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The Effect of Work Chair Improvement on Complaints of Musculoskeletal Disorders and Productivity in Workers in the Sewing Department of PT X

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Abstract:-This study aims to determine the influence of ergonomic chair improvements on Musculoskeletal Disorders (MSDs) complaints and productivity among sewing workers at PT X. The research population consisted of 30 workers in the sewing department using a sampling technique. This study employed an analytical quantitative design with a cross-sectional approach conducted at Company X. The sample size was 30 workers, selected through random sampling. Data collection involved anthropometric measurements, pre-improvement assessment of work chairs, the provision of ergonomic chairs tailored to the workers' anthropometry, and the use of the Nordic Body Map questionnaire to assess musculoskeletal complaints. Data processing and analysis were performed using the nonparametric Wilcoxon test in SPSS version 16.0. The analysis of the difference in musculoskeletal complaints before and after the intervention using the Wilcoxon test yielded an Asymp. Sig (2-tailed) value of 0.000 (p value 0.001 < 0.01), indicating a highly significant result. The analysis of the difference in total productivity before and after the intervention using the Wilcoxon test resulted in an Asymp. Sig (2-tailed) value of 0.004 (p value 0.004 < 0.05), indicating a highly significant result. In conclusion, this study demonstrates that there is an influence of ergonomic chair improvements on musculoskeletal complaints and productivity among sewing workers at PT X.

I. INTRODUCTION

Musculoskeletal complaints generally occur not directly but as a result of accumulated small and large impact injuries over a long period of time. This happens because workers sit for extended periods and the size of the chair does not match their body size, leading to injuries starting with pain, discomfort, and stiffness in various body parts. The muscles commonly affected by musculoskeletal complaints include those in the neck, shoulders, arms, hands, waist, fingers, back, and other lower body muscles.

Musculoskeletal complaints refer to complaints felt by individuals in their skeletal muscles, ranging from mild to severe. Muscles that repeatedly endure static loads over a long period of time are prone to damage in the joints, ligaments, and tendons. These complaints and damages are typically referred to as Musculoskeletal Disorders (MSDs) or injuries to the musculoskeletal system (Tarwaka, 2004).

Chairs are crucial work facilities, especially for employees who perform tasks while seated, particularly those that require high precision. The chairs used should be ergonomic. Non-ergonomic chairs can create risky working postures and have an impact on the spine (Benjamin W. Niebel, 2013). A good chair provides proper posture, circulation, and helps avoid discomfort. A comfortable chair is adjustable and has back support (Wasi, 2015).

The accuracy of selecting anthropometric data is the foundation for designing a work chair to ensure it provides comfort to the user. Anthropometric aspects need to be linked to the biomechanical requirements involved in determining chair dimensions. Body stabilization is not only related to the seating surface but also the legs, feet, and back, which should lean against other parts of the chair's surface. If anthropometric design is inaccurate and results in a chair that doesn't allow the user to lean their back or legs against the surface, the body's stability will be reduced, and additional muscle energy will be required to maintain balance. The greater the level of muscle energy or control needed, the greater the discomfort caused (Panero et al., 2013).

PT X is a company engaged in garment and cap manufacturing. It was established in 2013 and continues to operate until now. An initial survey revealed that the workers' chairs were non-ergonomic, lacking backrests, and their width and height did not match the workers' anthropometry. Through interviews conducted after work with 15 sewing workers at PT X, it was found that 10 of them experienced musculoskeletal complaints, primarily in the back, shoulders, neck, and buttocks.

Based on the ergonomic issues identified, the immediate concern is the problem of work chairs that do not match the sewing workers' anthropometry because failure to address this can lead to musculoskeletal complaints. Therefore, research is needed to improve work chairs tailored to the workers' anthropometry, with the aim of reducing musculoskeletal system disturbances and enhancing the productivity of sewing workers at PT X.

II. LITERATURE REVIEW

A. Ergonomic

Ergonomics originated from the Greek words "ergon" (work) and "nomos" (law), which means the science that studies the laws of work. Thus, ergonomics is a system that is oriented towards a scientific discipline, which is now applied to almost every aspect of human life or activity (Tarwaka, 2010). Ergonomics is an intersection of various fields of study such as anthropology, biometrics, work physiology, company hygiene and occupational health, work planning, applied research, and cybernetics. However, its main specificity lies in the planning of better work methods, including work organization and equipment. Ergonomics programs involve identifying problems, experimenting for solutions, implementing the results of experiments, and proving effectiveness, although in practice, they often use a trial-and-error approach (Suma'mur, 2009).

