Z E S Z Y T Y   N A U K O W E   P O L I T E C H N I K I   P O Z N A Ń S K I E J
Nr 89 Organizacja i Zarządzanie 2024

Agnieszka BARTKOWIAK*, Marcin BUTLEWSKI**

ORGANIZATIONAL AND ERGONOMIC DETERMINANTS OF MANUAL PASTA PACKAGING PROCESSES IN AN SME

DOI: 10.21008/j.0239-9415.2024.089.01

The motivation for undertaking the research was to identify the possibilities of using specific ergonomic methods to improve working conditions and reduce the risk of musculoskeletal disorders in the process of manual pasta packaging in an SME in the food industry. Therefore, the purpose of the study was to analyze the applicability of specific ergonomic methods in evaluating the process of improving the manual packaging of pasta. The study was conducted in a Polish pasta manufacturing company, covering two shifts of employees over a period of one month. Direct observation, video analysis, REBA method and Strain Index were used to accurately assess the workload of employees and identify key areas requiring intervention. Based on the research, it was found that the work related to pasta packaging was characterized by a fast pace and unnatural postures, leading to fatigue and overload. Recommendations for company managers include the need for changes such as automation of some manual processes, the use of ergonomic improvements (anti-fatigue mats, ergonomic chairs) and the implementation of organizational solutions (rotation between workstations, employee well-being monitoring system). The main limitations of the study include the focus on only one pasta manufacturing company, which may limit the generalizability of the results, and the limited duration of the study (one month), which may not take into account long-term ergonomic effects.

Keywords: ergonomics, SME, REBA, pasta production, employee welfare, Strain Index

1. INTRODUCTION

A key element affecting employee satisfaction, motivation and performance is the working environment. It includes both physical aspects (noise, vibration, light-

* Doctoral School of Poznan University of Technology. ORCID: 0000-0003-1435-6174.
** Poznan University of Technology, Faculty of Engineering Management. ORCID: 0000-0002-2663-4082.

ing) and technical-organizational factors such as biomechanical loads, monotony and repetitive activities, and interruptions. According to ISO 6385 [PN-EN ISO 6385:2016-12 – Principles of ergonomics in the design of work systems], an appropriate balance of dynamic and static loads while taking ergonomic principles into account allows achieving a high level of employee well-being and quality of work. Management of employee fatigue is also a way of preventing adverse events in the work environment, such as accidents, which may not be recorded, but have an impact on the company's organizational and financial areas (Butlewski et al., 2015). Thus, work ergonomics contributes not only to the creation of healthy working conditions, but also to the achievement of higher productivity as well as quality of manufactured products (Gajsek et al., 2021; Czernecka et al., 2023) and, in the case under consideration, the quality of the result of the pasta packaging process.

Workers in the food industry who perform manual (hand) work are exposed to a number of factors that affect their well-being and welfare while performing scheduled tasks in the company (Sadlowska-Wrzesinska, 2018). Among the most common disorders are MSDs (Musculoskeletal Disorders), or musculoskeletal disorders (Young et al., 1995). Therefore, in addition to other occupational diseases (respiratory, cardiovascular, hearing diseases), the prevention of MSDs is a major focus of research by by ergonomics scientists. (Rasoulivalajoozi et al., 2023; Major, 2021). Straker and colleagues (Straker et al., 2004) found that MSDs in poultry industry workers included damage to the spine, hands and neck, as well as tendon and nerve disorders. Mohamaddan (Mohamaddan et al., 2021) conducted a study on the effects of different tools design and oil palm harvesting techniques on MSDs of the arms and trunk. Results from the RULA and HMMA confirmed that the upper body was in awkward positions during harvesting tasks, leading to muscle fatigue, mainly due to repetition of the same movement during work. Other findings from a study of bespoke beverage sellers testify that repetition of the same limb movements (in this case, the wrist) results in the occurrence of musculoskeletal discomfort in the hands, although the discomfort varies with age and gender (Chen et al., 2020). Other factors that have a significant impact on workers' well-being include working in environments with high levels of noise and dust, reduced or elevated temperatures, as well as the use of artificial lighting on the production line (Juslén et al., 2007; Heran-Le Roy et al., 1999). Depending on the occurrence of the above-mentioned hazards during work, they lead to mechanical and psychological disorders of workers, which can further contribute to the development of occupational diseases (Ketola et al., 2001). Therefore, it is important to control the production process, regardless of the industry, to diagnose the ergonomic factors that impair the well-being of workers, and then to implement corrective measures that will minimize the effects of psycho-physical risks on production workers.

