

# Measurement of Musculoskeletal Disorders Risk Level with Job Strain Index and Quick Exposure Check Methods at Palm Oil Sorting Operators

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## Abstract

PT. Sawita Unggul Jaya or better known as PT. SUJ is a company engaged in the manufacturing industry engaged in the processing of Crude Palm Oil (CPO). Problems that are often experienced by sorting operators are excessive fatigue or frequent risk of musculoskeletal disorders such as pain in muscles, back and hands. For these problems, measurement of the impact of work on the risk of musculoskeletal disorders is carried out. The aim is to determine the level of risk of symptoms of musculoskeletal disorders at the sorting operator PT. Sawita Unggul Jaya and provide recommendations for corrective actions to sorting operators. The method used in this research is the Job Strain Index and Quick Exposure Check methods. The results for the Job Strain Index method with a value of 24 SI (Strain Index) for oil palm fruit dropping stations, 26 SI (Strain Index) for oil palm fruit sorting stations and 26 SI (Strain Index) oil palm fruit return stations with risk levels for the three station is a job that is observed to be dangerous. And the Quick Exposure Check method, the value for the station for lowering oil palm is 178%, for sorting oil palm fruit it is 179.5% and the return for sorting fruit is 181.5% and all stations in this sorting get an action level. change as soon as possible.

**Keywords:** Job Strain Index, Musculoskeletal Disorders, Risk Measurement, Quick Exposure Check.

## 1. Introduction

Industrialization is a process of socio-economic change that changes the livelihood system of an agrarian society into an industrial society [1] [2]. Industrialization can also be interpreted as a situation in which society focuses on the economy which includes increasingly diverse jobs (specializations), salaries, and higher incomes. Industrialization is part of the modernization process in which social change and economic development are closely related to technological innovation.

PT. Sawita Unggul Jaya is one of the managers of oil palm fruit located in the District of Bilah Hilir, a company that accommodates raw materials both from the company itself and raw materials from the community as much as 100 tons/day. By doing a 2 shift work system with each 1 shift of working hours as much as 8 hours of work. PT. Sawita Unggul Jaya performs the palm oil processing every day which automatically means that this company does 7 working days. PT Sawita Unggul Jaya has work stations which include, Loading

Ramp (Sortation) with 6 operators, Sterilizer with 3 operators, Tippler with 2 operators, Pressing with 1 operator, Kernel with 2 operators, Clarification with 1 operator, Engine Room with 1 operator, Boiler with 3 operators, Kernel Crushing Plant with 2 operators. The production process of PT. Sawita Unggul Jaya produces Crude Palm Oil (CPO) with guaranteed quality, with raw materials that are very supportive of being able to increase the quality of CPO, and will then be sent to produce pure oil [3] [4]. The problem that is often faced by sorting operators is that from a preliminary study conducted on 6 sorting operators, they often complain and often experience MSDS (Musculoskeletal Disorders) every time they do their work. Like pain in the muscles and back, this causes them to often experience fatigue [5] [6]. They often lose concentration while doing work and lack enthusiasm to do work and tend to avoid work [7] [8].

Job Strain index (JSI) is a method to evaluate the level of risk of a job that can cause injury to the upper part of the hand, wrist, upper arm, or elbow, in this method the researcher only measures the operator's upper body, namely, the hands, arms and back [9]. Quick Exposure Check is one method of measuring posture load, the advantages of the method that the researcher uses, namely, the Job Strain Index is a method to measure risk from measuring how the operator actually feels the load on the operator's body, while the advantages of the Quick Exposure Check method are: considering the combination and interaction of multiple risk factors in the workplace (multiple risk factors), both physical and psychosocial [10] [11].

## 2. Literature Review

The word ergonomics comes from the Greek language, which consists of the basic words "Ergos" which means work, and "Nomos" which means law, so that ergonomics can be defined as a legal rule in carrying out work activities [12] [6]. In simple terms, ergonomics is defined as the study of the interaction between humans and the objects they use and with the environment in which the interaction occurs.

The main purpose of ergonomics is to study the limitations on the human body in interacting with the work environment both physically and psychologically. In addition, to reduce fatigue that is too fast and produce a product that is comfortable, comfortable to wear by the wearer [13].

Work is a human activity to change certain conditions of the natural environment which is intended to maintain and maintain its survival. Ergonomics studies related to human work in this case are shown to evaluate and redesign work procedures that must be applied, in order to provide increased effectiveness and efficiency as well as comfort or safety for humans as workers. If the work posture used by workers is wrong or not ergonomic, workers will get tired quickly so that their concentration and level of accuracy decrease which in turn causes a decrease in productivity. Work posture is a regulation of body posture while working. Body posture in work is strongly influenced by the shape, arrangement, size and layout of equipment, placement of instructional tools, how to treat equipment such as types of motion, direction and strength [14] [15].