B. Anthropometry

Anthropometri is a study of systematic measurement of the human body, particularly regarding the dimensions, shape, and size of the body that can be used for anthropological classification and comparison (Tarwaka, 2010). According to Nurmianto (2003), it is related to the application of anthropometric data required in the process of product design or workspace facilities.

C. Chair Design

The basic essence of ergonomic evaluation in the design process is to consider human interests as early as possible so that they can be accommodated in every creativity and innovation of a "man-made object" (Sritomo, 2008). The focus of an ergonomic study will be directed towards achieving a design of a product that meets the requirement of "fitting the task to the man" (Tarwaka, 2010), so every design should always consider human interests, such as safety, health, security, and comfort. A good chair will provide proper posture and circulation and help avoid discomfort. The choice of a comfortable chair can be adjusted and have back support (Wasi, 2005). The height of the chair is influenced by the interaction with the seat height. The design of the chair should conform to the criteria to ensure that the working surface remains below the elbows, as mentioned earlier (Nurmianto, 2003). According to Grandjean in Tarwaka (2010), a chair should have back and lumbar support. A good chair can support workers with a comfortable working position and facilitate frequent changes in body position.

D. MSDS Complaints

Complaints related to the musculoskeletal system are complaints felt by individuals in various parts of the skeletal muscles, ranging from mild to severe pain. When muscles are subjected to repetitive and prolonged static loads, it can lead to complaints such as damage to joints, ligaments, and tendons. These complaints and damages are commonly referred to as musculoskeletal disorders (MSDs) or injuries to the musculoskeletal system (Grandjean, 1993; Lemasters, 1996 in Tarwaka, 2010). Studies on Musculoskeletal Disorders (MSDs) in various industries have been conducted, and the results show that the skeletal muscles frequently complained about include the muscles of the neck, shoulders, arms, hands, fingers, back, waist, and lower extremities. Among these complaints, Low Back Pain (LBP) is commonly experienced by workers and involves the muscles in the lower back (Tarwaka, 2004).

III. RESEARCH METHODOLOGY

This study is an analytical quantitative research with a cross-sectional approach conducted at Company X in Yogyakarta. The entire population of workers in the sewing department of Company X in Yogyakarta was included, and a portion of them was selected through random sampling. The sample size for this study was 30 individuals. Data collection was performed using the Nordic Body Map questionnaire to assess musculoskeletal complaints, and anthropometric measurements were taken to evaluate the ergonomic design of chairs. Data processing and analysis were conducted using the non-parametric Wilcoxon test statistical method using the SPSS computer program version 16.0.

IV. RESULTS AND DISCUSSION

A. NBM Measurement (Nordic Body Map)

The measurement of the Nordic Body Map was conducted at the beginning of the research to gather data on Musculoskeletal Disorders (MSDs) complaints experienced by workers. They were given a questionnaire consisting of 28 questions regarding the complaints they experienced while performing their tasks. The questionnaire utilized a research design with a 4-point Likert scale, ranging from "no pain" to "slight pain," "pain," and "severe pain" as the complaint levels. According to Tarwaka (2010) cited in the journal by Rahdiana (2017), the classification of skeletal muscle risk levels can be determined in a straightforward manner. To facilitate the grouping of Nordic Body Map complaints and classify the body parts experiencing the most significant complaints, the body is divided into nine sections, as depicted in Figure 1.

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Fig 1: Body Parts of the Nordic Body

The calculation method for scoring each complaint, as in the Nordic Body Map questionnaire table X, is as follows:

= Total x Weight
= (1 x 1) + (0 x 2) + (0 x 3) + ((0 x4)
= 1

Based on Table 1, a recapitulation of the percentage of workers' complaint levels is obtained. Looking at the table, the dominant complaint levels experienced are in the shoulder, waist, and neck pain. After obtaining the score calculation results, the overall sum will be obtained to determine the risk level on the muscle of each operator's body.