In addition, well-designed economic working conditions will contribute to employees' greater susceptibility to work-related challenges and acceptance of changes in production processes. Ergonomics can be effectively used to implement changes in enterprises seeking to increase their productivity, and the natural resistance of employees to implement new technologies and techniques can be reduced by the pro-ergonomic orientation of the implemented changes (Czernecka, Butlewski, 2024). Thus, the search for a way to ensure a culture of agility in a small manufacturing enterprise that cannot be highly automated and equipped with expensive technological solutions is to combine human and machine work in a way that ensures the highest efficiency of the system and, at the same time, the long-term ergonomic well-being of the employees (Bartkowiak, Butlewski, 2023).

The purpose of the research presented in the article was to analyze the applicability of specific ergonomic methods in evaluating the process of improving the manual packaging of pasta. The scope of the work included an analysis of the possibilities of using various ergonomic methods in assessing and improving the process of manual pasta packaging in a small and medium-sized enterprise (SME), with particular emphasis on ergonomic hazards resulting from the repetitiveness of activities. The study included a multi-stage analysis that allowed for the identification and elimination of non-ergonomic factors and the development of a set of occupational risk assessment methods adapted to the specificity of pasta packaging processes. The research is driven by the need for a qualitative approach (preservation of the characteristics of pasta desired by customers during manual packaging) and the search for methods that allow the evaluation of small changes in the scope of the packaging process to improve the working conditions of people performing individual activities (manual packaging). The problem here is also that, on the one hand, high efficiency in the processes of packaging and manufacturing of manual pasta is desired, and on the other hand, high efficiency in manual processes is associated with high repetitiveness, which is negative from the point of view of labor ergonomics. Taking into account the processes that take place in the SME, research methods were selected to determine ergonomic risks, and then solutions were proposed to improve the ergonomics of the pasta packaging process. The main novelty presented in the article was the application of various methods of occupational risk assessment in a pasta SME. The multi-stage analysis of the pasta packaging process made it possible to determine the causes of non-ergonomic factors, which in further steps were leveled, so as to ensure the highest possible level of well-being of the pasta production line workers. The result of the analysis is a set of methods allowing to value the processes of manual packaging of pasta, taking into account various criteria for the selection of these methods.

2. MATERIALS AND METHODS

An occupational risk assessment was carried out at a food company in Poland that produces pasta, taking into account ergonomic criteria of the manual pasta packaging process for selected workstations. The research was carried out for one month for two shifts and different workers at each production station. The analysis of the factors that worsen the ergonomics of work and the well-being of workers was carried out on the basis of:

– direct observation of workers during the manual packaging process of pasta;
– REBA method;
– Strain Index.

Direct observation was carried out both by the authors of this article and on the basis of video recordings. The analysis of the video recording allows a thorough examination of all worker movements, which makes it possible to detect repetitive actions that can lead to MSDs. Direct observation was performed to understand the interaction between the worker and their workstation, including the use of tools and machinery that may generate vibrations or necessitate the application of high physical force.

The REBA (Rapid Entire Body Assessment) method is a tool that allows rapid assessment of the load on segments of the musculoskeletal system during work, divided into upper limbs, head and neck, trunk and lower limbs. The procedure for assessing workers' activities consists of 14 steps. By observing the position at work, the angles of the musculoskeletal segments are identified and then assigned point values according to the REBA worksheet (Schwartz, 2019). Step I is for the neck, step II for the back, and step III for the lower extremities. In Step IV, a point