The impact of an unbalanced work posture is musculoskeletal complaints or a condition that interferes with the function of joints, ligaments, muscles, nerves and tendons as well as the spine [16] [17] [6]. Musculoskeletal is a complaint in the skeletal muscles that is felt by a person ranging from very mild complaints to very painful [18].

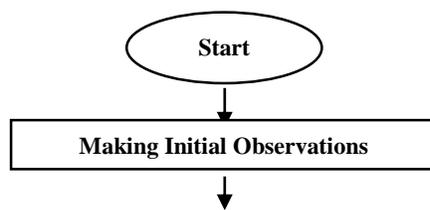
Musculoskeletal Disorders (MSDs) are the most frequently reported diseases among the many diseases caused by work, MSD gets a percentage of 53% which leads to a loss of workdays of 37% according to statistical data from The Health and Safety Executive (HSE) 2009/10 (Elyas, 2012). Musculoskeletal Disorders or Musculoskeletal Disorders refer to conditions that involve the nerves, tendons, muscles, and other supporting structures of the body. It can be said that there is an abnormality because there is a difference between the state of the body's supporting structure and the normal state [19] [7] [20].

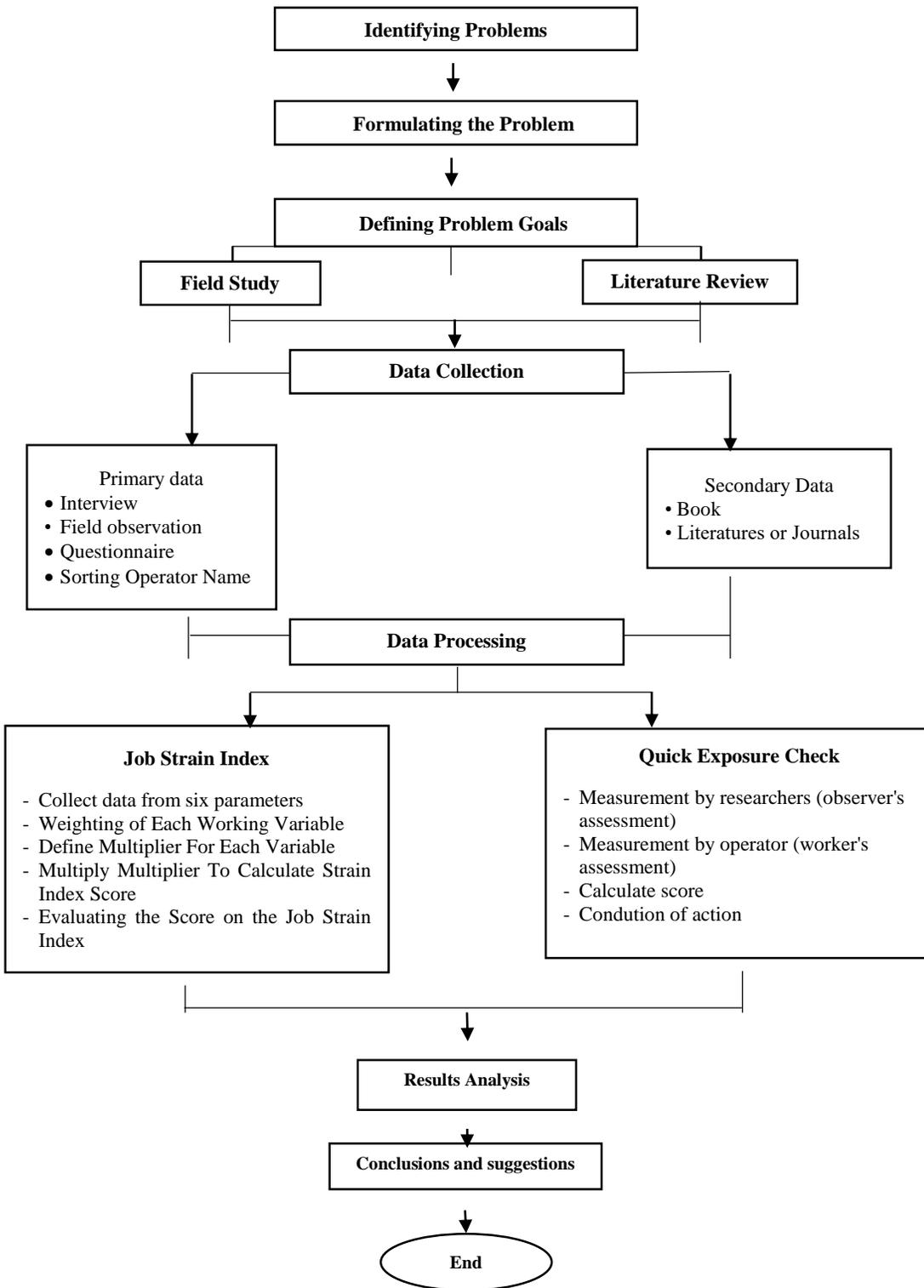
## 3. Methods

The research was conducted in Palm Oil Processing, namely PT. Sawita Unggul Jaya which is located on Jl. Medan – Ajamu, Negeri Lama (Km 2), District of Bilah Hilir, Labuhan Batu Regency, North Sumatra.

The research time was carried out as a whole from January 2020 starting with the preparation stage for the preparation of research proposals until September 2020. The object of research is the operator of the sorting workers of palm fruit bunches (FFB) at the PT. Sawita Unggul Jaya.

The research flow chart can be seen in Figure 1 as follows:





**Figure 1.** Research Diagram

#### 4. Result and Discussion

The report data on Crude Palm Oil production at PT Sawita Unggul Jaya can be seen in the following table:

**Table 1.** Data on CPO Results Reports for the 2015-2019 Period

Month	Crude Palm Oil Production (Kg)				
	2015	2016	2017	2018	2019
January	1.931.144	1.897.234	1.859.463	1.776.648	1.931.878
