration Office. One of the main tasks is as a testing agency in the field of occupational safety and health. The Work Safety Center is also registered as an environmental laboratory that actively serves environmental parameter testing (ambient) in this case is by testing the air quality from chimney emission sources. This test is one of the heaviest samplings carried out by the chimney air sampling officer because the sampling is carried out above the chimney height of 10 to 30 meters. In addition, high chimney temperatures and other problems that must be faced are weather conditions, heat, and rain have different impacts. Difficulty in sampling air quality from the chimney adds to the risk of the work; the air sampling officer, the officer must climb a vertical ladder to be able to reach the sampling chimney hole. In addition, the equipment used and must be carried up further adds to the weight of the burden insured by the sampling officer. This is at risk of causing occupational diseases such as complaints of musculoskeletal disorders (MSDs) [9].

The purpose of this study was to determine the level of risk of ergonomics in working postures using the Rapid Entire Body Assessment (REBA) method and the distribution of musculoskeletal disorders in the sampling activity of stack emission air quality.

2. RESEARCH METHODOLOGY

This research is quantitative research with an observational analytic method with a cross-sectional approach [10]. A cross-sectional approach was carried out to provide an adequate description of the study population and whether there was a relationship between research

variables, with data recording and assessing the level of complaints of MSDs carried out simultaneously. The description of work posture is obtained from direct observation in the field with the help of a digital camera. These observations were then analyzed using a Rapid entire body assessment (REBA) worksheet based on Tables A, B and C, as follow:

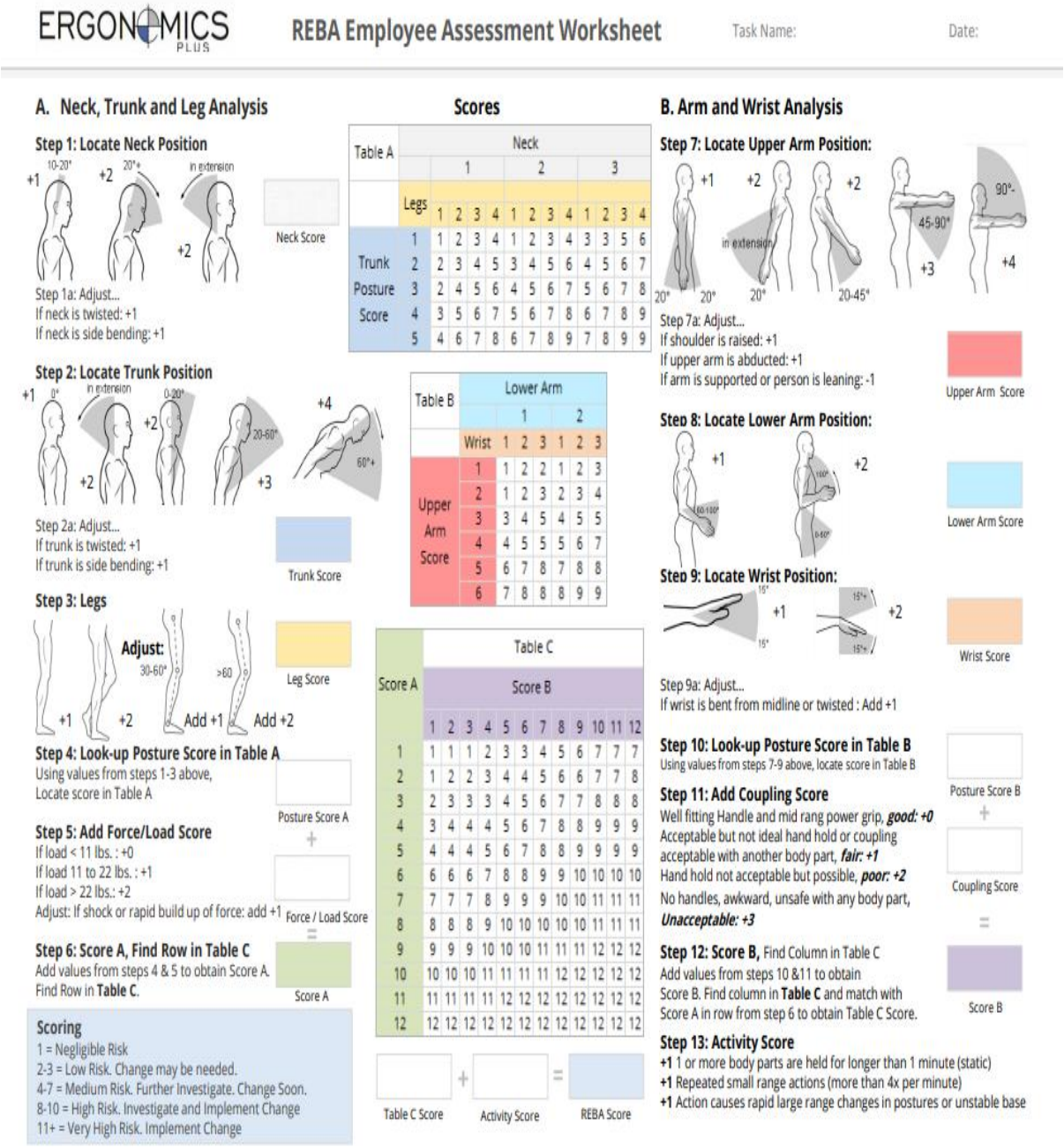

Fig. 1. Work Posture Observation Sheet (Table A, B and C scores)

At the same time, the assessment of the level of musculoskeletal disorders was carried out using a Nordic body map questionnaire. There are two variables in this study, the independent variable is the level of work posture risk, and the dependent variable is musculoskeletal disorder complaints (MSDs complaints) [11].

The primary data in this study came from direct observation and assessment of work posture based on the REBA method and the assessment results of the level of MSDs complaints with the nordic body map questionnaire. Assessment of work posture is done by direct observation of sampling the air quality of emission stacks [12]. Assessment of work posture is carried out by direct observation of the emission stack air quality sampling activity. The digital camera will record the activity from the beginning to the end of the sampling. The average duration of sampling takes between 1-3 hours [13]. The duration depends on the physical condition of the chimney and the number of sample parameters. However, this recording will only take pictures of the type of work that contains risk factors by determining the duration, load, and posture. The type of work observed is preparation when carrying sampling equipment and unloading sampling equipment when arriving at the sampling location. Observations were continued on the work of climbing the chimney using a vertical ladder. After arriving at the landing/work floor above the chimney, the sampling officer will raise the sampling equipment by pulling it using a rope; after the equipment is ready, all officers will start sampling. The emission sampling officer and lowers the sampling equipment back when the sampling has been completed. Officers will descend using ropes and vertical ladders on the same path. Observations will continue when the officer reloads the sampling device for the return trip. The assessment of MSDs complaints using the Nordic Body Map questionnaire utilized direct interviews after the sampling officer as a respondent had finished doing the job. Respondents will be shown a body map according to the Nordic body map questionnaire. Then an interview will be conducted regarding the level of pain in the body in question according to the questionnaire criteria that have been set in the Nordic body map.

The analysis used in this research is the univariate analysis and bivariate analysis. Univariate analysis was used to determine the distribution of proportions and frequencies to draw the independent variables (musculoskeletal complaints), and the dependent variable (work posture) understudy, so univariate analysis was needed. The results of the analysis are presented in the form of tables and adequate explanations. While univariate analysis to determine whether there is a relationship between the independent variable and the dependent variable which is the object of research, bivariate analysis is needed. The test used in this analysis is Spearman's rank correlation test, with the significance level being alpha ($\alpha = 0.05$) [14].

