

An Analysis of Employee Work Posture Assessment with The Quick Exposure Check (QEC) Approach in The Green Tea Production in A Green Tea Company

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Abstract

Candi Loka is a company engaged in the food sector, especially in producing green tea. Technology in the food sector is currently growing rapidly, resulting in a competitive competition. Candi Loka requires superior human resources to produce a high quality product. To realize this, it is necessary to carry out work with high accuracy and concentration by competent workers in their fields. The working conditions carried out by competent workers need to be considered because they greatly affect the work productivity. Uncomfortable working conditions will affect workers to have Musculoskeletal Disorders. The purpose of this study was to identify the musculoskeletal disorders developed by green tea production employees at Candi Loka and to identify the work posture of green tea production employees. Through this research, an assessment to find out the musculoskeletal disorders and to assess the work posture of workers in the green tea production section was carried out by using the QEC method. Pain complaints related to the musculoskeletal disorders that many workers in the green tea production department had were pain in the neck, shoulders, arms and back with a score of 40 and a proportion of 6.51%. The assessment of work posture by using the Quick Exposure Check (QEC) method for green tea processing workers had 79.09% E value with an action level of 4 and was included in the category of very dangerous risks and further action was needed as soon as possible, while tea sorting workers Green had an E value of 84.09% with an action level of 4 and was included in the very dangerous risk category and needed further action as soon as possible.

Keywords: Work Posture Assessment, Candi Loka, Nordic Body Map (NBM), Quick Exposure Check (QEC) Method

1. Introduction

Technology in the field of food is currently growing rapidly, resulting in increasingly competitive competition in the field of food technology. The company's efforts to compete in the field of food technology require superior human resources to produce high quality products. To realize this, it is necessary to carry out the work with high accuracy and concentration by competent workers in their fields. The working conditions carried out by competent workers need to be considered because they greatly affect the work productivity. If the working conditions are uncomfortable, they will cause workers to develop some musculoskeletal disorders. Those musculoskeletal disorders occur when the workers not ergonomically work. According to [1] Yassierli, et al. *Ergonomi Industri*. Bandung: PT Remaja Rosdakarya. 2020., ergonomics is a field of science that systematically utilizes information about human nature, abilities and limitations in designing a work system that is safe, healthy, productive and comfortable.

Candi Loka is a company which engages in the food sector, especially in producing green tea. Green tea is a processed tea product that is processed without using an enzymatic oxidation process. The content of compounds found in green tea such as

polyphenols and catechins which are quite high can be beneficial for health. Candi Loka produced 7 tons of green tea a day. The green tea production process there took 7 hours which was divided into two work shifts. The green tea production process required high precision and concentration in its work to maintain the content of the beneficial compounds and to complete the daily workloads. This condition caused the workers to work for a long time, make repetitive movements, and lift heavy loads which can lead them to have some symptoms of musculoskeletal disorders.

Candi Loka had taken several ways to reduce its employees' symptoms of musculoskeletal disorders, such as by changing the production line from two lines to one production line and reducing the working time which was originally included Saturdays, Sundays and national holidays as working days. However, the way that has been done was not optimal in reducing the employees' symptoms of musculoskeletal disorders. Therefore, it was necessary to conduct further research on the symptoms of musculoskeletal disorders and an assessment on the work postures using the Quick Exposure Check (QEC) method by conducting direct observations and interviews with employees who were experienced in tea processing. and green tea sorting. The reason for using the Quick Exposure

Check (QEC) method was because it has a high level of sensitivity and reliability and was used to find out injuries in the skeletal muscles which focused on the back, neck, shoulders and wrists. So with the research entitled An Analysis of Employee Work Posture Assessment Using the Quick Exposure Check (QEC) Approach in Green Tea Production in A Green Tea Company, it is hoped that this research can provide suggestions for improvement and assessment of work posture to reduce the symptoms of musculoskeletal disorders that the tea production employees of Candi Loka had.

Work posture is a determining point in analyzing the effectiveness of a job. If the operators' work postures are good and ergonomic, it can be ascertained that the results obtained by the operators will be good. However, if the operators' work postures are not ergonomic, the operator will tire easily. [2] Erliana, Cut Ita. Analisis Postur Kerja Pada Pekerja Es Balok CV. Mulieng Iceberg. Industrial Engineering Journal. 2022, 11 (2), 944.

The Nordic Body Map Questionnaire is one of the subjective assessment methods to assess the

severity of individual skeletal muscle disorders in work groups. [3] Purbasari, Annisa et al. Analisis Postur Kerja Secara Ergonomi Pada Operator Pencetakan Pilar Yang Menimbulkan Risiko Musculoskeletal. Sigma Teknika. 2019, 2 (2), 143 – 150.

The Quick Exposure Checklist (QEC) method also aims to determine whether a type of work has a risk of injury to the skeletal-muscular system by looking at the risk factors as a whole. This method is relatively easy to use and does not require complicated equipment. It takes about 30 minutes to learn this method and about 10 minutes to use it. [1] Yassierli, et al. Ergonomi Industri. Bandung: PT Remaja Rosdakarya. 2020.

Previous research on work posture analysis have been carried out before using a variety of different methods. Previous research have become a reference and comparison which were used to conduct this research in increasing knowledge of the theory used. The following is Table 1. Previous Research.