February	2.006.087	1.784.197	2.184.765	1.513.682	1.560.872
March	2.951.165	2.243.142	2.473.202	1.960.911	2.076.082
Apr	2.643.425	2.544.634	2.307.982	1.774.289	1.805.344
Mei	3.370.360	3.185.788	2.831.493	2.768.867	1.792.597
June	3.257.815	3.434.683	2.454.026	2.353.143	1.629.555
July	3.410.394	3.374.190,5	2.464.874	2.691.820	2.953.574
August	2.962.831	3.374.190,5	2.704.660	2.905.660	2.334.751
September	2.536.165	3.491.858	2.688.249	2.189.766	2.330.246
October	2.478.592	2.402.229	2.370.787	2.169.573	2.309.317
November	2.185.447	2.495.227	2.247.590	2.317.439	2.151.244
December	2.160.612	2.277.783	2.483.391	2.266.332	1.531.007
Total	31.894.037	32.505.156	29.070.482	26.688.130	24.406.467

Source: PT. Sawita Unggul Jaya

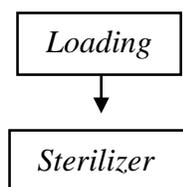
The number of machines used is based on the number of machines in the manufacture of Crude Palm Oil (CPO) starting from the initial production process until the end of the production process. The end of the production process. The following is the data on the number of machines in PT. Sawita Unggul Jaya for CPO processing can be seen in Table below.

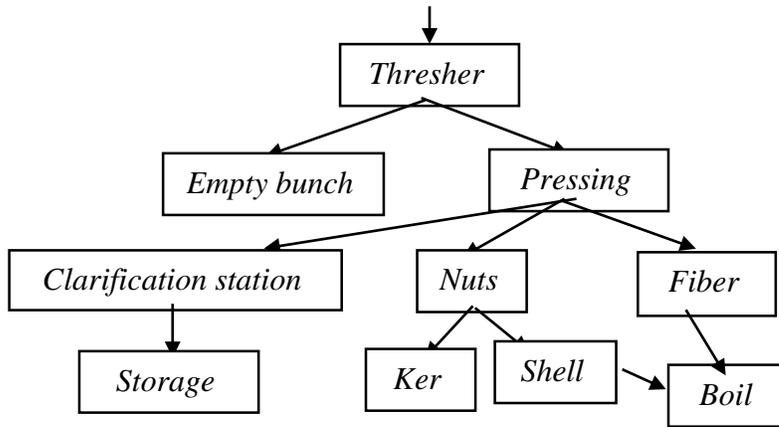
**Table 2.** Data on Number of Machines

Machine/Tool Name	Amount (unit)
Loading Roam	1
Sterilizer	1
Thresher	1
Pressing	1
Clarification Station	1
Kernel	1

Source: PT. Sawita Unggul Jaya

The flow data of the manufacturing process at Crude Palm Oil PT. Sawita Unggul Jaya is a flow that describes a cycle that includes a sequence of process activities from the beginning of the process to the end of the process. The process flow data in the manufacture of Crude Palm Oil can be seen in the following picture:





**Figure 2.** Process Flow of Crude Palm Oil

There are five data collection processes to determine the level of risk by using the job strain index method at the three oil palm operator stations, namely the Palm Oil Unloading Station, Sorting Station, Fruit Return Station and the results of the calculation can be seen as follows.