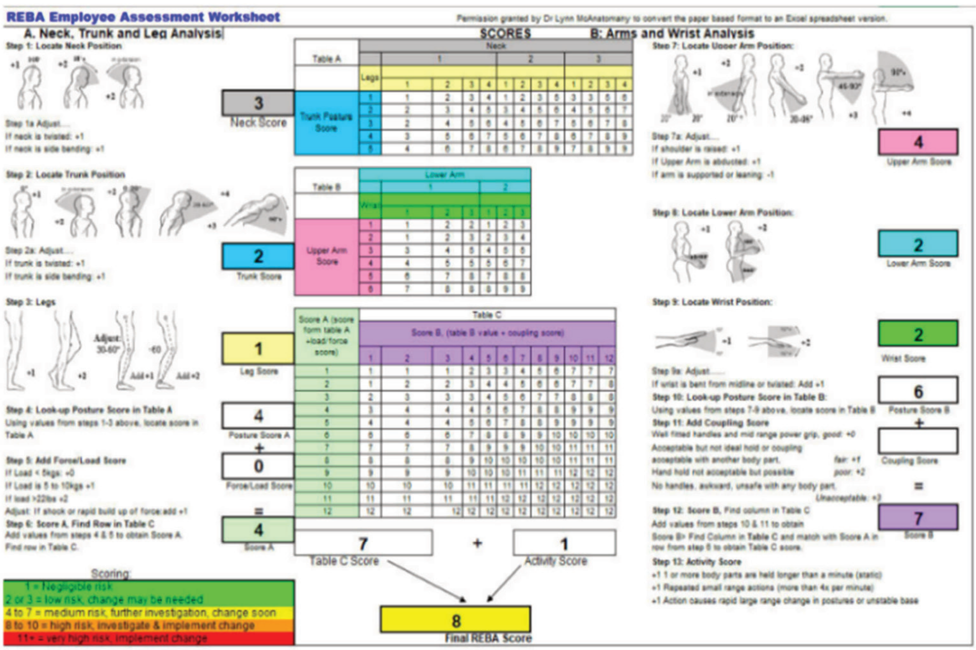

Fig. 1. REBA worksheet for pasta packaging used in the study

value is read from Table A based on the results from Steps I–III. The point values related to the load or force the worker must put into the task are then selected. In step VI, the values from Table A and from step V are summed. The procedure in steps VII–X is similar. Next, additional points related to the type of hand grip are determined in step XI. In step XIII, additional points are selected for static work lasting more than 1 minute, repetitive work (more than 4 times per minute), or for tasks requiring very rapid and large changes in position (or when there is no stable support). The score can reach a maximum of 15 points. An example view of the REBA employee assessment worksheet used in the study is shown in Figure 1.

The SI (Strain Index) is a tool used to assess the level of risk associated with work-induced hand, wrist, forearm or elbow disorders (Moore and Garg, 1995). The analysis takes into account six variables: intensity of exertion, duration of exertion, frequency of exertion per minute, hand/wrist position, work rate, and time worked per day. The SI is the product of these six variables and is compared with a gradient that determines the level of occupational risk. The SI is particularly useful for assessing the risk of developing MSDs in jobs that require intensive use of the hands, such as many assembly tasks. Once the six variables are defined for the task being evaluated, the corresponding coefficients are obtained and multiplied to produce SI score according to the following formula:

$$\text{SI score} = (\text{Effort intensity multiplier}) * (\text{Effort duration multiplier}) * (\text{Multiplier per minute}) * (\text{Posture multiplier}) * (\text{Work rate multiplier}) * (\text{Time per day multiplier}) \quad (1)$$

Work associated with distal upper limb disorders is assumed to have scores greater than 5, while the SI score should not exceed 7 (Bao et al., 2009).

The study was conducted for the following activities performed by the workers:
– rolling up the nest (standing position);
– flipping nests from plate to tabletop;
– packing nests into packages.

For each of the above-mentioned stages of production, the following were recorded and compiled the chronometer, i.e., the time of execution of individual movements by workers – and determined the loads acting on the worker. Then the load characteristics were performed for a given workstation using the methods described in this chapter.

3. RESEARCH RESULTS

3.1. Production stage – rolling nests (standing position)

The first stage of pasta production involves rolling of nests from previously prepared pasta strands. The chronometer of these steps is summarized in Table 1, while the individual steps performed by the workers are shown in Figure 2. It took about 1 to 1.5 seconds to perform each step.

The observation of the behavior of the workers made it possible to determine the numerical load value for each of the activities performed, with a distinction being made between picking up the pasta in the low and high positions (Table 2). Picking pasta while maintaining a high position was considered the most taxing, which also manifested itself in a high load category. The total share of this type of activity in the working day was about 2.3%. For the remaining activities performed during the nest-rolling stage, the load categories determined using the REBA method were medium.