Table 1: Presentation of Complaint Levels Operators With Nordic Body Map

NO	Location	Pain Level								Total	
		TS	%	AS	%	S	%	SS	%		%
0	Pain in the neck	3	0.36	17	2.02	8	0.95	2	0.24	30	3.57%
1	Pain in the nape	2	0.24	17	2.02	11	1.31	0	0.00	30	3.57%
2	Pain in left shoulder	2	0.24	10	1.19	18	2.14	0	0.00	30	3.57%
3	Pain in the right shoulder	2	0.24	9	1.07	19	2.26	0	0.00	30	3.57%
4	Pain in left upper arm	7	0.83	13	1.55	9	1.07	1	0.12	30	3.57%
5	Pain in the back	3	0.36	9	1.07	12	1.43	6	0.71	30	3.57%
6	Pain in the right upper arm	7	0.83	10	1.19	13	1.55	0	0.00	30	3.57%
7	Pain in the waist	3	0.36	11	1.31	13	1.55	3	0.36	30	3.57%
8	Hip pain	5	0.60	9	1.07	12	1.43	4	0.48	30	3.57%
9	Pain in the ass	4	0.48	10	1.19	12	1.43	5	0.60	30	3.69%
10	Pain in left elbow	11	1.31	10	1.19	4	0.48	1	0.12	30	3.10%
11	Pain in right elbow	15	1.79	10	1.19	5	0.60	0	0.00	30	3.57%
12	Pain in left forearm	12	1.43	10	1.19	8	0.95	0	0.00	30	3.57%
13	Pain in the right forearm	10	1.19	10	1.19	10	1.19	0	0.00	30	3.57%
14	Pain in left wrist	10	1.19	8	0.95	11	1.31	1	0.12	30	3.57%
15	Pain in right wrist	5	0.60	11	1.31	13	1.55	1	0.12	30	3.57%
16	Pain in left hand	12	1.43	10	1.19	8	0.95	0	0.00	30	3.57%
17	Pain in right hand	9	1.07	11	1.31	10	1.19	0	0.00	30	3.57%
18	Pain in left thigh	6	0.71	15	1.79	8	0.95	1	0.12	30	3.57%
19	Pain in the right thigh	5	0.60	13	1.55	12	1.43	0	0.00	30	3.57%
20	Pain in left knee	10	1.19	9	1.07	10	1.19	1	0.12	30	3.57%
21	Pain in right knee	8	0.95	8	0.95	14	1.67	0	0.00	30	3.57%
22	Pain in left calf	5	0.60	12	1.43	13	1.55	0	0.00	30	3.57%
23	Pain in right calf	4	0.48	12	1.43	14	1.67	0	0.00	30	3.57%
24	Pain in left ankle	10	1.19	9	1.07	11	1.31	0	0.00	30	3.57%
25	Pain in right ankle	7	0.83	9	1.07	14	1.67	0	0.00	30	3.57%
26	Pain in left leg	9	1.07	11	1.31	9	1.07	1	0.12	30	3.57%
27	Pain in right leg	4	0.48	17	2.02	9	1.07	0	0.00	30	3.57%
	TOTAL	190	22.7 %	310	36.9 %	310	36.9 %	27	3.2	840	100%

According to Tarwaka (2010) in the journal (Rahdiana, 2017), the classification of risk levels for skeletal muscles can be seen in Table 4.6. It is explained that a total score between 28 and 49 indicates a "Low" risk level, where no improvement is needed at this stage. A score of 50 to 70 indicates a "Moderate" risk level, where improvement may be needed in the future. A score of 71 to 91 represents a "High" risk level, requiring immediate action. Lastly, a score of 92 to 112 represents a "Very High" risk level, indicating the need for comprehensive action as soon as possible. From the research conducted by Rosanti (2016), it was found that out of 10 workers who used non-ergonomic chairs (lacking backrest and chairs with incorrect dimensions based on anthropometry), complaints were mainly felt in the buttocks, shoulders, neck, and back in the musculoskeletal system.