Characteristics of respondents who became the object of research include age, education, and work experience, as follows:

Table 1. Characteristics of respondents

Age	**Total (n)**	**Percentage (%)**
30-39	5	55,6
40-49	1	11,1
50-59	3	33,3
Total	9	100
Education	**Total (n)**	**Percentage (%)**
Senior High School	4	44,4
Academy	1	11,1
University	4	44,4
Total	9	100
Work experience (years)	**Total (n)**	**Percentage (%)**
1-10	5	55,6
11-20	2	22,2
21-30	2	22,2
Total	9	100

Based on the characteristics of the respondents, it can be categorized as fulfilling the requirements, namely age included in the productive category (not retired), minimum high school operator education with appropriate work experience [15].

3. RESULTS

3.1 Overview of Stack Emissions Air Quality Sampling

Sampling of stack emission air quality is the process of sampling through the stack/chimney which is exhaust emissions from the steam boiler engine, ss a heat-producing device, the steam boiler will undergo a combustion process using fuels including biomass, oil, coal, and gas [16]. The residue from the combustion process is then removed through the stack/chimney and samples are taken as an effort to control businesses that have the potential to cause pollution or environmental damage [17]. The work that is the object of observation by researchers is the

process of taking samples by air sampling officers. In every sampling of air quality, stack emissions are usually carried out by 2-3 sampling officers. The length of the sampling process varies between 1 – 3 hours depending on the physical condition of the stack, the level of difficulty, and the number of test parameters taken. While in a day the average sampling for each team is 2 - 3 stacks. The sampling process is carried out through a sampling hole which is located above the height of the chimney. The provisions for the location of the chimney as stipulated in the Decree of the Head of the Environmental Control Agency number 205 of 1996 are 8 times the diameter of the chimney/stack from the bottom of the chimney or 4 times the diameter of the chimney from the top of the chimney/stack [18].

A sampling of stack emission air quality by officers at the Work Safety Center is carried out in a company environment that previously submitted a request for environmental testing, so it takes time to travel from the office to the test location. The vehicle used is an official car in addition to transporting personnel who will take samples as well as transporting sampling equipment.

The stages of the air quality sampling process of the Central Java Province Work Safety Center stack emission in 2021 are as follows (Table 2).

Table 2. Stages of stack emission air quality sampling activities

No	Activity stage	Details of activity	Duration	Frequency
1	Pre Sampling Preparation.	The equipment to be used is inserted into the car and neatly arranged to avoid damage while in transit.	12 minutes	4 times/minute (48 times)
2	Preparation at the sampling site.	Unload the sampling equipment from the car to be brought to the sampling location.	12 minutes	4 times/minute (48 times)
3	Climb the vertical ladder.	The worker climbs the vertical ladder on the chimney to reach the sampling hole above the chimney.	3 minutes	25 times/minute (75 times)
4	Raise equipment to the top of the chimney.	The sampling officer pulls the equipment onto the work floor using a rope.	15 minutes	30 times/minute (450 times)
5	A sampling of gases with a probe.	Officers suck gas using a probe into the sampling hole.	10 minutes	-
6	Sampling with a gas analyzer.	Operate the gas analyzer on the stack in a sitting or squatting position.	15 minutes	-
7	Measurement of water content.	You insert a pitot into the sampling hole to be sucked with a pump at a certain speed.	10 minutes	-
8	Measurement of particulate levels.	Insert the probe into the sampling hole for suction with a pump at a certain speed.	10 minutes	-
9	Bringing down the sampling equipment	Lower the tool from the chimney bag by tying it with a rope and slowly stretching it.	15 minutes	-
10	Officers descending vertical stairs	Descend the vertical ladder after sampling is complete.	2 minutes	30 times/minute (60 times)

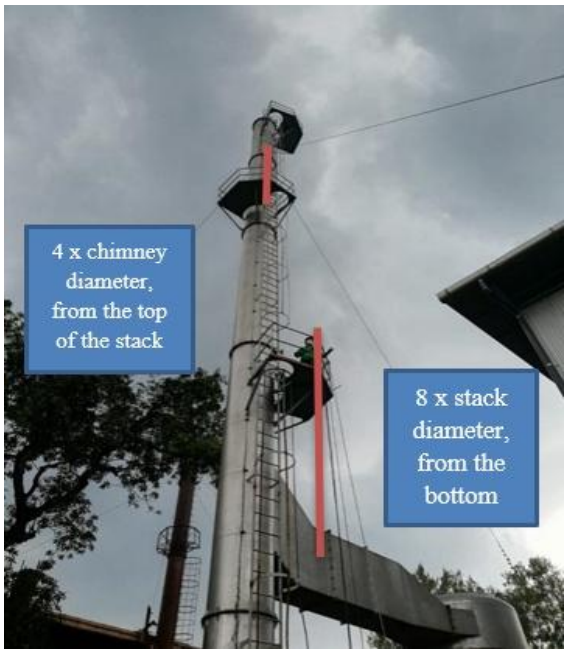

Fig. 2. Location of sampling hole points

Work posture risk assessment is carried out on all respondents to find out how much risk is caused by each stage of activity. The assessment is carried out using the REBA method by making direct observations of respondents when carrying out their work. In addition, the interview method and dig deeper into secondary data in the form of documentation images owned by the Work Safety Center, Central Java. The results of the work posture assessment are grouped into 5 categories, namely, if you get a value of 1, it means the risk can be ignored, a value of 2-3 means it is in a low category, a value of 4-7 means it is in the medium category, a value of 8-10 means that it is in the high category and a value of 11 -15 means that it is included in the very high category.

3.2 Pre-Sampling Preparation

In this stage of the activity, the neck posture looks down and forms an angle of 40$^{o.}$ According to the assessment of the REBA worksheet, the neck score gets a score of 2. Then for the foot posture, both of them support the body in a squatting position so that the legs bend and form an angle of 159$^{o.}$ The leg value for this position is 3. As for the back value, it looks like the back is bent at an angle of 45$^{o.}$ In this posture, it is given a value of 3. However, because the work is carried out in a circular motion to pick up and arrange items, it gets an additional score of 1, so the score for the back is 4. These three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet) and produce value 7. After that, the load value is added, where the load lifted by workers ranges from 5 to 10 kg and gets an additional value of 1, resulting in an A value of 8.The forearm posture forms an angle of 40o and gets a score of 2. While the upper arm posture forms an angle of 40o and gets a value of 2. While the wrist is in the power zone and gets a value of 1. The three values are then entered into the REBA table worksheet. B and get a value of 2. The value of Table B (Work Posture Observation Sheet) is then added with a grip value where the grip conditions are easy and comfortable, which means 0 (zero). So that the B value is 2. The A value and B value is then entered in the REBA worksheet Table C (Work Posture Observation Sheet) to produce a C value, which is 6. To produce the final REBA value, this C value is added to the activity value, wherein this pre-sampling preparation activity the position squatting for more than 1 minute so that you get an additional 1 and there is a repetition of lifting and moving objects with a frequency of more than 4 times in one minute, getting an additional value of 1, so that the final REBA value in this activity is 8. Based on the calculation of the REBA value, it can be known that the MSD's risk level is in the high category with action level 3 is requiring immediate corrective action.