Fig. 2. Activities performed by a worker while rolling the nests; a) pasta collection – high position, b) pasta collection – low position, c) rolling pasta in hands, d) putting the pasta back on the plate

Table 1. Chronometer of activities for rolling nests (standing position)

No.	The name of activity	Mass [kg]	Force [N]	Time [s]
1	Pasta collection – high position	–	–	1.5
2	Pasta collection – low position	–	–	1
3	Rolling pasta in hands	–	–	1–1.5
4	Putting the pasta back on the plate	–	–	1

Table 2. Summary of the REBA ratings for key positions taken during rolling nests (standing position)

No.	The name of activity	The numerical value of the load	Load category	Percentage of activities during the working day
1	Pasta collection – high position	9	High	2.31%
2	Pasta collection – low position	4	Average	0.96%
3	Rolling pasta in hands	5	Average	3.75%
4	Putting the pasta back on the plate	6	Average	2.50%

3.2. Production stage – flipping nests from plate to tabletop

A chronometric view of the activities performed by workers in the process of flipping nests from the plate to the tabletop is shown in Table 3. In the stage under consideration, 6 activities were distinguished, with activities identified that require workers to use a higher and lower upper limb position. A view of the individual activities summarized in Table 3 and identified during the production process is shown in Figure 3. The highest force was required to lift the plate with nests and was about 32 N. The recorded unit durations of individual activities were within 1 s, except for putting down the plate (lower option) - this activity took about 1.5 s.

Subsequently, the identified activities performed by the workers of the pasta production and packaging line were subjected to the REBA method (Table 4). For each activity, the numerical value of the load, its category and contribution to the total workday were determined. In the case of the process of flipping nests from the plate to the tabletop, it was noted that this generates significant loads on the musculoskeletal system when the worker used the high option. The situation was similar when putting the plate away (lower option) and in addition, this activity occupied 3% of the total time spent by workers on pasta production. Numerically, the highest load value was determined for lifting the plate with nests (high option).

Table 3. Chronometer of activities for flipping nests from plate to tabletop

No.	The name of activity	Mass [kg]	Force [N]	Time [s]
1	Lift plate with nests – high position	3.2	32	<1
2	Lift plate with nests – low position	3.2	32	<1
3	Flipping nests from plate to tabletop – high position	3.2	32	1
4	Flipping nests from plate to tabletop – low position	3.2	32	1
5	Putting the plate down – lower position	1.4	14	1.5
6	Putting the plate down – higher position	1.4	14	1

