The design of manual packaging work station based on workers’ dimension in beverage industry

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Abstract. Manual packaging with awkward work postures has a high level of work risk with recommendations for improvement that should be done as soon as possible. Work risks that can be caused by awkward work posture are Musculoskeletal disorder (MSDs). Therefore, this study aims to improve the manual packaging work station by designing work tables and chairs based on an ergonomic approach so that it can improve work posture and reduce or even eliminate work risks. The research method used is a quantitative method with a descriptive approach. The results of this study are the design of tables and chairs with sizes obtained from the results of anthropometric measurements of workers. The results of this study imply that workers can do their jobs with good work postures so that work risks can be minimized.

1. Introduction

One of the occupational diseases is musculoskeletal disorders (MSDs). MSDs are a group of soft tissue disorders (muscles, tendons, nerves, joints, cartilage, and ligaments) [1]. International Labor Organization (ILO) in the program The Prevention of Occupational Diseases mentions that in 27 European Union states, Musculoskeletal Disorders (MSDs) are the most common diseases associated with health problems at work [2]. Counting 33% of injuries are MSDs [1]. These MSDs can result in costs associated with worker compensation, employee turnover, absenteeism, poor quality and reduced productivity [3,4]. The main causes of MSDs are poor work posture, the amount of labor expended, and repetitive work [1,5,6].

CV. X is a company engaged in the beverage industry. The number of employees at this company is 41 people, with workdays Monday through Friday, work hours from 8:00 to 16:00 and break time from 12.00 to 13.00. The beverage production process consists of washing raw materials, draining, boiling, cutting, drying, crushing, filtering, weighing, mixing, packaging, and manual packaging.

The results of the spread of the Nordic Body Map questionnaire in the As’ad study in 2018 [7], showed that complaints felt by workers at this company were on the body parts of the neck, shoulders, upper back, lower back, wrists, thighs, and knees. The work station that feels the most complaints is the manual packaging. Movement in the manual packaging process is repeated. Repeated work requires muscle movements and rotation around the wrists, elbows, and shoulders which can cause symptoms of inflammation and pain [8]. The work position when doing manual packaging, workers bend when reaching aluminum foil packaging products, because the product is far from the reach of hands. Awkward posture occurs as a result of a mismatch between the dimensions of the tool and the work station, with dimensions of the size of the worker's body [5,9]. Therefore, in order to minimize or even...
eliminate the complaints, appropriate work facilities are needed. The purpose of this research is to redesign facilities at a manual packaging work station in one of the beverage industries.

2. Methodology
The research method used is a quantitative method using descriptive. Making the design using the ergonomic anthropometric method. Application of anthropometric data in the design of work facilities that can accommodate human strengths and weaknesses [4,6,8,10]. The size of the work facility in accordance with anthropometry can be added to musculoskeletal [10]. The work facilities used at this work station are tables and chairs. The study population was total operators / female workers in the beverage production division with an age range of 20-45 years. Before making measurements, measure the dimensions of the body that will be used in planning the work table that was made. Body dimensions were measured directly from 41 female workers or operators. Measurements are made on the body dimensions used in planning. Measurement results by calculating percentile values on each body dimension. Next, a designation is made for the design, according to the percentile used added with the license. The final stages are made with a predetermined size.

3. Result and discussion
Manual packaging is the final packaging process for this beverage product. There are several elements of work done on this work, which is to include products that have been packaged with aluminum foil into cardboard packaging. Next, give glue so that the packaging is tightly closed. The product is put together into one small paper bag of 5 pieces, then the operator attaches the straps to the paper bag. The last activity carried out was packing 10 paper bags into one plastic bag. Each work element is carried out one by one (in series) by all parts of the final packaging. The manual packaging process can be seen in figure 1.

![Figure 1. The manual packaging process.](image-url)
for four people. Seat design added back. This backrest is important so that the operator can rest his back between working hours [5].

The body dimensions used in the design of the manual packaging workbench are the reach of the hands forward, the elbow range, and the height of the sitting elbows. The reach of the hands forward is used to determine the length of the table so that the operator can easily reach the object or tool that is furthest away. The elbow range is used to determine the width of the table. The height of the seat elbow is used to determine the height of the table mat so that the arms are supported by the table mat so that the operator does not feel tired at work.

Body dimensions used for chair design are popliteal height, hip width, shoulder width, shoulder height, and buttocks to the knees. The height of the popliteal is used to determine the height of the chair mat so that the worker's feet touch the floor so that the worker feels more comfortable. Hip width is used to determine the width of the pillow to fit the size of the buttocks / thighs of the operator so that the body load is spread evenly and the operator feels more comfortable. Shoulder width is used to determine the width of the back. Increased back support is needed to reduce the risk of complaints in the back, shoulder-width adjustment so that the entire back can lean. The height of the seated shoulder is used to determine the height of the seat that can rest the entire back. Buttocks to the knee are used to determine the length of the mat so that all parts of the buttocks / thighs are supported evenly by a pillow and the back is close to the back so the operator does not get tired quickly. After determining the dimensions of the body, then measurements and calculations of each body dimension are used. Calculation results can be seen in Table 1. The dimensions of the design of workbench facilities can be seen in Figure 2 and the design dimensions of the chair facilities are shown in figure 3.

Table 1. Size in design.

| Work facilities | Dimensions of Work Facilities | Dimensions Used | Selected percentiles | Size (cm) | Size with tolerance (cm) |
|-----------------|------------------------------|-----------------|----------------------|----------|-------------------------|
| Table Length    | 1 x Hand Reach Forward       | P50             | 72,63                | 75       |
| Table Width     | 4 x Length of Elbow Range   | P95             | 332,24               | 340      |
| Work desk       | table mat height             | Sitting Elbow Height | P50 | 70,26 | 75 |
|                  | Box Container Storage Length | 1 x Box Container Length (28.5 cm) |         | 28,5 | 30 |
|                  | Box Container Storage Height | 1 x Pallet Box Height (16.5 cm) |         | 16,5 | 20 |
|                  | Box Container Storage Width  | 1 x Box Container Width (41.5 cm) |         | 41,5 | 45 |
| Chair           | Sitting Height               | Polypepteal height | P50 | 42,55 | 45 |
|                  | Sitting Base Width           | Hip width       | P95 | 46,56 | 50 |
|                  | Backrest Width               | Shoulder Width  | P95 | 45,16 | 50 |
|                  | Chair height                 | Sitting Shoulder Height | P50 | 97,5  | 100 |
|                  | Sitting Base Length          | Bottom to the Knee (PL) | P50 | 50,89 | 55 |
4. Conclusion
Based on this research it can be concluded, the design of work facilities at the manual packaging work station is done by designing tables and chairs used at this work station. The size of work facilities is made based on the dimensions of the human body dimensions and the order of work, to improve work posture to minimize complaints felt by workers.

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