3.3 Assessment of Work Posture on Preparation at the Sampling Site

At this activity stage, the neck posture looks down and forms an angle of 90o, according to the REBA worksheet assessment the neck value gets a value of 2. Then for the foot posture, both support the body with the legs bent and form an angle of 68o, the foot value for this position is 3. As for the back value, it looks bent at an angle of 75$^{o.}$ In this posture, it is given a value of 4. However, because the work is carried out in a circular motion to lower items, it gets an additional score of 1, so the score for the back is 5. The three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet), and results in a score of 8. then added to the value of the load, where the load lifted by workers ranged from 5 to 10 kg and got an additional value of 1, resulting in an A value of 9.The forearm posture forms an angle of 40o and gets a value of 2. While the upper arm posture forms an extension angle of 70o and gets a value of 2. While the wrist is in the power zone and gets a value of 1. The three values are

then entered into the REBA worksheet. Table B (Work Posture Observation Sheet) and get a value of 2. The value of Table B (Work Posture Observation Sheet) is then added to the grip value where the grip condition is easy and comfortable which means 0 (zero). So for the value of B is 2.The A and B values are then entered in the REBA worksheet Table C (Work Posture Observation Sheet) to produce a C value of 6. To produce the final REBA value, this C value is added to the activity value, wherein the preparation activities at this sampling location the squatting position remains for more than 1 minute so that it gets an additional 1 and there is a repetition of lifting and moving objects with a frequency of more than 4 times in one minute, getting an additional value of 1. So that the final REBA value in this activity is 8.Based on the calculation of the REBA value, it can be seen that the MSD's risk level is in the high category with action level 3, requiring immediate corrective action.

Fig. 3. Pre-sampling activities

Fig. 4. The REBA assessment on preparation at the sampling site

3.4 REBA Assessment Activities for Climbing Vertical Stairs

At this stage of the activity, the neck posture looks down and forms an angle of 18$^{o.}$ According to the REBA worksheet assessment, the neck gets a score of 1. Then for the foot posture, one leg supports the body alternately with the leg bent and forming an angle of up to 95$^{o.}$ The leg value for this position is 4. As for the back value, it looks like the back is straight, it is given a value of 1. The three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet) , and produce a value of 4. After that, the load value is added, where The worker's own body is a burden due to climbing stairs, weighing >10 kg, and getting an additional value of 2. In addition, there is a shock load due to the activity of climbing a vertical ladder and gets an additional value of 1. So that it produces an A value of 7.The forearm posture is almost straight to the upper arm and gets a score of 2. While the upper arm posture forms an angle of 128^{o} and gets a score of 4. Meanwhile, for the wrist, it forms an angle >15o and gets a score of 2. The three values are then entered into the REBA table worksheet. B and get a value of 6. The value of Table B (Work Posture Observation Sheet) is then added with a grip value where the grip conditions are easy and comfortable which means 0 (zero). So for the value of B is 6.Values A and B values are then entered in the REBA worksheet Table C to produce a C value of 9. To produce the final REBA value, this C value is added to the activity value, wherein the activity, climbing the vertical chimney ladder there is the repetition of foot and hand movements. when climbing a vertical ladder with a frequency of more than 4 times in one minute, it gets an additional value of 1. So the final REBA value in this activity is 10.

3.5 The REBA Assessment Activities Upgrade the Sampling Equipment

At this stage of the activity, the neck posture looks down and forms an angle of 40$^{o.}$ Following the assessment of the REBA worksheet, the neck value gets a value of 2. Then for the foot posture, both legs support the body and form an angle of up to 40$^{o.}$ The foot value for this position is 2. As for the back value, it can be seen that the back is bent at an angle of 30$^{o.}$ In this posture, it is given a value of 3. The three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet), and produce a value of 5. After that, the load value is added, where the weight of the load ranges from 5-10 kg and gets an additional value of 1. So yields an A of 7.The forearm posture forms an angle of 34o and gets a score of 2. While the upper arm posture forms an angle of 28o and gets a score of 2. While the wrist is in a power zone position, between 15o up and 15o down, and gets a value of 1. The three values then it is entered into the REBA worksheet Table B and get a value of 2. The value of Table B (Work Posture Observation Sheet) is then added to the grip value where the grip condition on the rope which is quite good is not ideal, which means plus 1. So the value of B is 3.The value of A and value of B is then entered in the REBA worksheet Table C (Work Posture Observation Sheet) to produce a C value of 6. To produce the final REBA value, this C value is added to the activity value, wherein this activity of raising the sampling equipment there is the repetition of hand movements when pulling the rope in the frequency of more than 4 times in one minute, gets an additional value of 1. And the position of the feet still standing statically for more than 1 minute gets an additional value of 1. So the final REBA score in this activity is 8.

Fig. 5. The REBA assessment activities for climbing vertical stairs

Fig. 6. REBA Assessment Activities to upgrade the sampling equipment

3.6 The REBA Assessment Activities Gas Sampling with Probe

At this stage of the activity, an upright neck posture is seen. According to the REBA worksheet assessment, the neck value gets a value of 1. Then for the foot posture, both legs support the body in an upright position. The leg value for this position is 1. As for the back value, it looks like the back is straight. In this posture, the value is 1. The three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet), and produce a value of 1. After that, the load value is added, where there is no load in this activity, plus 0 (zero). This results in an A value of 1.The forearm posture forms an angle of 90o, gets a score of 1. While the upper arm posture forms an angle of >90o and gets a value of 4. While the wrist is in a power zone position, between 15o up and 15o down, and gets a value of 1. The three values Then it is entered into the REBA worksheet Table B and get a value of 4. The value of Table B (Work Posture Observation Sheet) is then added to the grip value where the grip condition is quite good but not ideal which means plus 1. So for the value of B is 5.The A value and B value is then entered in the REBA worksheet Table C (Work Posture Observation Sheet) to produce a C value, which is 4. To produce the final REBA value, this C value is added to the activity value, wherein the sampling activity with this gas analyzer the position of the feet is static while standing. for more than 1 minute, you get an additional 1 and the unstable footing condition on the scaffold gets an additional 1. So the final REBA value in this activity is 6.Based on the calculation of the REBA value, it can be seen that the MSD's risk level is in the moderate category with action level 2 requiring corrective action.

3.7 The REBA Assessment Sampling Activity with Gas Analyzer

At this stage of the activity, the neck posture looks down and forms an angle of 23$^{o.}$ Following the assessment of the REBA worksheet, the neck value gets a value of 2. Then for foot posture, both legs support the body in a squatting state and form an angle of up to 125$^{o.}$ The leg value for this position is 3. As for the back value, it can be seen that the back is bent at an angle of 35$^{o.}$ In this posture, it is given a value of 3. The three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet) , and produce a value of 6. After that, the load value is added, where there is no load in this activity, plus 0 (zero). So it produces an A value of 7.The forearm posture is straight in the direction of the upper arm, getting a score of 2. While the upper arm posture forms an angle of 60o and gets a score of 2. Meanwhile, the wrist is in a power zone position, between 15o up and 15o down, and gets a value of 1. The three values then it is entered into the REBA worksheet Table B (Work Posture Observation Sheet) and get a value of 4. The value of Table B (Work Posture Observation Sheet) is then added to the grip value where the

grip condition is comfortable and easy to grip, which means plus 0 (zero). So for the value of B is 4. The value of A and value of B is then entered in the REBA worksheet Table C (Work Posture Observation Sheet) so that it produces a C value of 6. To produce the final REBA value, this C value is added to the activity value, wherein the sampling activity with this gas analyzer the position of the feet is static while squatting. for more than 1 minute, gets an additional 1. So the final REBA score in this activity is 7. Based on the calculation of the REBA value, it can be seen that the MSD's risk level is in the moderate category with action level 2 requiring corrective action.