Table 1.
Previous Research

No	Title of the Research	Researcher(s)	Result of the Research
1	Analisa Penilaian Postur Kerja Berdasarkan Metode <i>Quick Exposure Checklist</i> (Qec) Pada Operator Mesin Milling (Studi Kasus: Pt. Alis Jaya Ciptatama)	Rio Himawan (2020) [4]	Based on the results of data processing using the QEC method, it can be concluded that 5 machine operators in Mill 2, the production section of Alis Jaya Ciptatama Ltd. had an Exposure Level in action category 3, which required further research and changes to be made. Even though all operators had Exposure Level in action category 3, the highest Exposure Level value was the rustic spindle machine operator which was equal to 67.05%.
2	Analisis Tingkat Postur Kerja Dan Musculoskeletal Disorders pada Pekerja di Pabrik Roti Latansa Gontor	Ani Asriani Basri dan Dian Afif Arifah (2020) [5]	Based on the research conducted at the Latansa Bakery Factory, the result of the assessment of work posture using QEC on its bakery workers showed that the majority of workers were at the Exposure level of 72% -82% indicating that research and changes must be carried out as soon as possible. However, the results of the assessment of MSD's disorders based on the Nordic Body3 Map (NBM) on the workers showed that these disorders were categorized as mild disorders.
3	Analisis Postur Kerja Secara Ergonomi Pada Operator Pencetakan Pilar Yang Menimbulkan Risiko Musculoskeletal	Annisa Purbasari, Maria Azista, danBenedikta Anna H. Siboro (2019) [3]	The conclusion of this study was about the work posture of operators who were assessed using QEC in pillar molding activities. In this activity, the exposure score values for each operator were 135, 135, 130, 169, 117, and 145. Meanwhile, the exposure level values for pillar printing activities were 76.70%, 76.70%, 73.86% , 96.02%, 66.48% and 82.39%.
4	Analisis Ergonomi Dalam Penggunaan Mesin Penggilingan Pupuk Menggunakan Metode <i>Quick Exposure Checklist</i> Pada Pt. Putra Manunggal Sakti	Satria Adi Susanto, Ferida Yuamita (2022) [6]	From the results of the assessment using the QEC method in the milling process which used the existing machine at Putra Manunggal Sakti Ltd, 6 operators who worked there had the exposure score between 50% -69%, which means that further research was needed and changes needed to be made. The first operator got a value of 68.78, while the second operator got the resultsof 66.34, the third operator got the result of 66.34, the fourth operator got the result of 68.78, the fifth operator got the result of 66.34, and the sixth operator got the result of 66.34. The results obtained from this study showed that changes were necessary to be made to reduce pain complaints felt by operators. Based on the results of the QEC assessment, improvements were also needed in the near future.
5	<i>Analysis Of Work Posture Based On Quick Exposure Check & Manual Task Risk Assessment Method</i>	Stefani Prima Dias K, Fransisca Tania (2019) [7]	The result of this research concluded that the current work posture for the lowering process in the work of unloading raw materials from trucks to wooden pallets had a risk of injury that can endanger the workers' body with the greatest potential danger located on the back. This conclusion was obtained from the results of the QEC method and the ManTRA method with which both showed that the current work posture must be investigated further and improved immediately. The good work posture for lowering that can reduce the risk of work injuries and musculoskeletal disorders was to maintain a straight back and slightly bent legs posture.
6	Analisis Postur Kerja Dan	M. Agustiansyah,	From the results of data analysis using the Quick Exposure Check

No	Title of the Research	Researcher(s)	Result of the Research
	<i>Redesign Peralatan Kerja Dengan Metode Quick Exposure Check (Qec) Pada Pekerja Pencetakan Gerabah</i>	Mahmud Basuki, Hermanto MZ, Tolu Tamalika, Togar P.O.S. (2023) [8]	(QEC) and Nordic Body Map (NBM) methods for the two pottery printing workers, it was known that the two workers are at condition of Action Level 3 and their postures were needed to be assessed.
7	<i>Analisis Postur Kerja Dengan Metode Owas (Ovako Working Posture Analysis System) Dan Qec (Quick Exposure Checklist) Untuk Mengurangi Terjadinya Kelelahan Musculoskeletal Disorders Di Pt. Truva Pasifik</i>	Sofian Bastuti, Marjuki Zulziar, Edih Suaedih (2023) [9]	Truva Pacific Ltd. Work lines consisted of 19 elements of activities, the operators' body parts which were most dominantly used and had the highest risk level of musculoskeletal disorders were the back (90.5%) for 114 workers, followed by the right shoulder (87.3%) for 110 workers, the right hand (81.7%) for 103 workers, the lower neck and right calf (78.6%) for 99 workers, and the waist (71.4%) for 90 workers. In addition, the QEC method showed an action level value (70.5%) in the activity of taking sacks with a risk level of 4 (further investigation and handling were needed as soon as possible)
8	<i>Analisis Postur Kerja Operator Pemanen Kelapa Sawit dengan Metode Quick Exposure Check (QEC)</i>	Faradila Ananda Yul, Saputra (2021) [10]	Based on the data processing and the discussion of analysis in this study, it was concluded that the results of calculating body posture for oil palm harvesting operators using the Quick Exposure Check method showed that all operators were in the action level 4 position with an average Action Level value of 88.97%. It means that immediately actions to handle this problem were needed.
9	<i>Penilaian Postur Kerja Menggunakan Quick Exposure Checklist Pada Pekerja Sortir</i>	Dian Almira, Lukman Handoko, Haidar Natsir Amrullah (2022) [11]	This research was conducted at a plastic packaging company in the sorting section by observing workers' postures and repetitive works. Based on the results of the sorting workers' posture assessment, an exposure level of 65.34% was found to be in the category which needed further research and improvement. Due to their repetitive work, the workers' backs, wrists and necks had the highest Exposure Scores. The improvement which can be given in the sorting work section is by doing the engineering control, such as: redesigning the workbench to meet the standards given by the Minister of Manpower, adding a rope hanging pole to make the workers' neck position more neutral and not bowing, and giving assistance to help workers handling problems caused by their repetitive works.
10	<i>Identification of Ergonomic Risk on Workers Using Quick Exposure Check and Rapid Upper Limb Assessment Methods</i>	Cut Ita Erliana, Defi Irwansyah, Dahlan Abdullah, Subhansah Zega, Muammar Faturrahman Hasibuan (2022) [12]	Based on the results of Quick Exposure Check (QEC) calculations for all workstations in PKS Pulau Tiga, the most risky workstation was in the loading ramp station which had an exposure level of 104.55% in the action category. This indicated that research and changes needed to be made as soon as possible.