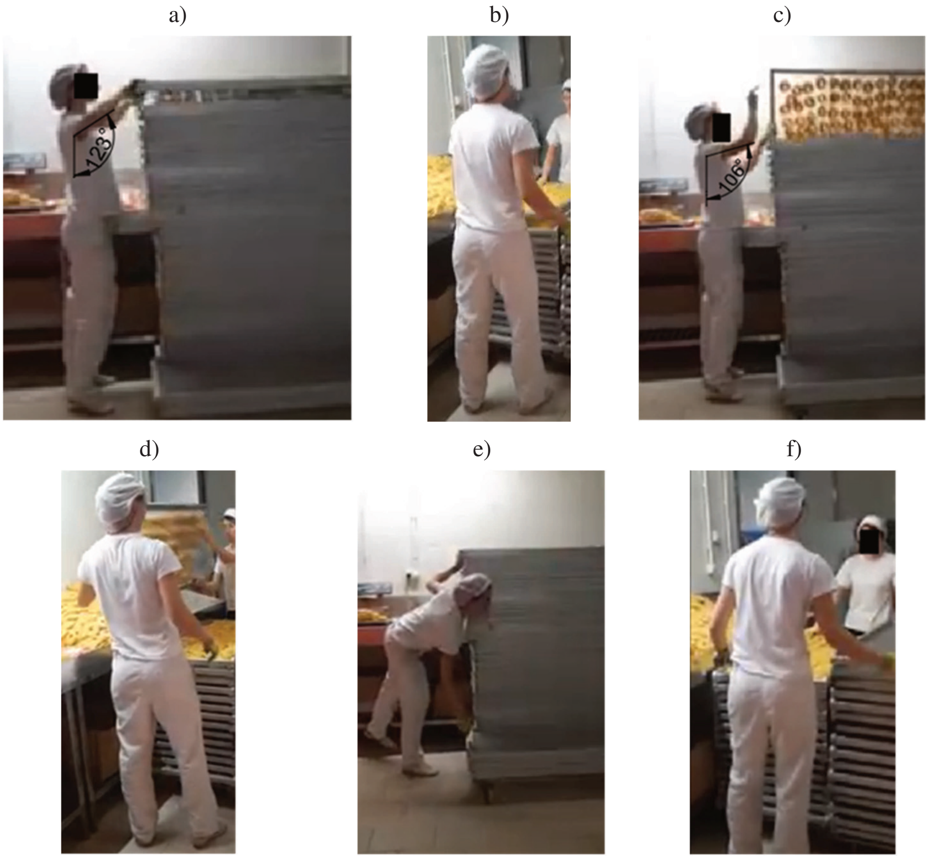

Fig. 3. Activities performed by a worker while flipping nests from plate to tabletop; a) lift plate with nests – high position, b) lift plate with nests – low position, c) flipping nests from plate to tabletop – high position, d) Flipping nests from plate to tabletop – low position, e) putting the plate down – lower position, f) putting the plate down – higher position

Table 4. Summary of the REBA ratings for key positions assumed during the work of flipping nests from plate to tabletop

No.	The name of activity	The numerical value of the load	Load category	Percentage of activities during the working day
1	Lift plate with nests – high position	10	High	2.00%
2	Lift plate with nests – low position	3	Low	1.71%
3	Flipping nests from plate to tabletop – high position	9	High	2.00%
4	Flipping nests from plate to tabletop – low position	4	Average	1.71%
5	Putting the plate down – lower position	9	High	3.00%
6	Putting the plate down – higher position	4	Average	1.71%

3.3. Production stage – packing nests into packages

The last stage of those considered in the production of pasta included activities related to the operation of packing nests into packages (Table 5). Within this stage, 9 activities were distinguished (Figure 4).