In the following, we will explain one example of the calculation for the activity of the Palm Oil Lowering Station.

1. Intensity of Exertion

Determining the results of the intensity of extable can be seen in Figure below:



**Figure 3.** Decreasing Oil Palm Fruit

So that the results obtained from direct observations can be seen in Table below:

**Tabel 3.** Results of Intensity Of Extable Palm Fruit Drop Station

Category	Maximum Percentage	Strength	Borg scale	Description
Weight (Hard)	30% - 49%		5	Requires more effort

Source: Data Processing

By measuring and observing the sorting operators, it was found that the intensity of exertion on the sorting operators at the drop station for oil palm fruit was in the Hard category.

2. Duration of Exertion

For the duration of exertion, the results are obtained using the following formula:

$$\begin{aligned}
 \%DE &= \frac{100 \times \text{"Total Power Usage Time"}}{\text{"Total Observation Time"}} \\
 &= \frac{100 \times 4 \text{ hour}}{6 \text{ hour}}
 \end{aligned}$$

$$= 66,67\% DE.$$

### 3. Minutes Effort

For work per minute the results are obtained using the following formula:

$$EM = \frac{\text{"Number of All Activities"}}{\text{"Total Observation Time"}}$$

$$= \frac{2700 \text{ "activity"}}{360 \text{ "minute"}}$$

$$= 7,5 \text{ EM.}$$

### 4. Hand or Wrist Posture

The hand or wrist posture can be seen in Figure below:



Figure 4.3 Wrist Posture at Palm Fruit Drop Station

So that the results obtained from direct observations can be seen in Table below:

**Table 4.** Results of Intensity Of Extables for Palm Oil Fruit Drop Station

Category	Maximum Percentage	Strength	Borg scale	Description
Weight (Hard)	30% - 49%		5	Requires more effort

By measuring and observing the sorting operators, it was found that the intensity of exertion on the sorting operators at the drop station for oil palm fruit was in the Hard category.

### 5. Working Speed

The speed of work is obtained from the results of direct observations by researchers so that the results are shown in Table below:

**Table 5.** Results of Working Speed of Palm Fruit Dropping Stations

Category	Comparison with MTM-1 <sup>^</sup>	Description
Fast Enough	91%-100%	Normal speed

### 6. Duration of work per day

Duration of work per day PT. Sawita Unggul Jaya that is, 8 hours per day.

The weighting of each work variable is carried out to determine the rating on each parameter that has been calculated and measured. So that obtained for the strain index table can be seen in Table below:

**Table 6.** Strain Index Results of Oil Palm Fruit Drop Station

Rating	Intensity of Exertion/ IE	Duration of Exertion/ DE	Efforts per Minute / EM	Hand/Wrist Posture/ HWP	Speed of Work/SW	Duration of Task per Day/DD
1	Light (1)	<10% (0,5)	<4 (0,5)	Very good (1)	Very slow (1)	<1 (0,25)
2	Somewhat Hard (3)	10%-29% (1)	4-8 (1)	good	Slow (1)	1-2 (0,5)

3	<i>Hard</i> (6)	30%-49% (1,5)	9-14 (1,5)	<i>Fair</i> (1,5)	<i>Fair</i> (1)	2-4 (0,75)
4	<i>Very Hard</i> (9)	50%-79% (2)	15-19 (2)	<i>Bad</i> (2)	<i>Fast</i> (1,5)	8 (1)
5	<i>Near maximal</i> (13)	100% (3)	≥20(3)	<i>Very bad</i> (2)	<i>Very Fast</i> (2)	≥8 (1,5)

Source: Data Processing

The table above is the strain or weighting value of the six parameters that have been calculated. As for determining the multiplier for each variable, it can be done in the following way in Table below:

**Table 7.** Multiplying Variables of Palm Fruit Drop Station

<i>Rating</i>	<i>Intensity of Exertion / IE</i>	<i>Duration of Exertion / DE</i>	<i>Efforts per Minute / EM</i>	<i>Hand/ Wrist Posture / HWP</i>	<i>Speed of Work / SW</i>	<i>Duration of Task per Day / DD</i>
1	1	0,5	0,5	1,0	1,0	0,25
2	3	1,0	1,0	1,0	1,0	0,5
3	6	1,0	1,5	1,0	1,0	0,75
4	9	2,0	2,0	2,0	1,5	1,0
5	13	3,0	3,0	2,0	2,0	1,5