According to the research conducted by Djaali (2019), using the Nordic Body Map (NBM) instrument, it was found that employees experienced complaints in the waist area at 12.43%, upper neck at 10.36%, and lower neck at 9.84%. The locations of muscles frequently affected by musculoskeletal complaints include the neck, shoulders, arms, hands, waist, fingers, back, and other lower body muscles. Among these musculoskeletal complaints, Low Back Pain (LBP) is commonly experienced by workers, particularly in the waist area. Waist pain occurs due to ergonomic errors in chairs and prolonged sitting time. When working, the body remains in the same position for a long time, especially for workers in the manufacturing field. If discomfort occurs, the body becomes stressed, resulting in waist pain or stiffness (Tarwaka, 2004).

Table 2: MSDs Risk Level Based on Individual Total Score

Likert Skala	Individual Score Total	Risk Level	Corrective Action
1	28 - 49	Low	No corrective action is required
2	50 – 70	Medium	Action may be required at a later date
3	71 – 91	High	Urgent action is required
4	92 - 112	Very High	Comprehensive action is needed as soon as possible

To obtain more detailed information about the complaints and ergonomic risk levels experienced by each worker in their skeletal muscles, you can refer to Table 2. Based on the table, it can be seen that there are 16 operators with a "High" risk level of MSDs, accounting for approximately 53.33%, while 10 operators have a "Moderate" risk level, accounting for 33.33%. Additionally, 4 operators have a "Low" risk level, accounting for 13.33%. The percentage values are obtained by dividing the sum of the MSDs risk levels by the total overall risk level, and then multiplying it by 100%.

Table 3: Classification of MSDs Risk Levels Based on Individual Total Scores

Operator	Individual Score Level	MSDs Risk Level	Operat or	Individual Score Level	MSDs Risk Level
1	52	Medium	16	53	Medium
2	34	Low	17	72	High
3	75	High	18	54	Medium
4	82	High	19	71	High
5	85	High	20	54	Medium
6	52	Medium	21	70	High
7	70	High	22	72	High
8	52	Medium	23	73	High
9	53	Medium	24	72	High
10	71	High	25	54	Medium
11	52	Medium	26	73	High
12	71	High	27	52	Medium
13	38	Low	28	72	High
14	71	High	29	74	High
15	31	Low	30	38	Low

The researcher suggests implementing both physical and non-physical improvement actions. Some ways that can be done include periodically rotating work tasks, incorporating stretching exercises during working hours, and thereby minimizing complaints experienced in skeletal muscles. One of the things that can be done to stretch the muscles is by engaging in light exercises for 10 minutes regularly every day. This approach aims to make employees feel happier and more comfortable.

B. Chair Improvement Proposal

The workplace improvement based on employees' complaints focuses mainly on the lower back region. Therefore, the researcher proposes the design of ergonomic chairs tailored to the anthropometric measurements of the employees.

➢ *Normality Test for Sewing Workers' Anthropometric*

Data The anthropometric data of the sewing workers are tested to determine whether they follow a normal distribution using statistical tests, specifically the Shapiro-Wilk test (If sig. $\rho > 0.05$, then H0 is accepted; if sig. $\rho < 0.05$, then H0 is rejected). After processing the data using

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SPSS software, the level of significance is obtained through the normality test for anthropometric data, as shown in Table 4. Based on the test results in Table 4, it is observed that the measurements of Popliteal-Gluteal Length, Popliteal Height, Hip Width, Shoulder Width, and Sitting Elbow Height have sig. values greater than 0.05. Therefore, it can be concluded that all the tested data mentioned above follow a normal distribution.

Table 4: Anthropometric Data Normality Test

No	Measurement	sig.	ρ	Explanation
1	Popliteal-buttock distance	0,118	0,05	Normal Data
2	Popliteal Height	0,109	0,05	Normal Data
3	Hip Width	0,140	0,05	Normal Data
4	Shoulder Width	0,076	0,05	Normal Data
5	Sitting Elbow Height	0,072	0,05	Normal Data

- *Tailor Anthropometric Data Uniformity Test*

The data uniformity test is conducted to determine whether the collected anthropometric data of the sewing workers is consistent or falls within the upper and lower control limits. The results of the data uniformity test for the anthropometric data of the sewing workers are obtained as shown in Table 4.36. From the calculations in Table 4.36, it is found that the measurements of Popliteal-Gluteal Length, Popliteal Height, Hip Width, Shoulder Width, and Sitting Elbow Height fall within the upper and lower control limits. These results indicate that all the data is uniform.