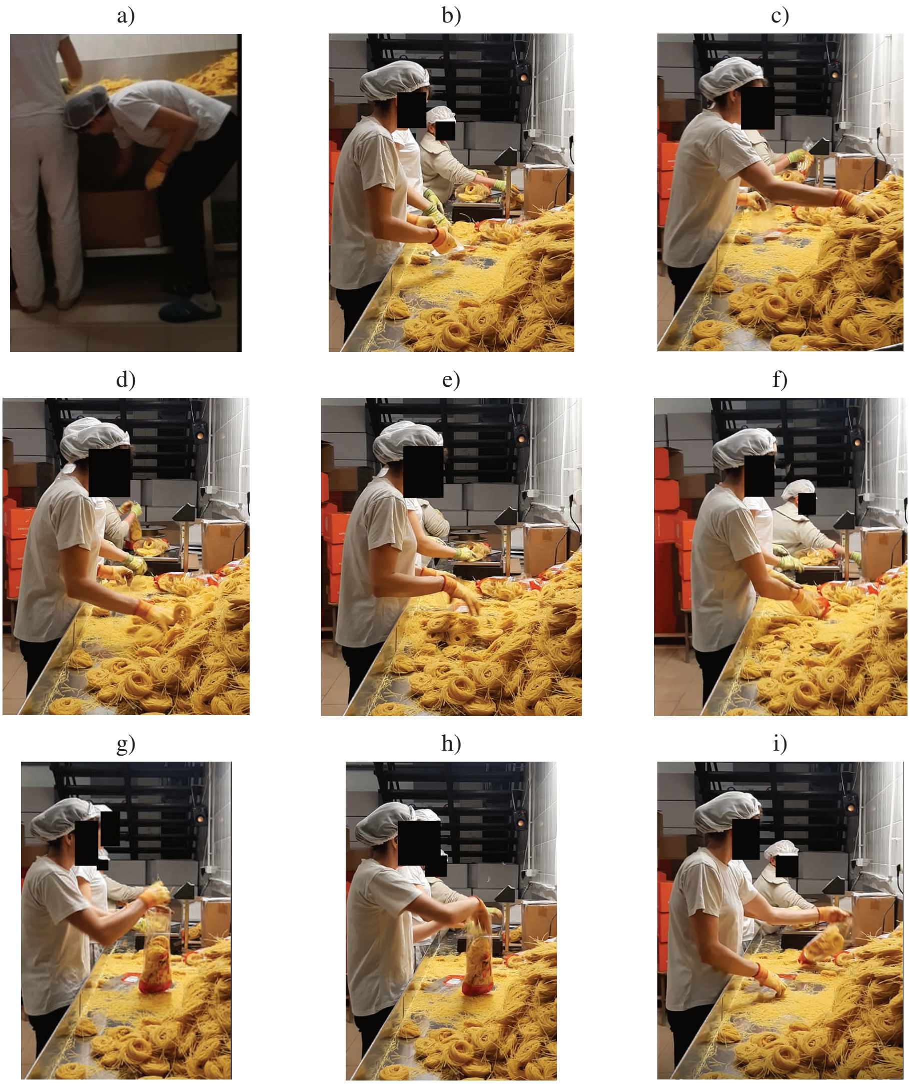

Fig. 4. Activities performed by the worker during the packaging of nests; a) picking a new package from under the tabletop, b) picking a new package from the tabletop, c) move the pasta (position 1), d) move the pasta (position 2), e) collecting nests, f) placing the nests in the package (position 1), g) placing the nests in the package (position 2), h) placing the nests in the package (position 3), i) putting away the completed package

Table 5. Chronometry of activities for packaging of nests into packages

No.	The name of activity	Mass [kg]	Force [N]	Time [s]
1	Picking a new package from under the tabletop	–	–	3
2	Picking a new package from the tabletop	–	–	0.5
3	Move the pasta (position 1)	–	–	1
4	Move the pasta (position 2)	–	–	1
5	Collecting nests	0.1	1	1.5
6	Placing the nests in the package (position 1)	0.1	1	0.5
7	Placing the nests in the package (position 2)	0.1	1	0.5
8	Placing the nests in the package (position 3)	0.1	1	0.5
9	Putting away the completed package	0.5	5	0.5

Two of the nine activities considered, namely moving the pasta and inserting the nests into the package, had additional variants that were used by the production workers. The longest lasting activity was picking up the package from under the tabletop, which took about 3 s. Other activities ranged from 0.5 to 1.5 s and did not require significant force. The chronometry of all activities is summarized in Table 5, and a view of these activities performed by workers is shown in Figure 4.

Considering the results obtained using the REBA method, the highest load category was obtained by picking up a new package from under the tabletop (Table 6). The remaining activities were characterized by an average category of loads. In addition, collecting nests took the most time of all the activities that were undertaken by employees and analyzed in the present study. The other activities did not take as much time as a percentage of the total workday.

Table 6. Summary of REBA ratings for key positions taken during nest packaging work

No.	The name of activity	The numerical value of the load	Load category	Percentage of activities during the working day
1	Picking a new package from under the tabletop	9	High	1.00%
2	Picking a new package from the tabletop	3	Low	0.50%
3	Move the pasta (position 1)	5	Average	0.33%
4	Move the pasta (position 2)	4	Average	0.33%
5	Collecting nests	4	Average	10.04%
6	Placing the nests in the package (position 1)	4	Average	3.35%
7	Placing the nests in the package (position 2)	6	Average	3.35%
8	Placing the nests in the package (position 3)	7	Average	3.35%
9	Putting away the completed package	6	Average	0.50%

3.4. Characterization of loads using the SI method

The SI method was used to examine two main processes, which included rolling pasta and packing pasta nests into packages (Figure 5). Based on observations, risk factors were identified and parameterized to identify activities that could negatively affect the well-being of workers.

a) b)

Fig. 5. Activities performed by the worker during the packaging of the nests; a) rolling the pasta, b) packing the pasta nests

Table 7. Summary of SI scores for key positions taken during pasta rolling

No.	Risk factor	Measured value	Verbal evaluation	Observations	Right hand
1	Intensity of effort	–	Light	–	1
2	Cycle time	When observed for 40s, the percentage of the hand as active is 14.06%	More than 80%	–	3
3	Number of “efforts” per minute	24	Over twenty	–	3
4	Wrist posture	39.25	Fair/poor	Slightly unnatural	1.25
5	The pace of work	–	Quick	Accelerated, but ability to maintain pace	1.5
6	Duration of the task during the working day	8 h	Between four and eight hours	–	1
					Result = 16.875

Tables 7 and 8 summarize the key positions occupied by a worker during the rolling and packaging of pasta. Considering these data, it can be concluded that a score of SI = 16.875 indicates a moderate risk of MSDs associated with the activities performed during the pasta rolling process. This is mainly influenced by the significant number of repetitions per minute, the wrist posture and the long duration of the task during the working day.