To multiply in calculating the strain index score can be solved by Formula below:

$$SI = IE \times DE \times EM \times HWP \times SW \times DD$$

$$= 6 \times 2 \times 1 \times 2 \times 1 \times 1$$

$$= 24 \text{ SI.}$$

After multiplying the six variables, the next step is to evaluate the value of the Job Strain Index. There are 3 categories in determining the level of work risk, which can be seen in Table below:

**Table 8.** Results of Oil Palm Fruit Drop Station Risk Levels

<b>Scale</b>	<b>Description</b>
Value ≥ 7	Work that is observed to be dangerous

Source: Data Processing

The multiplication of the six variables resulted in the 24 Strain Index (SI), after which the JSI score was evaluated. The results of table 4.8 show that the oil palm fruit dropping station gets information on the scale of work that is observed to be dangerous.

After calculating the exposure level from the exposure formula (E), then to determine what actions to take based on the results of the total exposure score calculation. Actions to be taken based on the values generated in the calculation of exposure levels can be seen in the following table:

**Tabel 4.33** Action Level Quick Exposure Score

<b>Work Station</b>	<b>Exposure Level</b>	<b>Action</b>
Lowering Palm Fruit	178,0 %	Conducted Research and Changes Immediately
Sorting Palm Fruit.	179,5 %	Conducted Research and Changes Immediately
Returns Sorted Fruit.	181,5 %	Conducted Research and Changes Immediately

Source: Data Processing

From the results of calculations that have been carried out with two methods, namely Job Strain Index and Quick Exposure Check. For the Job Strain Index, sorting operators always do their work using extra strong body tools such as shoulders, back and hands. From the calculation of the Job Strain Index, it shows that there is an effect of a fairly heavy workload, with production always running, making sorting work experience overtime. From the 8 working hours observed by the researchers and it is sufficient to prove that the operator has symptoms of musculoskeletal disorders, it is evident from the results obtained using the Job Strain Index method with a value of 24 SI (Strain Index) for oil palm fruit dropping stations, 26 SI (Strain Index) for oil palm fruit drop stations. sorting of oil palm fruit and 26 SI (Strain Index) oil palm fruit return stations. Shows a score evaluation on a value scale of more than 7 with a description of the work observed as dangerous at the three stations located at the sorting operator PT. Sawita Unggul Jaya. For the Quick Exposure Check method, this method counts the questionnaires that have been distributed by the observers, after the questionnaires have been distributed, they are filled out by the operators themselves. Then the matching results obtained using the Strain Index table and the results are contained in table 4.24 as many as 6 operators. After being entered into the strain index table, each work

station is calculated using the scores in the table above. Then the calculation is carried out so that a value is obtained, for the work station operator to reduce the palm oil exposure level, the exposure level is 178% with the action being researched and changes as soon as possible, for the work station operator sorting the exposure check fruit, it is 179.5% with the action being researched and changing as soon as possible. and for the station operator to return the results of the exposure check, 181.5% was obtained with the action of doing research and repairing it as soon as possible.

Meanwhile, the Quick Exposure Check method showed no difference in the results from the (JSI) method, especially the station sorting oil palm fruit on the effects of community fruit as I explained in the introduction. The instability of the fruit from the community makes the work must be extra and clear, so that the operator experiences fatigue due to the weight of the work and the perceived burden.

## 5. Conclusion

Based on the research that has been done, several conclusions can be obtained, namely as follows:

1. The results of measuring the risk of musculoskeletal disorders using two methods, namely, Job Strain Index and Quick Exposure Check. Shows that the results of the JSI calculation prove that by counting the three stations contained in the sorting operator, for the drop station for oil palm fruit with a value of 24 SI (Strain Index), for the oil palm fruit sorting station the results obtained are 26 SI (Strain Index) and the final station and 26 SI (Strain Index) results for the oil palm fruit return station. And in the category of work that is considered dangerous. Meanwhile, the Quick Exposure Check method yielded 178% exposure check for oil palm fruit-sorting stations, 179.5% for oil palm fruit sorting stations, and 181.5% for the last station that returned the sorting fruit. And the three stations received action, research and changes were carried out as soon as possible. The change is believed to improve the work system and reduce work accidents, so that operators feel a better impact and special attention from the company.

2. Observers see directly the performance of each operator and provide recommendations for improvements to the sorting operator. Technology that can help operators such as Bulldozer, This tool is believed to make their work easier. And increasing the number of operators at each station will also help the performance of these operators even more, and speed up the situation in the event of a surge in raw materials coming from the public.

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