Table 5: Anthropometric Data Uniformity Test

	N	Minimum	Maximum	Mean	Std. Deviation
Popliteal-buttock distance	30	41,00	48,00	43,90	1,8071
Popliteal Height	30	42,00	47,00	44,43	1,4065
Hip Width	30	42,00	49,00	44,97	1,9911
Shoulder Width	30	41,00	47,00	44,77	1,4782
Sitting Elbow Height	30	33,00	38,00	35,67	1,4464
Valid N (listwise)	30				

- *Percentile Calculation*

Before determining the chair size, calculations based on percentiles need to be conducted. The percentiles used are the 5th percentile for small percentile measurements, the 50th percentile for average percentile measurements, and the 95th percentile for large percentile measurements. Table 5 provides percentile measurements that can be used to ensure that the chair design covers the human population, considering dimensions equal to or smaller than the percentile measurements. Calculating percentiles helps determine the size of an ergonomic chair for the sewing workers.Based on the research conducted by Wulandari (2011), the measured length of the chair at the 95th percentile is 27 cm, and the buttock-popliteal length at the 95th percentile is 37 cm. Therefore, the chair length is shorter than the upper leg length (27 cm < 37 cm). If the seat depth is too deep, the backrest does not support the lower back, and the backward curvature of the spine can cause discomfort, indicating that the chair length is not ergonomic.

Based on Table 5, the buttock-popliteal length for the population of thin individuals at the 5th percentile is 40.92 cm. The buttock-popliteal length for the population of individuals with ideal weight, meaning neither thin nor overweight, at the 50th percentile is 43.90 cm. The buttock-popliteal length for the population of overweight individuals at the 95th percentile is 46.87 cm.The popliteal height for the population of individuals with shorter stature at the 5th percentile is 42.12 cm. The popliteal height for the population of individuals with average height at the 50th percentile is 44.43 cm. The popliteal height for the population of individuals with taller stature at the 95th percentile is 46.74 cm.The hip width for the population of thin individuals at the 5th percentile is 41.69 cm. The hip width for the population of individuals with ideal weight at the 50th percentile is 44.96 cm. The hip width for the population of overweight individuals at the 95th percentile is 48.24 cm.

The shoulder width for the population of thin individuals at the 5th percentile is 42.33 cm. The shoulder width for the population of individuals with ideal weight at the 50th percentile is 44.76 cm. The shoulder width for the population of overweight individuals at the 95th percentile is 47.19 cm.Finally, the sitting elbow height for the population of individuals with shorter stature at the 5th percentile is 33.28 cm. The sitting elbow height for the population of individuals with average height at the 50th percentile is 35.66 cm. The sitting elbow height for the population of overweight individuals at the 95th percentile is 38.04 cm.

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Table 6: Size Percentile

		Popliteal-buttock distance	Popliteal Height	Hip Width	Shoulder Width	Sitting Elbow Height
N	Valid	30	30	30	30	30
	Missing	0	0	0	0	0
Percentiles	5	40,927	42,120	41,691	42,335	33,287
	50	43,900	44,433	44,967	44,767	35,667
	95	46,873	46,747	48,242	47,198	38,046

- *Decide on an Ergonomic Chair*

The calculation results of the percentile that have been obtained can be used to create a complete design of an ergonomic chair with an allowance. The dimensions of the chair used can be seen in Table 7.

Table 7: Ergonomic Chair Size

No	Seat Section	Size (cm)	Allowance (cm)	Total Size (cm)
1	Seat Width	48,2	+3	51,20
2	Chair Leg Height	42,1	+0,5	42,60
3	Chair Length	43,9	+0,5	44,40
4	Backrest Width	47,1	+1	48,10
5	Backrest Height	35,6	+0,5	36,10

In Figure 2, the results of the ergonomic chair design based on the anthropometric measurements of the employees can be seen. This chair is designed to provide comfort to the workers during sewing activities, as the current chairs being used are causing discomfort and stiffness in the lower back.