3.8 The REBA Assessment Activities for Measuring the Water Content of the Chimney

At this stage of the activity, the neck posture is not too bent and forms an angle of 9$^{o.}$ Following the assessment of the REBA worksheet, the neck value gets a value of 1. Then for the foot posture, both legs support the body in a squatting state and form an angle of up to 104$^{o.}$ The foot value for this position is 3. As for the back value, it looks like the back is bent at an angle of 12$^{o.}$ In this posture, it is given a value of 2. The three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet), and produce a value of 4. After that, the load value is added, where there is no load in this activity, plus 0 (zero). So that it produces an A value of 4. The posture of the forearm forms an angle of 82o, so it gets a value of 1. While the upper arm posture forms an angle of 55o and gets a value of 3. While for the wrist it forms an angle of 21o and gets a value of 2. The three values are then entered into in the REBA worksheet Table B and get a value of 4. The value of Table B (Work Posture Observation Sheet) is then added to the grip value where the grip condition is comfortable and easy to grip, which means plus 0 (zero). So that the B value is 4. The A value and B value is then entered in the REBA Table C worksheet so that it produces a C value, which is 4. To produce the final REBA value, this C value is added to the activity value, wherein this water content measurement activity the position Stand still while squatting for more than 1 minute, you get an additional 1. So that the final REBA value in this activity is 5. Based on the calculation of the REBA value, it can be seen that the MSD's risk level is in the moderate category with action level 2 requiring corrective action.

3.9 The REBA Assessment Measurement of Particulate Levels

At this stage of the activity, the neck posture looks down and forms an angle of 61$^{o.}$ Following the assessment of the REBA worksheet, the neck value gets a value of 2. Then for foot posture, both legs support the body well. The leg value for this position is 1. As for the back value, it can be seen that the back is bent at an angle of 40^{o}. In this posture, it is given a value of 3. These three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet), and produce a value of 4. After that, the load value is added, where there is no load in this activity, plus 0 (zero). This results in an A value of 4.The posture of the forearm

Fig. 7. The REBA assessment activities gas sampling with probe

Fig. 8. The REBA assessment sampling activity with gas analyzer

Fig. 9. The REBA assessment samplingactivity of measuring the air content of the chimney water

Fig. 10. The REBA assessment samplingparticulate content measurement activities

forms an angle of 78^{o}, so it gets a value of 1. While the posture of the upper arm is upright and gets a value of 3. Meanwhile, for the wrist in the power zone position between 15o up and 15o down, it gets a value of 1. The three values are then entered into the REBA worksheet Table B and get a value of 1. The value of Table B (Work Posture Observation Sheet) is then added to the grip value where the grip condition is comfortable and easy to grip, which means plus 0 (zero). So for the value of B is 1.Values A and B values are then entered in the REBA worksheet Table C (Work Posture Observation Sheet) to produce a C value, which is 2. To produce the final REBA value, this C value is added to the activity value, wherein this particulate level measurement activity the position of the feet is statically standing for more than 1 minute, gets an additional 1. So the final REBA score in this activity is 3.Based on the calculation of the REBA value, it can be seen that the MSD's risk level is in the low category with action level 1, which may require corrective action.

3.10 The REBA Assessment Activity Deriving Sampling Tool

At this stage of the activity, the neck posture looks down and forms an angle of 61$^{o.}$ Following the assessment of the REBA worksheet, the neck value gets a value of 2. Then for foot posture, both legs support the body well. The leg value for this position is 1. As for the back value, it can be seen that the back is bent at an angle of 40^{o}. In this posture, it is given a value of 3. These three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet), and produce a value of 4. After that, the load value is added, where there is no load in this activity, plus 0 (zero). This results in an A value of 4. The forearm posture forms an angle of 78^{o,} so it gets a value of 1. While the upper arm posture is upright and gets a value of 3. While for the wrist in the power zone position between 15^{o} up and 15^{o} down it gets a value of 1. The three values are then entered into the REBA worksheet Table B (Work Posture Observation Sheet) and get a value of 1. The Table B Work Posture Observation Sheet value is then added to the grip value where the grip condition is comfortable and easy to grip, which means plus 0 (zero). So that the B value is 1. The A value and the B value are then entered in the REBA worksheet Table C (Work Posture Observation Sheet) to produce a C value, which is 2. To produce the final REBA value, this C value is added to the activity value, wherein this particulate level measurement activity the position standing still for more than 1 minute, gets an additional 1. So that the final REBA value in this activity is 3. Based on the calculation of the REBA value, it can be seen that the risk level of MSD's is in the low category with action level 1 maybe corrective action is needed.

3.11 The REBA Assessment Activity Descending Vertical Stairs

At this stage of the activity, an upright neck posture is seen. Following the assessment of the REBA worksheet, the neck value gets a value of 1. Then for the foot posture, one leg supports the body alternately with the foot forming an angle of 68$^{o.}$ The leg value for this position is 4. As for the back value, it looks like the back is straight. In this posture, the value is 1. The three values are then entered into the REBA worksheet Table A (Work Posture Observation Sheet) , and produce a value of 4. After that, the load value is added, where the load is the worker's body weight due to climbing stairs with criteria > 10 kg, and got a value of 2. So that it produces an A value of 6.The posture of the forearm forms an angle of 53^{o}, so it gets a score of 2. While the posture of the upper arm forms an angle of 70o and gets a score of 3. Meanwhile for the wrist that forms an angle of >15^{o} gets a score of 2. These three values are then entered into the REBA worksheet Table B (Work Posture Observation Sheet) and get a value of 5. The value of Table B (Work Posture Observation Sheet) is then added to the grip value where the grip condition is easy to grip well and gets a value of 0 (zero). So for the value of B is 5.Value A and value B are then entered in the REBA worksheet Table C (Work Posture Observation Sheet) to produce a C value of 7. To produce the final REBA value, this C value is added to the activity value, wherein this activity down the vertical stairs the repetition of hand and foot activities is more than 4 times per minute gets an additional 1. So the final REBA score in this activity is 8.

Based on the calculation of the REBA value, it can be seen that the MSD's risk level is in the high category with an action level of 3.

Based on the direct observation method at the study interview location and using secondary data in the form of photo documentation of the test, the results of the REBA assessment were obtained at each stage of the air quality sampling activity of the Occupational Safety Center stack emission at the pre-sampling preparation stage,

respondents with a high-risk level were 66.7% or 6 people and moderate risk as much as 33.3% or 3 respondents. In the preparation stage at the sampling location, respondents with a high-risk level were 55.6% or five people, and moderate risk was 44.4% or four respondents. At the stage of climbing the vertical stairs, respondents with a high-risk level were 44.4% or four people, and moderate risk was 55.6% or five respondents. At the stage of increasing the sampling equipment, respondents with a high-risk level were 66.7% or six people, and moderate risk was 33.3% or three respondents. At the sampling stage with the probe, respondents with a high-risk level were 88.9% or eight people, and a moderate risk was 11.1% or one respondent. At the sampling stage using a gas analyzer, respondents with a high-risk level were 22.2% or two people, and moderate risk was 77.8% or seven respondents. When measuring the water content, respondents with a high-risk level were 11.1% or 1 person, and a moderate risk was 88.9% or eight people. At the particulate level measurement stage, respondents with low-risk levels were 77.8% or seven people, and moderate risk was 22.2% or two people. At the stage of lowering the sampling equipment, respondents with a high-risk level were 66.7% or six people, and moderate risk was 33.3% or 3 people. At the stage of descending the vertical stairs, respondents with a high-risk level were 66.7% or six people, and moderate risk was 33.3% or three people. Meanwhile, for the assessment of M.S.D.s complaints based on the results of data collection through a Nordic Body Map questionnaire for ten officers who took air quality samples from stack emissions, the following results were obtained (Table 3).