2. Methodology

This research methodology had two flowcharts that were used to explain the stages of the research. The research flowchart explained the stages carried out during the research to achieve the objectives of the research which can be seen in the following diagram:

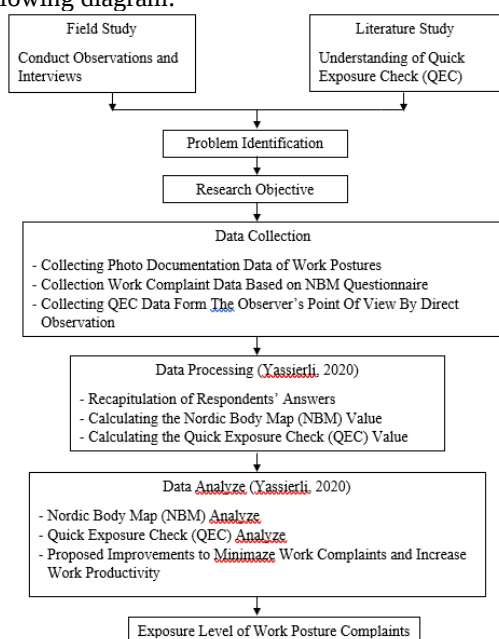


Figure 1. Research Flowchart

The second flowchart was the Quick Exposure Check (QEC) method. The flowchart of the Quick Exposure Check (QEC) method showed the stage of work posture assessment using the Quick Exposure Check (QEC) method. The following is the Quick Exposure Check (QEC) Method Flowchart:

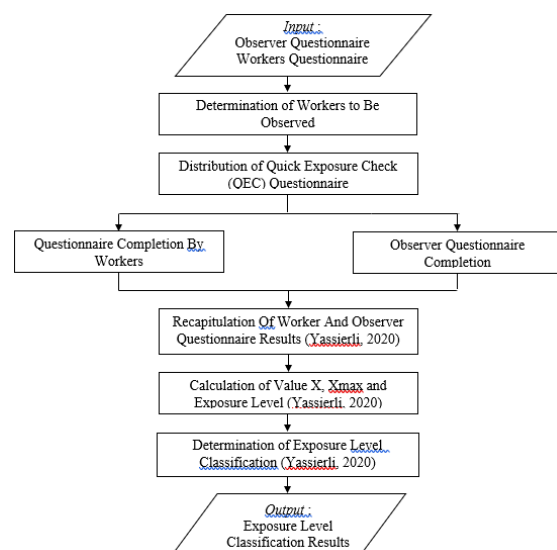


Figure 2. Quick Exposure Check (QEC) Method Flowchart

3. Result and Discussion

4.1 Green Tea Production Workers' Pain Complaints Based on NBM

According to Devi (2017), Musculoskeletal Disorders (MSDS) complaints are complaints of pain in the part of the skeletal muscles ranging from mild to severe complaints [13]. Pain complaints from Musculoskeletal Disorders (MSDS) can be identified by the characteristic categories of the workers. In other words, the characteristic categories such as such as: age, sex, work section, and years of work,

affected the workers' performance at work. For example, workers with 6 years of work tended to increase the rate of Musculoskeletal Disorders (MSDS) symptoms by 40%. The data about workers' the characteristic categories were obtained by interviewing 10 workers in the green tea production section at Candi Loka. The 10 workers were divided into two divisions, namely green tea processing experienced workers and green tea sorting experienced workers. The following is Table 1. Characteristics of Green Tea Production Workers at Candi Loka.