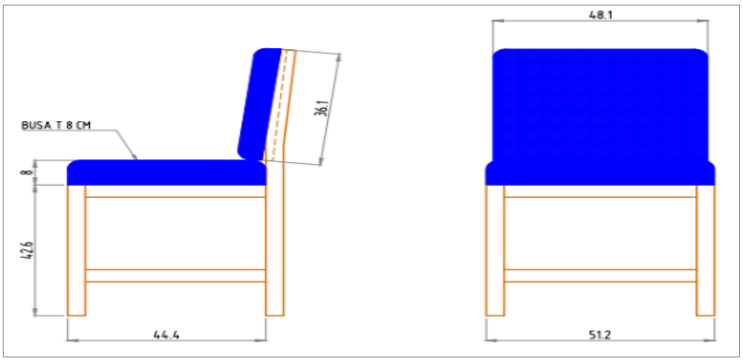

Fig. 2: Chair Design

Fig. 3: 3D Chair Design

C. *Design Validity Test*

The validity test of the design was conducted to determine the gap or difference between the design before and after the improvements. The test was based on three attributes: safety, ease of movement, and comfort, with a significance level of 5%. The data for the validity test of the design can be found in Table 7.

Table 8: Proposed Homogeneity Marginal Test Results

Design	Marginal homogeniety (Z-Value)	Significance Level 5%
Safe	0,003	0,05
Easy to move	0,002	0,05
Comfortable	0,000	0,05

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Based on the marginal homogeneity test results with a significance level of 5%, the obtained Z-Value is greater than 0.05. With this result, it indicates that there is a difference between the proposed design and the existing design, fulfilling the desired outcome.

D. Intervention Result

- *MSDs Complaints (Subjective Complaints)*

The musculoskeletal complaints commonly experienced by workers in the industrial field are often related to the lower back. The subjective complaint survey conducted in this research also yielded similar results. Therefore, in order to reduce musculoskeletal complaints related to the spinal structure, ergonomic interventions are carried out as shown in Figure 4.

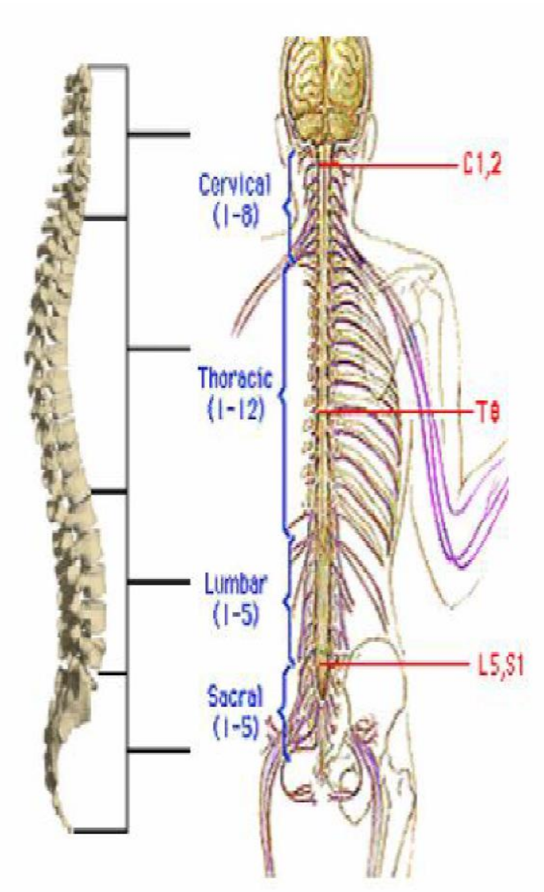

Fig. 4: Structure of the Human Spine

Nordic Body Map is used as a reference in the musculoskeletal survey, focusing on the neck, shoulders, back, waist, and buttocks, as described in Figure 4.

Fig. 5: Nordic Body Map

The complaints of pain are categorized into 4 categories on a Likert scale. Table 4.41 shows the differences in subjective musculoskeletal complaint levels in the neck, shoulders, back, waist, and buttocks before and after the intervention.