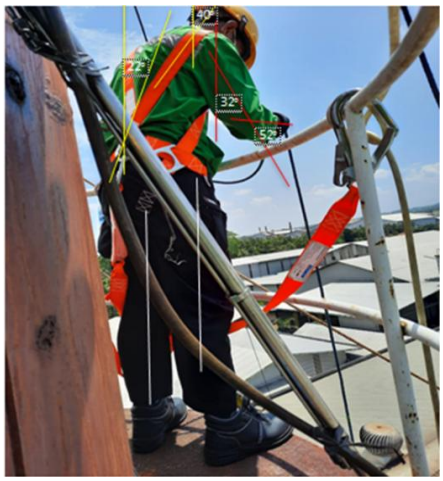

Fig. 11. The activity of bringing down the sampling tool

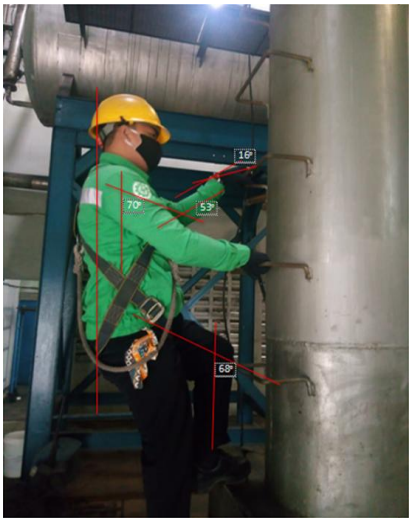

Fig. 12. The activities downstairs

Table 3. Frequency distribution of respondents based on the level of MSDs complaints to the stack emission air quality sampling officer

Respondent	**N.B.M. value**	*MSDs* Complaints
Respondent 1	71	High Complaint
Respondent 2	71	High Complaint
Respondent 3	73	High Complaint
Respondent 4	69	Moderate complaint
Respondent 5	59	Moderate complaint
Respondent 6	70	Moderate complaint
Respondent 7	46	Low Complaint
Respondent 8	63	Moderate complaint
Respondent 9	71	High Complaint

Table 4. Distribution of respondents' M.S.D.s complaints by body part at the stack emission air quality sampling officer

Complaints of Parts of body	***MSDs* Complaints**							
	Painless (n)	**%**	**Low category pain**	**%**	**Moderate pain(n)**	**%**	**High category pain(n)**	**%**
Upper neck	5	55,6	3	33,3	1	11,1	0	0
Lower neck	5	55,6	4	44,4	0	0	0	0
Left shoulder	1	11,1	4	44,4	3	33,3	1	11,1
Right shoulder	1	11,1	3	33,3	3	33,3	2	22,2
Left upper arm	1	11,1	2	22,2	6	66,7	0	0
Back	0	0	1	11,1	1	11,1	7	77,8
Right upper arm	1	11,1	1	11,1	7	77,8	0	0
Waist	1	11,1	0	0	0	0	8	88,9
Below waist	1	11,1	0	0	1	11,1	7	77,8
Butt	10	100	0	0	0	0	0	0
Left elbow	10	100	0	0	0	0	0	0
Right elbow	10	100	0	0	0	0	0	0
Left lower arm	2	22,2	3	33,3	4	44,4	0	0
Right forearm	2	22,2	3	33,3	3	33,3	1	11,1
Left wrist	2	22,2	3	33,3	3	33,3	1	11,1
Right wrist	2	22,2	1	11,1	4	44,4	2	22,2
Left hand	1	11,1	3	33,4	5	55,6	0	0
Right hand	1	11,1	0	0	8	88,9	0	0
Left thigh	0	0	5	55,6	4	44,4	0	0
Right thigh	0	0	5	55,6	4	44,4	0	0
Left knee	0	0	4	44,4	4	44,4	1	11,1
Right knee	0	0	2	22,2	6	66,7	1	11,1
Left calf	2	22,2	6	66,7	1	11,1	0	0
Right calf	2	22,2	6	66,7	1	11,1	0	0
Left ankle	5	55,6	2	22,2	2	22,2	0	0
Right ankle	5	55,6	2	22,2	2	22,2	0	0
Left Foot	2	22,2	3	33,3	4	44,4	0	0
Right foot	2	22,2	3	33,3	4	44,4	0	0

Bivariate analysis was used as a statistical test to determine the relationship between variables, work posture as an independent variable, and complaints of musculoskeletal disorders as the dependent variable using the Spearman rank test. The results of the analysis of the relationship between work postures and complaints of M.S.D.s on the sampling officers of the Central Java Province Work Safety Center showed a value ($p = 0.002$) < ($\alpha = 0.05$). Thus Ho is rejected, and Ha is accepted, which means there is a significant relationship between work posture and M.S.D.s complaints as follow:

Table 5. Relationship of work posture at the sampling preparation stage with *MSDs* complaints

Pre-sampling preparation work posture	*MSDs* Complaints						Total		P-*value*
	Low complaint		Moderate complaint		High complaint				
	N	%	N	%	N	%	N	%	
Low risk	0	0	0	0	0	0	0	0	0,036
Medium risk	1	11,1	3	33,3	0	0	4	44,4	
High risk	0	0	1	11,1	4	44,4	5	55,6	
Total	1	11,1	4	44,4	4	44,4	9	100	

The working posture at the pre-sampling preparation stage has 2 levels of risk, namely moderate risk, and high risk. Meanwhile, the *MSDs* complaints felt by the stack emission air quality sampling activity consisted of low complaints, moderate complaints, and high complaints. A total of 5 respondents (55.6%) who work with a high-risk work posture experienced moderate complaints as many as 1 or 11.1% of respondents and 4 or 44.4% of other respondents experienced high complaints. Respondents with moderate risk work posture are 4 or 44.4%. Three of them or 33.3% had moderate complaints and the remaining 1 respondent had low complaints. Based on the results of the Spearman's Rank statistical test, the value ($p = 0.036$) < ($\alpha = 0.05$). Thus, Ho is rejected and Ha is accepted, which means that there is a significant relationship between pre-sampling preparation work posture and *MSDs*complaints.

Based on Table 6, that as many as 5 respondents (55.6%) who work with high-risk work postures experienced moderate complaints as many as 1 or 11.1% of respondents and 4 or 44.4% of other respondents experienced high complaints. Respondents with moderate risk work posture are 4 or 44.4%. Three of them or 33.3% had moderate complaints and the remaining 1 respondent had low complaints. Based on the results of the Spearman's Rank statistical test, the value ($p = 0.009$) < ($\alpha = 0.05$). Thus, Ho is rejected and Ha is accepted, which means that there is a significant relationship between the preparatory work posture at the sampling location and the complaints of *MSDs*.

Based on Table 7, as many as 4 respondents (44.4%) who work with high-risk work postures experience high complaints as much as 4 or 44.4%. Respondents with moderate risk work posture are 5 or 55.6%. Four of them or 44.6% had moderate complaints and the remaining 1 respondent had low complaints.Based on the results of the Spearman's Rank statistical test, the value ($p = 0.000$) < ($\alpha = 0.05$). Thus Ho is rejected and Ha is accepted, which means there is a significant relationship between work postures climbing vertical stairs with *MSDs* complaints.