Table 1.
Characteristics of Green Tea Production Workers at Candi Loka

No	Name	Age	Sex	Work Section	Years of Work	Highest Academic Level
1	Agus	34 Years Old	Male	Processing	14 Years	High School
2	Faisal	24 Years Old	Male	Processing	5 Years	Vocational School
3	Santoso	30 Years Old	Male	Processing	10 Years	Vocational School
4	Sikur	37 Years Old	Male	Processing	18 Years	High School
5	Karsini	52 Years Old	Female	Processing	27 Years	Junior High School
6	Diyah	23 Years Old	Female	Sorting	1 Years	High School
7	Anggi	24 Years Old	Female	Sorting	1 Years	High School
8	Novi	24 Years Old	Female	Sorting	1 Years	High School
9	Nindy	35 Years Old	Female	Sorting	3 Years	Vocational School
10	Palupi	45 Years Old	Female	Sorting	8 Years	Junior High School

Source: Data Processed, 2023

The Data collection on pain complaints related to Musculoskeletal Disorders (MSDS) was carried out by distributing the Nordic Body Map (NBM) questionnaire which was grouped into 28 body parts to the 10 green tea production workers at

Candi Loka. The following is Table 2. Results of the Questionnaire on pain complaints related to Musculoskeletal Disorders (MSDS) based on the Nordic Body Map (NBM).

Table 2.
Complaint Questionnaire Results Based on Nordic Body Map (NBM)

No	Complaint	Workers										Number of Complaints	Percentage(
		1	2	3	4	5	6	7	8	9	10		
0	Upper Neck	4	4	4	4	4	4	4	4	4	4	40	6,51
1	Lower Neck	4	4	4	4	4	4	4	4	4	4	40	6,51
2	Left Shirt	4	4	4	4	4	4	4	4	4	4	40	6,51
3	Right Shirt	4	4	4	4	4	4	4	4	4	4	40	6,51
4	Left Upper Arm	4	4	4	4	4	4	4	4	4	4	40	6,51
5	Back	4	4	4	4	4	4	4	4	4	4	40	6,51
6	Right Upper Arm	4	4	4	4	4	4	4	4	4	4	40	6,51
7	Waist	3	2	2	2	2	3	2	3	3	3	25	4,07
8	Below the Waist	2	1	1	1	2	2	1	2	2	1	15	2,44
9	Buttocks	1	1	1	1	1	1	1	1	1	1	10	1,63
10	Left Elbow	1	1	1	1	1	1	1	1	1	1	10	1,63
11	Right Elbow	1	2	2	1	1	1	1	1	2	1	13	2,12
12	Left Forearm	3	2	3	4	4	3	3	3	4	4	33	5,37
13	Right Forearm	3	3	4	4	4	3	3	3	3	3	33	5,37
14	Left Wrist	2	3	2	2	2	2	2	2	2	2	21	3,42
15	Right Wrist	2	3	3	3	3	2	2	2	2	2	24	3,91
16	Left Hand	2	1	2	1	2	1	2	2	1	1	15	2,44
17	Right Hand	2	1	1	1	1	1	2	2	1	2	14	2,28
18	Left Thigh	1	1	1	1	1	1	1	1	1	1	10	1,63
19	Right Thigh	1	2	1	1	1	1	1	1	1	1	11	1,79
20	Left Knee	1	2	1	1	1	1	1	1	1	1	11	1,79
21	Right Knee	1	2	1	1	1	1	1	1	1	1	11	1,79
22	Left Calf	1	2	1	1	1	1	1	1	1	1	11	1,79
23	Right Calf	1	1	2	2	2	2	3	1	2	2	18	2,93
24	Left Ankle	1	1	2	2	2	1	2	1	1	2	15	2,44
25	Right Ankle	1	1	2	2	2	1	1	1	1	2	14	2,28
26	Left Foot Sole	1	1	1	1	1	1	1	1	1	1	10	1,63
27	Right Foot Sole	1	1	1	1	1	1	1	1	1	1	10	1,63
Total		60	62	63	62	64	59	61	60	61	62	614	

Source: Data Processed, 2023

Based on Table 2 above, it can be seen that the pain related to the musculoskeletal disorders that were felt by 10 workers in the green tea production division at Candi Loka were on the neck, shoulders, arms and back. The total number of pain complaints on the upper neck, lower neck, left shoulder, right shoulder, left upper arm, right upper arm, and back was 40 with a percentage of 6.51%. The assessment of the complaints above can be used as a reference for the initial assessment to address the musculoskeletal disorders-related pain felt by workers in the green tea production division at Candi Loka.

4.2 Assessment of Work Posture with the QEC Method

According to Erliana (2022), assessment of work postures is a determining point in analyzing the effectiveness of a job [12]. The scientific reason for assessing the work postures is to find out the musculoskeletal disorders-related pain felt by workers and to provide suggestions for improvements in reducing the pain felt by these workers.

The method used for assessing the workers' work posture was the Quick Exposure Check (QEC) method. The Quick Exposure Check (QEC) method is a method of assessing body load for work related musculoskeletal disorders, which was introduced by Dr. Guanyang Li and Peter Buckle.

Data collection was carried out at Candi Loka with workers in the green tea production section chosen as the research subjects. The subjects were divided into two divisions, namely: experienced workers in the green tea processing section and experienced workers in the green tea sorting section. Data collection was carried out by distributing the work posture questionnaires using the Quick Exposure Check (QEC) method to 5 green tea production experienced workers and 5 green tea sorting experienced workers. The Quick Exposure Check (QEC) questionnaires consisted of two types of questionnaires, namely a research questionnaire

filled in by the researchers and a worker questionnaire filled out by the workers to analyze the condition of their work station.