Table 8. Summary of SI method evaluations for key items taken during pasta packaging

No.	Risk factor	Measured value	Verbal evaluation	Observations	Right hand
1	Intensity of effort	–	light	–	1
2	Cycle time	When observed for 35s, the percentage of the hand as active is 10.05%	More than 80%	–	3
3	Number of "efforts" per minute	34	Over twenty	–	3
4	Wrist posture		Bad	Unnatural	2
5	The pace of work	–	Quick	Accelerated, but ability to maintain pace	1.5
6	Duration of the task during the working day	8 h	Between four and eight hours	–	1
					Result = 27

The SI score of 27 was obtained for the activities performed as part of the pasta packaging process, suggesting a very high risk of MSD associated with the activities performed. This result is primarily due to the number of "efforts" per minute, poor wrist posture as well as the significant duration of the various activities.

4. RESULTS ANALYSIS

The most important research results presented in the previous chapters of the article include:

– in the process of rolling pasta nests, the highest load category is generated by the high position during the pasta collection operation, which accounts for 2.3% of the time during the working day;
– putting away the tray by the employee (lower option) generates a high level of load, and in addition, this activity took 3% of the total time spent by employees on pasta production;

- the highest load category was obtained when packing nests into packages, specifically when a new package was taken from under the tabletop. The remaining activities were characterized by an average load category;
- a very high risk of MSDs was determined for the activities performed as part of the pasta packaging process, based on the identified SI = 27.

The results show that there is a significant risk of MSDs associated with repetitive activities performed by workers in pasta packaging. Similar conclusions regarding repetitive activities during the execution of work were obtained by other authors (Bhatia et al., 2021; Kee, 2021). The REBA analysis allowed the assessment of body positions and the identification of critical points, such as forced working positions and high number of efforts per minute, which significantly increase the risk of injury (Palęga et al., 2019). The results of the SI index further confirmed these risks, indicating high exertion intensity and prolonged musculoskeletal strain on the upper extremities. Based on observations of workers in the company, it was determined that work at pasta-packing stations involves fast paced and unnatural postures, leading to fatigue and overload and, consequently, to work-related MSDs. It should be remembered that it is important to ensure that employees have a comfortable reach of their hands and body position, which allows them to move freely and reduce the effort resulting from the tasks they perform (Pacholski, 1986).

After analyzing the work process and selected positions, the following categories of changes are proposed:

- elimination of the highest repetitiveness resulting from manual work – automation of some of the manual processes – such as rolling pasta nests;
- reducing loads through the use of ergonomic improvements such as anti-fatigue mats and ergonomic chairs (taking into account hygienic and sanitary requirements);
- organizational solutions – such as rotations between jobs and the introduction of a system of continuous monitoring of employee well-being in order to increase work comfort and employee productivity at the same time.

Anti-fatigue mats designed for multi-shift work in a dry environment allow to increase comfort while increasing the efficiency of the work performed by the employee. The underlay helps to eliminate ailments such as pain in the feet, legs and back, which occur during prolonged standing. The mat provides good amortization and comfort of use, effectively helps in the fight against fatigue at the workplace. In addition, it provides insulation for the worker from the cold floor and eliminates the risk of tripping. The mat can contain an antimicrobial substance based on silver particles, which protects the produced pasta from getting biological contamination (Kalinowska et al., 2018).

When introducing organizational solutions, it is recommended to take into account the nature of the workload of employees during rotations and to evenly load individual body parts. It is advisable for employees at high-load jobs to perform their assigned tasks in a circular manner. Moreover, it is recommended to constantly and systematically check the working conditions and safety of employees in order to improve work comfort.