Table 6. Relationship between work postures at sampling locations and complaints of *MSDs* at the preparation stage

Working posture in the preparation stage at the sampling site	*MSDs* Complaints						Total		P-*value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	
Low risk	0	0	0	0	0	0	0	0	0,009
Medium risk	1	11,1	3	33,3	0	0	4	44,4	
High risk	0	0	1	11,1	4	44,4	5	55,6	
Total	1	11,1	4	44,4	4	44,4	9	100	

Table 7. The relationship between work posture at the stage of climbing vertical stairs and *MSDs*. Complaints

Working posture at the stage of climbing the vertical stairs	*MSDs* Complaints						Total		P-*value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	0
Low risk	0	0	0	0	0	0	0	0	
Medium risk	1	11,1	4	44,4	0	0	5	55,6	
High risk	0	0	0	0	4	44,4	4	44,4	
Low risk	1	11,1	4	44,4	4	44,4	9	100	

Table 8. Relationship between work posture at the stage of raising the sampling equipment and complaints of MSDs

Working posture at the stage of raising the sampling equipment	*MSDs* Complaints						Total		P *value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	
Low risk	0	0	0	0	0	0	0	0	0,036
Medium risk	1	11,1	2	22,2	0	0	3	33,3	
High risk	0	0	2	22,2	4	44,4	6	66,7	
Total	1	11,1	4	44,4	4	44,4	9	100	

Based on Table 8, as many as 6 respondents (66.7%) who work with high-risk work postures experienced high complaints as many as 4 or 44.4%, and 2 people or 22.2% experienced moderate complaints. Respondents with moderate risk work posture are 3 or 33.3%. two of them or 22.2% had moderate complaints and the remaining 1 (11.1%) respondents had low complaints.Based on the results of the Spearman's Rank statistical test, the value ($p = 0.036$) < ($\alpha = 0.05$). Thus, Ho is rejected and Ha is accepted, which means that there is a significant relationship between the work posture of increasing the sampling equipment and the complaints of *MSDs*.

Based on Table 9, as many as 8 respondents (88.9%) who work with moderate risk work postures experienced high complaints as many as 3 or 33.3%, moderate complaints 4 respondents (44.4%), and 1 person or 11.1% experienced low complaints. Respondents with high-risk work postures are 1 or 11.1% and have high complaints.Based on the results of the Spearman's Rank statistical test, the value ($p = 0.320$) > ($\alpha = 0.05$). Thus Ho is accepted and Ha is rejected, which means that there is no significant relationship between the work posture of sampling with the probe and *MSDs* complaints.

Table 9. The relationship between working posture at the sampling stage with the probe and *MSDs* complaints

Working posture at the sampling stage with the probe	*MSDs*complaints						Total		P-*value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	
Low risk	0	0	0	0	0	0	0	0	0,32
Medium risk	1	11,1	4	44,4	3	33,3	8	88,9	
High risk	0	0	0	0	1	11,1	1	11,1	
Total	1	11,1	4	44,4	4	44,4	9	100	

Table 10. The relationship between the working posture of the sampling stage with the gas analyzer and the complaints of *MSDs*

Working posture at the sampling stage with a gas analyzer	MSDS Complaints						Total		P-*value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	
Low risk	0	0	0	0	0	0	0	0	0,111
Medium risk	1	11,1	4	44,4	2	22,2	7	77,8	
High risk	0	0	0	0	2	22,2	2	22,2	
Total	1	11,1	4	44,4	4	44,4	9	100	

Based on Table 10, as many as 7 respondents (77.8%) who work with moderate risk work postures experienced high complaints as much as 2 or 22.2%, moderate complaints 4 respondents (44.4%), and 1 person or 11.1% experienced low complaints. Respondents with high-risk work postures are 2 or 22.2% and have high complaints.Based on the results of the Spearman's Rank statistical test, the value (p = 0.111) > (α = 0.05). Thus Ho is accepted and Ha is rejected, which means that there is no significant relationship between the work posture of sampling with a gas analyzer and *MSDs* complaints.

Based on Table 11, as many as 8 respondents (88.9%) who work with moderate risk work postures experienced high complaints of 3 or 33.3%, moderate complaints 4 respondents (44.4%), and 1 person or 11.1% experienced low complaints. Respondents with high-risk work postures are 1 or 11.1% and have high complaints.Based on the results of the Spearman's Rank statistical test, the value (p = 0.320) > (α = 0.05). Thus Ho is accepted and Ha is rejected, which means that there is no significant relationship between the work posture of measuring water content and complaints of MSDs.

Based on Table 12, as many as 8 respondents (88.9%) who work with moderate risk work postures experienced high complaints of 3 or 33.3%, moderate complaints 4 respondents (44.4%), and 1 person or 11.1% experienced low complaints. Respondents with high-risk work postures are 1 or 11.1% and have high complaints.Based on the results of the Spearman's Rank statistical test, the value (p = 0.320) > (α = 0.05). Thus Ho is accepted and Ha is rejected, which means there is no significant relationship between work posture measuring water content and MSDs complaints.

Based on Table 13, as many as 6 respondents (66.7%) who work with high-risk work postures experienced high complaints as many as 4 or 44.4%, and 2 people or 22.2% experienced moderate complaints. Respondents with moderate risk work posture are 3 or 33.3%. two of them or 22.2% had moderate complaints and the remaining 1 (11.1%) respondents had low complaints.Based on the results of the Spearman's Rank statistical test, the value (p = 0.036) < (α = 0.05). Thus Ho is rejected and Ha is accepted which means there is a significant relationship between work posture lowering sampling equipment and complaints of MSDs.

Table 11. The relationship between the work posture of the water content measurement stage and the complaints of *MSDs*

Working posture at the stage of measuring water content	*MSDs* Complaints						Total		P-*value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	
Low risk	0	0	0	0	0	0	0	0	0,111
Medium risk	1	11,1	4	44,4	3	33,3	8	88,9	
High risk	0	0	0	0	1	11,1	1	11,1	
Total	1	11,1	4	44,4	4	44,4	9	100	

Table 12. The relationship between work posture in the particulate level measurement stage with *MSDs*. complaints

Work posture at the particulate level measurement stage	*MSDs* Complaints						Total		P-*value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	
Low risk	1	11,1	4	44,4	2	22,2	7	77,8	0,771
Medium risk	0	0	0	0	2	22,2	2	22,2	
High risk	0	0	0	0	0	0	0	0	
Total	1	11,1	4	44,4	4	44,4	9	100	

Table 13. The relationship between work posture in the lowering stage of the sampling equipment and the complaints of MSDs

Working posture at the stage of lowering the sampling equipment	*MSDs* Complaints						Total		P-*value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	
Low risk	0	0	0	0	0	0	0	0	0,036
Medium risk	1	11,1	2	22,2	0	0	3	33,3	
High risk	0	0	2	22,2	4	44,4	6	66,7	
Total	1	11,1	4	44,4	4	44,4	9	100	

Table 14. The relationship between work posture when descending vertical stairs and complaints of MSDs

Working posture at the stage of lowering the sampling equipment	MSDS Complaints						Total		P-*value*
	Low Complaint		Moderate complaint		High Complaint				
	N	%	N	%	N	%	N	%	
Low risk	0	0	0	0	0	0	0	0	0,036
Medium risk	1	11,1	2	22,2	0	0	3	33,3	
High risk	0	0	2	22,2	4	44,4	6	66,7	
Total	1	11,1	4	44,4	4	44,4	9	100	

Based on Table 14, as many as 6 respondents (66.7%) who work with high-risk work postures experienced high complaints as many as 4 or 44.4% and 2 people or 22.2% experienced moderate complaints. Respondents with moderate risk work posture are 3 or 33.3% two of them or 22.2% had moderate complaints and the remaining 1 (11.1%) respondents had low complaints.