4.2.1 QEC Assessment of Green Tea Processing Workers

5 workers were involved in the Quick Exposure Check (QEC) assessment of workers in the green tea processing section. The workers in the green tea processing division worked for around 7 hours per day with 2 hours of overtime (according to the company's policy). The working hours were divided into two shifts. The first shift started at 07.00 am until 02.00 pm and the second shift started at 03.00 pm until 09.00 pm. The processing of green tea consisted of several working processes, namely withering, milling, and drying the green tea. The following is Figure 3. The Working Process of the Green Tea Processing:



Figure 3. The Working Process of the Green Tea Processing Workers

Source: Data Processed, 2023

The Quick Exposure Check (QEC) assessment of experienced workers in the green tea processing section was carried out by distributing two types of questionnaires to the 5 workers, namely the researchers' questionnaire and the workers' questionnaire. After the Quick Exposure Check (QEC) questionnaire was distributed and filled out by the 5 experienced workers in the green tea processing division, then a recapitulation of the answers from the researcher's questionnaire and the workers' questionnaire was carried out. The following is Table 3. Recapitulation of Questionnaire Answers by Researchers and Observers of the Green Tea Processing Experienced Workers.

Table 3.

Recapitulation of Questionnaire Answers by Researchers and Observers of the Green Tea Processing Experienced Workers

Workers	Researcher							Worker						
	A	B	C	D	E	F	G	A	b	C	d	e	f	g
Agus	A2	B2	C2	D2	E1	F3	G2	a3	b3	c3	d2	e2	f2	g1
Faisal	A2	B2	C2	D3	E1	F3	G3	a3	b3	c2	d1	e2	f1	g2
Santoso	A3	B2	C2	D3	E1	F3	G3	a3	b3	c2	d1	e2	f1	g2
Sikur	A2	B2	C2	D2	E1	F3	G2	a3	b3	c2	d1	e2	f1	g2
Karsini	A2	B2	C2	D2	E1	F3	G3	a3	b3	c2	d2	e2	f1	g2

Source: Data Processed, 2023

Based on Table 3 above, it can be seen that when Agus was working, the researchers saw the worker's back turning or bending to the side for 20° - 60° which was symbolized by A2 with the movement done by approx. 8 times per minute which was symbolized by B2. The position of the arm when

working was around the chest which was symbolized by C2 with the frequency that occurred in a fixed condition which is symbolized D2. The position of the wrist is almost straight which is symbolized E1 with the movements for more than 20 times per minute due to the heavy weight being lifted which

was symbolized F3. The position of the neck was in a bending or rotating position for several times to hold the load he was carrying. This neck posture was symbolized by G2.

Based on the worker's questionnaire that was filled in directly by Agus, it can be seen that the maximum weight which he carried was 11 to 20 kg, which was symbolized by a3. The time he spent for work was more than 4 hours. His working hour was 7 hours per day which was symbolized by b3. The maximum weight required to do his job was also more than 4 kg which was symbolized by c3. The body tremor that he had while working was symbolized by d2. The work carried out by Agus almost did not require precision in vision which was

symbolized by e1. Sometimes Agus also had difficulty while working because the load that he carried was more than 4 kg which was symbolized by f2 with the level of stress that he felt was none which was symbolized by g1.

After recapitulating the answers of the researchers' and observers' questionnaires on the 5 green tea processing experienced workers, the exposure scores on four body parts of the 5 green tea processing workers at Candi Loka were calculated. The calculation of the exposure score used the Quick Exposure Check (QEC) score sheet. The following is Figure 4. The Green Tea Processing Experienced Workers QEC Score Sheet.

Nama Operator : Agus
Pekerjaan : Pemrosesan
Tanggal Penilaian : 16 Mei 2023

PUNGGUNG				BAHULENGAN				PERGELANGAN TANGAN				LEHER			
Posisi Postur (A) & Beban (a)				Tinggi (C) & Beban (a)				Gerakan Berulang (F) & Kelelahan (c)				Posisi Leher (G) & Durasi (b)			
A1 A2 A3				C1 C2 C3				F1 F2 F3				G1 G2 G3			
a1 2 4 6				a1 2 4 6				c1 2 4 6				b1 2 4 6			
a2 4 6 8				a2 4 6 8				c2 4 6 8				b2 4 6 8			
a3 6 8 10				a3 6 8 10				c3 6 8 10				b3 6 8 10			
a4 8 10 12				a4 8 10 12				10				10			
Score 1				Score 1				Score 1				Score 1			
Posisi Postur (A) & Durasi (b)				Tinggi (C) & Durasi (b)				Gerakan Berulang (F) & Durasi (b)				K. Visual (e) & Durasi (b)			
A1 A2 A3				C1 C2 C3				F1 F2 F3				e1 e2			
b1 2 4 6				b1 2 4 6				b1 2 4 6				b1 2 4 6			
b2 4 6 8				b2 4 6 8				b2 4 6 8				b2 4 6 8			
b3 6 8 10				b3 6 8 10				b3 6 8 10				b3 6 8 10			
Score 2				Score 2				Score 2				Score 2			
Durasi (b) & Beban (a)				Durasi (b) & Beban (a)				Durasi (b) & Kelelahan (c)				Gerakan (d)			
b1 b2 b3				b1 b2 b3				b1 b2 b3				d1 d2 d3			
a1 2 4 6				a1 2 4 6				c1 2 4 6				1 4 9			
a2 4 6 8				a2 4 6 8				c2 4 6 8							
a3 6 8 10				a3 6 8 10				c3 6 8 10							
a4 8 10 12				a4 8 10 12				10							
Score 3				Score 3				Score 3							
Posisi Statis (E) & Durasi (b)				Frekuensi (D) & Beban (a)				Posisi P. Tangan (E) & Kelelahan (c)				Kecepatan Berjalan (f)			
E1 E2				D1 D2 D3				E1 E2				f1 f2 f3			
b1 2 4 6				a1 2 4 6				c1 2 4 6				1 4 9			
b2 4 6 8				a2 4 6 8				c2 4 6 8							
b3 6 8 10				a3 6 8 10				c3 6 8 10							
Score 4				Score 5				Score 4							
Frekuensi (E) & Beban (a)				Frekuensi (D) & Durasi (b)				Posisi P. Tangan (E) & Durasi (b)				Stress (g)			
E1 E2 E3				D1 D2 D3				E1 E2				g1 g2 g3 g4			
a1 2 4 6				b1 2 4 6				b1 2 4 6				1 4 9 16			
a2 4 6 8				b2 4 6 8				b2 4 6 8							
a3 6 8 10				b3 6 8 10				b3 6 8 10							
a4 8 10 12				b4 8 10 12				10							
Score 5				Score 6				Score 5							
Frekuensi (E) & Durasi (b)															
E1 E2 E3															
b1 2 4 6															
b2 4 6 8															
b3 6 8 10															
Score 6															
Total Score 42				Total Score 42				Total Score 42				Total Score 16			