Table 9: Comparison of Subjective Complaint Levels Before and After Intervention

No Responden	Average Score Before Intervention	Average Score After Intervention	Difference in Average	Subjective Complaint Level
1	1.9	1.5	-0.4	Decrease
2	1.2	1.2	0	**Same**
3	2.7	1.5	-1.2	Decrease
4	2.9	1.6	-1.3	Decrease
5	3.0	1.8	-1.2	Decrease
6	1.9	2.2	0.3	Increase
7	2.5	1.8	-0.7	Decrease
8	1.9	1.5	-0.4	Decrease
9	1.9	1.4	-0.5	Decrease
10	2.5	1.5	-1	Decrease
11	1.9	2.1	0.2	**Increase**
12	2.5	1.6	-0.9	Decrease
13	1.4	1.4	0	**Same**
14	2.5	1.5	-1	Decrease
15	1.1	1.6	0.5	**Increase**
16	1.9	1.4	-0.5	Decrease
17	2.6	1.5	-1.1	Decrease
18	1.9	1.3	-0.6	Decrease
19	2.5	1.6	-0.9	Decrease
20	1.9	1.5	-0.4	Decrease
21	2.5	1.4	-1.1	Decrease
22	2.6	1.6	-1	Decrease
23	2.6	1.7	-0.9	Decrease
24	2.6	1.9	-0.7	Decrease
25	1.9	1.6	-0.3	Decrease
26	2.6	1.5	-1.1	Decrease
27	1.9	1.4	-0.5	Decrease
28	2.6	1.4	-1.2	Decrease
29	2.6	2.0	-0.6	Decrease
30	1.4	1.7	0.3	**Increase**

Based on Table 8, 24 respondents or 80% reported a reduction in pain, 4 respondents or 13% experienced increased pain, and 2 respondents or 7% did not experience any change in their complaints. Based on Table 8, it can be concluded that the majority of respondents experienced positive impacts after the implementation of workplace improvements. The increase in complaints is likely due to the mismatch between the workers' anthropometric measurements and the dimensions of the chairs. Therefore, the height of the chairs needs to be adjusted, such as raising the height or adding cushioning to make the chairs higher. This aligns with the findings of Mahardika and Pujotomo (2014), which indicate that incorrect working postures are a strong contributing factor to MSD complaints. The seat depth should not be too large, as a forward position can cause the back to be unsupported (Darsono, 2016).

To assess the impact of workplace improvements on reducing the level of Musculoskeletal Disorders (MSDs) complaints, a Wilcoxon Test was conducted, and the results are presented in Table 9.

Table 10: Results of Wilcoxon Test for complaints of musculoskeletal disorders before and after intervention

Variable	N	(X)	SD	P Value
Before Intervention	30	65.9	0.50	0.00
After Intervention		47.7	0.22	

Table 10.It indicates that the P-value < 0.05, thus demonstrating that ergonomics intervention has a significant impact on musculoskeletal complaints.

E. Wilcoxon Test Before and After Intervention on Productivity and Quality

The quantity of production within a 7-hour effective working period indicates the level of productivity and work quality of the sewing department employees in the garment industry. If a product fails the quality test, it will be repaired to meet the standards. Additionally, the garment production output also serves as a reference for the quality of the sewing department's products. Table 11 presents the production output data before and after the intervention, while Table 4.56 shows the results of the t-test for productivity and quality.

Table 11: Production Data Before and After Intervention

Production data of pieces/day	
Before intervention	After Intervention
253	283
221	245
255	285
216	239
272	308
219	240
245	275
269	303
258	289
251	279

Table 12: Results of the Wilcoxon Test before and after intervention

Variable	N	(X)	SD	P Value
Before Intervention	30	2.459	20.43	0.04
After Intervention		2.746	25.09	

Based on observations of production outputs from each operator (n=10), a mean difference between before and after intervention of 28.7 was found, with a P-value < 0.05. This means that ergonomic intervention has a significant impact on productivity improvement. The average increase in output is 28 pieces per day out of a total production target of 246 pieces. Therefore, it can be concluded that there is a productivity increase of 11.3%.

V. CONCLUSION

Based on the analysis of the difference in musculoskeletal complaints before and after the chair improvement using the Wilcoxon test, the obtained result for Asymp. Sig (2-tailed) is 0.000 (p-value). With a p-value ≤ 0.01, it indicates a highly significant difference between the complaints before and after the chair improvement. Therefore, there is an influence of the chair improvement on musculoskeletal complaints in the sewing work at PT X. The chair improvement can reduce musculoskeletal complaints in sewing work by 80% and increase productivity by 11.3%.

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