Based on the results of the Spearman's Rank statistical test, the value ($p = 0.036$) < ($\alpha = 0.05$). Thus Ho is rejected and Ha is accepted which means that there is a significant relationship between working postures going down vertical stairs with MSDs complaints.

4. DISCUSSION

Awkward work posture is a working position with body parts away from the body's natural position, such as a bent head position (flexion) or looking up (extension) while the natural posture is that the neck is perpendicular to the body, the body/back is bent while the normal posture of the back is straight, not bent. In general, awkward work postures occur due to work environment conditions, task demands, and non-ergonomic equipment [15]. In the REBA assessment sheet, not only body posture is the object of observation, but also other elements including repetition (repetition of movements), static position, grip position load, and activity assessment. Repeated movements will

potentially cause fatigue in skeletal muscles in a static position, this position can cause muscles and joints to stiffen because there is no stretching. The burden of the insured will cause the use of energy to be greater in line with the burden borne by the workers. An uncomfortable grip position will cause fatigue even with the risk of an accident [16]. Work posture is very influential on comfort at work. On the other hand, an awkward work posture will cause discomfort in carrying out work. Several things that cause the high-risk value of ergonomics in work postures at several stages of this stack emission air quality sampling activity [17], include (1) Neck down posture. The natural posture of the neck is straight, the lower the neck posture, the more likely it is to cause complaints. At several stages of activity, such as pre-sampling preparation at the sampling location, and sampling with a gas analyzer, respondents were seen with a bowed neck posture. The reason is cramped working conditions and non-ergonomic equipment [18], (2) Back bent posture. As in the neck, the natural posture of the back is straight; a Back that is too bent for a long time can cause complaints and disturbances. Several respondents were seen bending over at the pre-sampling preparation stage, at the sampling site, sampling with a gas analyzer, sampling with a probe, and lowering the sampling equipment [19], (3) The position of the foot does not support it perfectly. The ideal foot posture supports body weight perfectly, and the load is evenly distributed. Some poor foot postures include resting on only one leg, feet at an angle, or standing imperfectly. Some of these postures can be seen in the stages of pre-sampling preparation, preparation at the sampling location, climbing stairs, and descending stairs [20]. (4) The arm position deviates from its natural posture. The arm posture has the best angle for working or the power zone, between 0-200 for the upper arm and 60^{o}-100^{o} for the forearm. While for the wrist, the best working angle is 15^{o} up and 15^{o} down [21]. (5) The weight of the load received. The burden received by the respondents in the form of a sampling tool reached 10 kg. In the activity of climbing and descending vertical stairs, the respondent's weight is considered as the burden of the insured when raising and lowering the equipment so that the respondent receives an additional shock load on the activity [19]. (6) The existence of repetitive and static movements. Repetitive movements performed more than four times a minute or static movements for more than 1 minute also affect the assessment of work posture. This movement is seen in pre-sampling preparation activities, preparation at the sampling location, up and down, and raising and lowering sampling equipment [22].

Complaints of musculoskeletal disorders (M.S.D.s) are pain or pain related to tendons, muscle tissue, ligaments, the nervous system, cartilage, bone structure, and blood vessels. from very mild complaints to very sick complaints [23]. Research on risk analysis of musculoskeletal disorders (MSDs) on Logistics Distribution Workers in Surabaya. This study discusses the risk of Musculoskeletal Disorders (MSDs) which cause tissue damage in the skeletal muscles caused by the body receiving a lot of weight or doing postures repeatedly for a long time. The risk level for MSDs in logistics distribution workers is high, which is caused by confusing and interrelated postures, durations, and frequencies at work [24].

Based on the research results obtained through the Nordic Body Map questionnaire, it is known that from 9 respondents, all of them experienced complaints. A total of 1 respondent, or 11.1%, had mild complaints, four respondents, or 44.4%, had moderate complaints, and the remaining four respondents, or 44.4%, had high complaints. The body part that experienced the highest level of complaints, namely "very sick" was the waist, felt by 88.9% of respondents and the back and below the waist by 77.8%, respectively. Other body parts that complained of pain were the right hand by 88.9% and the right upper arm by 77.8%. While the parts of the body with a degree of pain that respondents complained about were the right and left calves each 66.7% and the right and left thighs each 55.6%.The body parts that did not experience complaints were the buttocks, left elbow, and right elbow. Most respondents complained about the body parts for all complaints were the back, left thigh, right thigh, left knee, and right knee. This is following the results of research conducted by Zakaria, J., Sukadarin, E.H., Omar, F.A.C. and Salleh, N.F.M. 2017, that the highest prevalence of M.S.D.s symptoms during the last 12 months was low back pain (54.50%) followed by upper back pain. (27.30%) and in the shoulder area (22.70%). RULA analysis from the observation results showed that 43.20% of scavengers had a score of 7, indicating a change in posture should be done immediately.Meanwhile, 45.5% of scavengers got a score of 5, indicating that changes in posture must be carried out immediately. The chi-square analysis showed a significant relationship between the neck and low

back pain prevalence with an identified risk level at p<0.05 [25]. Complaints of musculoskeletal disorders are thought to be influenced by non-ergonomic work postures, according to the REBA method assessment of the factors that cause complaints of musculoskeletal disorders, including long working time, loading, frequency, and handgrip [26]. Galih Prakoso (2019) Research on musculoskeletal disorders often occurs in non-ergonomic work postures. This study aims to determine the extent of operator interference and which body parts are needed to improve work posture with an assessment method using a Nordic Body Map questionnaire. the results of the study, the main abnormalities were found in the right and left elbow body parts by 93%. Second, 87% of the body right knee and left knee, third, right and left forearm, 80% right and left wrist, fourth in the second upper arm, and 73% in the palm. The fifth is on the right shoulder, back, and calves 60%. Therefore, it is necessary to improve work posture to reduce the risk of musculoskeletal injuries [27].

The results of the study on the work postures of pre-sampling preparation activities using the REBA method found work postures with a moderate level of ergonomics (values 4-7) as many as three people. Work posture with a high level of ergonomic risk (value 8-10) as many as 6 respondents. Meanwhile, based on the Nordic Body Map questionnaire, it is known that the complaints of *MSDs*in the low category (scores 28-49) are one respondent, the category of moderate complaints (scores 50-70) is four respondents, and high complaints (scores 71-90) are four respondents. The statistical tests show that the greater the level of risk of work posture, the higher the level of complaints of *MSDs*. The results of the assessment there are six respondents with a high level of risk: respondents who experience high *MSDs* complaints are 4 respondents, moderate complaints are 2 respondents. 3 respondents with moderate work posture risk: 2 respondents with moderate MSDs complaints and 1 respondent with common complaints. Based on the Spearman rank statistic test, the result is p = 0.036.

The study results on the work postures of the preparation activities at the sampling location using the REBA method found working postures with a moderate level of ergonomics (values 4-7) as many as four people. Work posture with a high level of ergonomic risk (value 8-10) as many as five respondents. The results of statistical tests show that the greater the level of risk of work posture, the higher the level of complaints of MSDs. In this case, out of 5 respondents with a high level of risk, four respondents experienced high MSDs complaints, one respondent with moderate complaints. In respondents with moderate work posture risk as many as four people, there are three respondents with moderate MSDs complaints and one respondent with common complaints. Spearman rank statistical test that was carried out obtained the results of p = 0.009.