Figure 4. The Green Tea Processing Experienced Workers QEC Score Sheet
Source: Data Processed, 2023

Based on Figure 4 above, it can be seen that the totals of the Green Tea Processing Experienced Workers exposure scores were found in four parts of his body as follows: 42 for the back, 42 for the shoulders or arms, 42 for the wrists, 16 for the neck, 4 for the body tremor, 4 for the speed of work, and 1 for the stress. Aside from that, the recapitulation of all answers of the questionnaires on the 5 green tea processing experienced workers obtained by calculating them based on their Quick Exposure Check (QEC) score sheets can be seen in the following table:

Table 4.

Recapitulation Summary of the Exposure Scores of the Green Tea Processing Experienced Workers.

Body Part	Worker				
	Agus	Faisal	Santoso	Sikur	Karsini
Back	42	42	46	42	42

Body Part	Worker				
	Agus	Faisal	Santoso	Sikur	Karsini
Shoulders/Arms	42	46	46	42	42
Wrists	42	36	36	36	36
Neck	16	18	18	16	16
Body Tremor	4	1	1	1	4
Work Speed	4	1	1	1	1
Stress	1	4	4	4	4
Total (Exposure Score)	151	148	152	142	145

Source: Data Processed, 2023

Based on Table 4 above, it can be seen that the total exposure scores of pain felt in the seven body parts by Agus was 151, Faisal was 148, Santoso was 152, Sikur was 142, and Karsini was 145.

The exposure score value which has been obtained from the 5 green tea processing experienced workers, were then calculated by using a predetermined formula. The following is the calculation of the exposure level value for Agus:

$$\begin{aligned} E &= \frac{X}{X_{max}} \times 100\% \\ &= \frac{151}{176} \times 100\% \\ &= 85,79\% \end{aligned}$$

Note :

E = Exposure Level value

X = Total Score

Xmax = Total of Maximum Manual Handling

Based on the calculation of the exposure level value for Agus above, a result of 85.79% was obtained by dividing his total exposure score of 151 by the maximum total of 176 then multiplying the result by 100%. The Xmax value of 176 is a statutory value when the work still uses human labor or manual handling. All exposure scores were calculated for their exposure level values to determine the level of the QEC. The following is Table 5. Recapitulation Summary of the Exposure level Values of the Green Tea Processing Experienced Workers:

Table 5.
Recapitulation Summary of the Exposure level Values of the Green Tea Processing Experienced Workers

Worker	QEC Score	E Value	Action Level
Agus	151	85,79%	4
Faisal	148	84,09%	4
Santoso	152	86,36%	4
Sikur	142	80,68%	4
Karsini	145	82,38%	4
Average Score (Exposure Level)	147,6	83,86 %	4

Source: Data Processed, 2023

Description of Action Levels:

1. Conditions are acceptable
2. Further investigation can be done
3. Further investigation and action changes need to be done immediately
4. Further investigation and action changes need to be done as soon as possible

Based on Table 5 above, it can be seen that the green tea processing experienced workers had an average QEC score of 147.6, rounding off to 148. The average E value was 83.86% with an action level of 4. According to the Quick Exposure Check (QEC)

method, the average score of 148 with the action level 4 was considered as the very dangerous risk category and further action was needed as soon as possible.

4.2.2 QEC Assessment of the Green Tea Sorting Department Workers

Similar to the assessment for the processing section, the Quick Exposure Check (QEC) assessment of experienced workers in the green tea sorting section also took 5 workers to be assessed. The experienced workers in the green tea sorting section here also worked for 7 hours per day with 2 hours of overtime (according to the company's policy), however they only had one shift in the sorting section which started at 07.00 am. until 14.00 pm. There were several work processes in this sorting process, namely sorting and classifying the green tea quality. The following is Figure 5. Work Process of the Experienced Workers in the Green Tea Sorting Section.



Figure 5. Work Process of the Experienced Workers in the Green Tea Sorting Section

Source: Data Processed, 2023

The Quick Exposure Check (QEC) assessment of the experienced workers in the green tea sorting section was carried out by distributing two types of questionnaires to the 5 workers, namely the researcher's questionnaire and the worker's questionnaire. After the Quick Exposure Check (QEC) questionnaire was distributed and filled in by the 5 experienced workers in the green tea sorting section, a recapitulation of the answers from the researcher's questionnaire and the workers questionnaire was carried out. The following is Table 6. Recapitulation of Questionnaire Answers by Researchers and Observers on the Green Tea Sorting Experienced Workers:

Table 6.
Recapitulation of Questionnaire Answers by Researchers and Observers on the Green Tea Sorting Experienced Workers

Worker	Researcher							Pekerja						
	A	B	C	D	E	F	G	a	b	c	d	e	f	g
Diyah	A2	B1	C1	D2	E1	F2	G2	a4	b3	c3	d1	e1	f1	g3
Anggi	A2	B1	C1	D2	E1	F2	G2	a4	b3	c3	d2	e2	f2	g2
Novi	A2	B1	C1	D2	E1	F2	G3	a4	b3	c3	d1	e2	f1	g3
Nindy	A2	B1	C2	D3	E1	F2	G2	a3	b3	c3	d1	e1	f2	g2

Worker	Researcher						Pekerja							
	A	B	C	D	E	F	G	a	b	c	D	e	f	G
Palupi	A2	B1	C2	D3	E1	F2	G2	a4	b3	c3	d3	e1	f1	g3

Source: Data Processed, 2023

Based on Table 6 above, it can be seen that when Diyah was working, the researchers observed that the workers' back was turning or bending sideways for about 20° - 60° which was symbolized by A2 with the movement done around 3 times per minute or less which was symbolized by B1. Meanwhile, the position of the arm while she was working was around the waist or below it which was symbolized by C1 with the frequency that occurs in a fixed condition which was symbolized by D2. The position of the wrist was almost straight, which was symbolized by E1, with movements of 11 to 20 times per minute due to the heavy weight being lifted which was symbolized by F2. The position of the neck was in bending or rotating position for several times to hold the load she was carrying which was symbolized by G2.

Based on the worker's questionnaire that was filled in directly by Diyah, it can be seen that the maximum weight that she handled was more than 20

kg which was symbolized by a4. The time spent on working was more than 4 hours. Her working hour was 7 hours per day which was symbolized by b3. The maximum weight required was more than 4 kg which was symbolized by c3. Diyah did not have body tremor while working which was symbolized d1. The work done by Diyah hardly required precision in vision which was symbolized by e1. Diyah did not experience any work difficulties which was symbolized by f1 and a moderate level of perceived stress which was symbolized by g3.

After recapitulating the answers of the researchers' and observers' questionnaires on the 5 green tea sorting experienced workers, the exposure scores on four body parts of the 5 green tea sorting experienced workers were calculated. The calculation of the exposure score used the Quick Exposure Check (QEC) score sheet. The following is Figure 6. The Green Tea Sorting Experienced Workers QEC Score Sheet:

Nama Operator : Diyah Pekerjaan : Sortasi Tanggal Pengisian : 16 Mei 2023																																																																					
PUNGUNG Posisi Punggung (A) & Beban (a) <table border="1"> <tr><td>A1</td><td>A2</td><td>A3</td></tr> <tr><td>a1</td><td>2</td><td>4</td></tr> <tr><td>a2</td><td>4</td><td>6</td></tr> <tr><td>a3</td><td>6</td><td>8</td></tr> <tr><td>a4</td><td>8</td><td>10</td></tr> </table> Score 1				A1	A2	A3	a1	2	4	a2	4	6	a3	6	8	a4	8	10	BAHULENGAN Tinggi (C) & Beban (a) <table border="1"> <tr><td>C1</td><td>C2</td><td>C3</td></tr> <tr><td>a1</td><td>2</td><td>4</td></tr> <tr><td>a2</td><td>4</td><td>6</td></tr> <tr><td>a3</td><td>6</td><td>8</td></tr> <tr><td>a4</td><td>8</td><td>10</td></tr> </table> Score 1				C1	C2	C3	a1	2	4	a2	4	6	a3	6	8	a4	8	10	PERGELANGAN TANGAN Gerakan Berulang (F) & Kekuatan (c) <table border="1"> <tr><td>F1</td><td>F2</td><td>F3</td></tr> <tr><td>c1</td><td>2</td><td>4</td></tr> <tr><td>c2</td><td>4</td><td>6</td></tr> <tr><td>c3</td><td>6</td><td>8</td></tr> </table> Score 1				F1	F2	F3	c1	2	4	c2	4	6	c3	6	8	LEHER Posisi Leher (G) & Durasi (b) <table border="1"> <tr><td>G1</td><td>G2</td><td>G3</td></tr> <tr><td>b1</td><td>2</td><td>4</td></tr> <tr><td>b2</td><td>4</td><td>6</td></tr> <tr><td>b3</td><td>6</td><td>8</td></tr> </table> Score 1				G1	G2	G3	b1	2	4	b2	4	6	b3	6	8
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Total Score 46				Total Score 44				Total Score 38				Total Score 14																																																									

Figure 6. The Green Tea Sorting Experienced Workers QEC Score Sheet

Source: Data Processed, 2023

Based on Figure 4 above, it can be seen that the totals of the green tea sorting experienced

workers exposure scores were found in four parts of his body as follows: 46 for the back, 44 for the

shoulders or arms, 38 for the wrists, 14 for the neck, 1 for the body tremor, 1 for the speed of work, and 9 for the stress. Aside from that, the recapitulation of all answers of the questionnaires obtained by calculating them based on their Quick Exposure Check (QEC) score sheets can be seen in the following table:

Table 7.