The study results on the work posture of climbing vertical stairs using the REBA method found working postures with a moderate level of ergonomics (values 4-7) as many as four people. Work posture with a high level of ergonomic risk (value 8-10) as many as five respondents. From the results of statistical tests, it is known that the greater the level of risk of work posture, the higher the level of complaints of MSDs. In this case, out of 5 respondents with a high level of risk, four respondents experienced high MSDs complaints, one respondent with moderate complaints. In respondents with moderate work posture risk as many as 4 people, there are 3 respondents with moderate MSDs complaints and 1 respondent with low complaints. Based on the Spearman rank statistic test, the result is p = 0.000.

The study results on work postures for raising sampling equipment using the REBA method found work postures with a moderate level of ergonomics (value 4-7) as many as three people. Work posture with a high level of ergonomic risk (value 8-10) as many as six respondents. The statistical tests show that the greater the level of risk of work posture, the higher the level of complaints of M.S.D.s. In this case, out of 6 respondents with a high level of risk, four respondents experienced high M.S.D.s complaints, two respondents had moderate complaints. In respondents with moderate risk of work posture as many as three people, there are two respondents with moderate M.S.D.s complaints and one respondent with common complaints. Based on the Spearman rank statistic test, the result is p = 0.036.

The study results on the work posture of sampling activities with the probe using the REBA method found work postures with a moderate level of ergonomics (values 4-7) as many as eight people. Work posture with a high

level of ergonomic risk (value 8-10) as many as one respondent. The statistical tests are known from 1 respondent with a high level of risk of experiencing high MSDs complaints. In contrast, in respondents with moderate work posture risk as many as eight respondents, there are three respondents with high MSDs complaints, four respondents with moderate complaints, and one respondent with common complaints. Based on the Spearman rank statistic test, the result is p = 0.320.

The study results on the work posture of sampling activities with a gas analyzer using the REBA method found work postures with a moderate level of ergonomics (values 4-7) as many as seven people. Work posture with a high level of ergonomic risk (value 8-10) as many as two respondents. The results of statistical tests are known from 2 respondents with a high risk of experiencing high M.S.D.s complaints as many as two respondents, while in respondents with moderate work posture risk as many as 7 respondents there are 2 respondents with high M.S.D.s complaints, 4 respondents with moderate complaints and 1 respondent with low complaints. Based on the Spearman rank statistic test, the result is p = 0.111.

The results of the study on work postures of water content measurement activities using the REBA method found work postures with moderate ergonomic levels (values 4-7) as many as 8 people. Work posture with a high level of ergonomic risk (value 8-10) as many as 1 respondent. the results of statistical tests are known from 1 respondent with a high level of risk of experiencing high M.S.D.s complaints, while in respondents with moderate work posture risk as many as 8 respondents there are 3 respondents with high M.S.D.s complaints, 4 respondents with moderate complaints, and 1 respondent with low complaints. Based on the Spearman rank statistic test, the result is p = 0.320.

The results of the study on work postures for measuring particulate levels using the REBA method found work postures with a low level of ergonomics (value 2-3) as many as 7 respondents, and a moderate level of ergonomic risk (value 4-7) as many as 2 people. the results of statistical tests are known from 2 respondents with a moderate level of risk of experiencing high M.S.D.s complaints 1 respondent and 1 respondent moderate complaints, while for respondents with low work posture risk as many as 7 respondents there are 3 respondents with high M.S.D.s complaints, 3 respondents with moderate complaints and 1 respondent with low complaints. Based on the Spearman rank statistic test, the result is p = 0.320.

The results of the study on work postures for lowering sampling equipment using the REBA method found work postures with a moderate level of ergonomics (value 4-7) as many as 3 people. Work posture with a high level of ergonomic risk (value 8-10) as many as 6 respondents. the results of statistical tests show that the greater the level of risk of work posture, the higher the level of complaints of M.S.D.s. In this case, out of 6 respondents with a high level of risk, four respondents experienced high M.S.D.s complaints, two respondents had moderate complaints. In respondents with moderate risk of work posture as many as three people, there are two respondents with moderate M.S.D.s complaints and 1 respondent with low complaints. Based on the Spearman rank statistic test, the result is p = 0.036.

Based on these data, it can be seen that the higher the risk of work posture, the higher the level of M.S.D.s complaints. These results are reinforced by research that has been carried out by Aini et al. (2020) regarding the Relationship of Physical Workload with Complaints of Musculoskeletal Disorders in Nurses in Hospitals with the results of the chi-square statistical test on Ergonomic risk level variable and M.S.D.s complaint variable show p-value = 0.001 which means there is a relationship between ergonomics risk level and M.S.D.s complaints [28]. However, this is different from the research results conducted by Indraswari [29] on pedicab drivers in the Delanggu District. This study states that most of the respondents, namely 92.9%, had a high level of ergonomics risk of working postures, and M.S.D.s complaints were more at the moderate level of 59.5%. Based on the chi-square test results, it was found that p = 0.556, which means that there is no relationship between the level of ergonomics risk of work postures with M.S.D.s complaints on pedicab drivers in Delanggu District in 2018 [30]. Research on the Relationship of Musculoskeletal Discomfort with Body Mass Index (BMI) in Cleaning Workers who Work in High Places, aims to measure the level of musculoskeletal discomfort of every cleaning worker who works at high places by distributing Nordic Body Map questionnaires. Research conducted by Julianus et al. (2020) regarding The Relation of Musculoskeletal Discomfort with Body Mass

Index (BMI) for Cleaning Workers, Who Work at an Elevated Place, states that areas of uncomfortable musculoskeletal pain are the left shoulder, right shoulder, back, waist, buttocks, right knee and left leg. . From the results of the ChiSquare Test, the p-value of the left shoulder = 0.006, right shoulder = 0.003, back = 0.00, waist = 0.00, buttocks = 0.00, right knee = 0.001 and left leg = 0.00. the significant relationship between BMI and perceived musculoskeletal discomfort [29].

5. CONCLUSION

The description of the risk level of ergonomics in work postures based on the activity stages in preparation for pre-sampling REBA (Rapid Entire Body Assessment) values 7-8 (medium-high), preparation at sampling locations with REBAvalues 7-8 (medium-high), climbing vertical stairs with REBA values 7-10 (medium-high). high), improvement of sampling equipment REBA value 7-8 (medium-high), sampling with probe REBA(Rapid Entire Body Assessment value) 6-8 (medium-high), sampling with gas analyzer REBA value 6-8 (medium-high), measurement REBA value of 5-8 (medium-high), measurement of particulate levels of REBA value of 3-4 (low-medium), decreasing of the sampling tool REBA value of 7-8 (medium-high) and going down the vertical ladder REBA value of 7-8 (medium -tall). Complaints of musculoskeletal disorders experienced by respondents were divided into three categories, namely low complaints (11.1%), moderate complaints (44.4%), and high complaints (44.4%). The limbs with the most complaints of M.S.D.s with extreme pain were the waist (88.9%), back, and below the waist, each with 77.8%.

6. SUGGESTION

To avoid the occurrence of M.S.D.s complaints, several things that can be done are the need for stretching activities before the sampling officer does the work—redesigning work stations that cause awkward postures in the workplace, for example, a car hood that is too low so that the back posture must be bent, extending the work floor above the chimney so that staff has free space to work.

DATA AVAILABILITY

All relevant data is in the papers and supporting information files. This study will help researchers to uncover critical areas of ergonomic risk level in work postures using the Rapid Entire Body Assessment (REBA) method and the distribution of musculoskeletal disorders in chimney emission sampling activities.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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