Recapitulation Summary of the Exposure Scores of the Green Tea Sorting Experienced Workers

Body Part	Worker				
	Diyah	Anggi	Novi	Nindy	Palupi
Back	46	44	44	38	44
Shoulders/Arms	44	44	44	46	52
Wrists	38	38	38	38	38
Neck	14	16	18	16	14
Body Tremor	1	4	1	1	9
Work Speed	1	4	1	4	1
Stress	9	4	9	4	9
Total (Exposure Score)	153	154	155	147	167

Source: Data Processed, 2023

Based on Table 7 above, it can be seen that the total exposure score of the seven complaints felt by Diyah was 153, Anggi was 154, Novi was 155, Nindy was 147, and Palupi was 167.

The exposure score value which has been obtained from the 5 green tea sorting experienced workers, were then calculated by using a predetermined formula. The following is the calculation of the exposure level value for Diyah:

$$\begin{aligned}
 E &= \frac{X}{X_{max}} \times 100\% \\
 &= \frac{153}{176} \times 100\% \\
 &= 86,93\%
 \end{aligned}$$

Note:

E = Exposure Level Value

X = Total Score

Xmax = Total of *Maximum Manual Handling*

Based on the calculation of the exposure level value for Diyah above, a result of 86.93% was obtained by dividing his total exposure score of 153 by the maximum total of 176 then multiplying the result by 100%. The Xmax value of 176 is a statutory

value when the work still uses human labor or manual handling. All exposure scores were calculated for their exposure level values to determine the level of the QEC. The following is Table 8. Recapitulation Summary of the Exposure level Values of the Green Tea Sorting Experienced Workers:

Table 8.

Recapitulation Summary of the Exposure level Values of the Green Tea Sorting Experienced Workers

Worker	QEC Score	E Value	Action Level
Diyah	153	86,93%	4
Anggi	154	87,50%	4
Novi	155	88,06%	4
Nindy	147	83,52%	4
Palupi	167	94,88%	4
Average Score (Exposure Level)	155,2	88,18%	4

Source: Data Processed, 2023

Description of Action Levels:

1. Conditions are acceptable
2. Further investigation can be done
3. Further investigation and action changes need to be done immediately
4. Further investigation and action changes need to be done as soon as possible

Based on Table 5 above, it can be seen that the 5 green tea sorting experienced workers had an average QEC score of 155.2, rounding off to 155. The average E value was 88.18% with an action level of 4. According to the Quick Exposure Check (QEC) method, the average score of 155 with the action level 4 was considered as the very dangerous risk category and further action was needed as soon as possible.

4.3 Suggestion for Work Improvements

Based on the assessment results on the musculoskeletal disorders-related pain complaints and the exposure levels of the workers in the green tea production division at Candi Loka, several work improvements can be proposed to reduce the musculoskeletal disorders (MSDS) symptoms that the workers had. The following is Table 9. Suggestion for Work Improvements.

Table 9.

Suggestion for Work Improvements

No	Suggestion Improvements		Picture	
	Before	After	Before	After
1	There is no training and workers work with postures that are not ergonomic.	Providing socialization and training on how to work with ergonomics postures to green tea production workers at PT Candi Loka	-	

No	Suggestion Improvements		Picture	
	Before	After	Before	After
2	Workers in the green tea processing work with a body positions that is too bent when lifting weights	The body should be in an upright position with a straight back and squat with the right foot next to the weight and left foot behind when lifting the weight		
3	Workers in green tea sorting work with their neck too low while sitting on the floor	It is better to keep your neck upright and not look down often which will cause stiffness in the neck		
4	The green tea production workers at PT Candi Loka still use human labor to lift weights	Use ergonomic conveyance to lift weights to reduce the risk of injury complaints	-	

Source: Data Processed, 2023

4. Conclusion

The following are the conclusions of the research on the workers' work posture assessment which was conducted at Candi Loka:

1. It was identified that pain related to the musculoskeletal disorders that many workers in the green tea production department felt were in the neck, shoulders, arms and back with a score of 40 and a percentage of 6.51%.
2. The results of the analysis on the work posture assessment using the Quick Exposure Check (QEC) method were that the workers in the green tea processing section had 79.09% of E value with an action level of 4 which was then categorized as the very dangerous risk category. Thus further actions were needed as soon as possible. Similarly, the workers in the green tea sorting section had 84.09% E value with an action level of 4 which was categorized as the very dangerous risk category in which further actions were needed to be done as soon as possible in the form of socialization and training on ergonomic posture to experienced workers in the green tea processing and sorting division.
3. As the exposure level was 4, some suggestions for the work improvements are proposed as follows: conducting socialization of understanding and providing training on how to work with the correct posture for workers in the green tea production division at Candi Loka, correcting the workers' posture with the better work posture as suggested and using ergonomic conveyances in transporting

the tea leaves to the production site to reduce the risk of the musculoskeletal disorders-related pain felt by workers.

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