The scientific problem considered in this article was the applicability of various ergonomic methods in assessing and improving the process of manual pasta packaging in an SME. The manual production and packaging of pasta is appreciated by customers, and such a product is desired and rated higher by them than products manufactured exclusively by machines. The key goal of the entire SME production process is to maintain the quality of pasta desired by customers, which requires a qualitative approach, and to seek methods to evaluate small changes in the packaging process aimed at improving the working conditions of employees. This problem is multidimensional because, on the one hand, companies are striving for high efficiency of the processes of packaging and producing manual pasta – intensifying production and increasing productivity. High efficiency of manual processes is associated with high repeatability of tasks, which is unfavorable from the point of view of work ergonomics. Working in monotonous conditions can lead to health problems such as musculoskeletal disorders, which reduce employee comfort and productivity. An additional challenge is the specificity of SMEs, which often have limited resources for implementing advanced ergonomic methods and have to deal with specific working conditions, which affects ergonomic risk.

5. CONCLUSIONS

The purpose of the research presented in the article was to analyze the applicability of specific ergonomic methods in evaluating the process of improving the manual packaging of pasta Therefore, the authors conducted a multi-stage analysis of the pasta packaging process, identifying non-ergonomic factors and proposing solutions to reduce them. All of these activities made it possible to achieve the main objective. The most important conclusion resulting from the conducted research is the fact that there is a significant risk of MSDs related to repetitive activities performed by employees during pasta packaging. In order to reduce the load on the musculoskeletal system, changes were proposed and implemented in the company, which came down to introducing breaks, changing the pace of work, improving the wrist posture, and reducing the number of repetitive movements.

The main limitations of the conducted research include focusing only on one pasta manufacturing company, which may limit the possibility of generalizing the results, and the limited duration of the research (one month), which may not take into account long-term ergonomic effects. The obtained results are of great importance for the development of science because they provide SMEs with tools to improve work ergonomics with limited resources (a characteristic feature of SMEs). The introduction of such methods can not only increase the comfort of employees, but also reduce their absenteeism and turnover, which has a direct impact on the operating costs of enterprises and the production process. The conclusions from the article can be applied not only in the pasta production industry, but also in other sectors where manual packaging and production are common. The introduction of ergonomic solutions, such as anti-fatigue mats and ergonomic chairs, can not only improve the well-being of employees, but also contribute to increasing the organizational agility of the enterprise, enabling faster adaptation to changes and improving production efficiency. Work ergonomics, by reducing fatigue and the risk of injuries, allows for better use of human resources, which in the long term leads to greater flexibility and competitiveness on the market. Directions for further research include primarily verification of the introduced modifications and determining their impact on the well-being of employees producing pasta. In addition, further work will develop a system for monitoring work ergonomics and employee well-being that can be applied not only to food SMEs but also to other industries.

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ORGANIZACYJNE I ERGONOMICZNE UWARUNKOWANIA PROCESÓW RĘCZNEGO PAKOWANIA MAKARONU NA PRZYKŁADZIE MŚP

Streszczenie

Motywacją do podjęcia badań było zidentyfikowanie możliwości zastosowania określonych metod ergonomicznych w celu poprawy warunków pracy oraz zmniejszenia ryzyka zaburzeń układu mięśniowo-szkieletowego w procesie ręcznego pakowania makaronu w MŚP z branży spożywczej. Dlatego postawiono cel badań, którym była analiza możliwości zastosowania określonych metod ergonomicznych w ocenie procesu usprawniania ręcznego pakowania makaronu. Badanie przeprowadzono w polskiej firmie produkującej makaron, obejmując dwie zmiany pracowników przez miesiąc. Bezpośrednia obserwacja, analiza wideo, metoda REBA oraz Strain Index zostały użyte do dokładnej oceny obciążenia pracowników i identyfikacji kluczowych obszarów wymagających interwencji. Na podstawie badań stwierdzono, że prace związane z pakowaniem makaronu charakteryzowały się szybkim tempem i nienaturalnymi postawami prowadzącymi do zmęczenia i przeciążenia. Zalecenia dla osób zarządzających przedsiębiorstwem obejmują potrzebę zmian, takich jak automatyzacja niektórych procesów manualnych, zastosowanie usprawnień ergonomicznych (maty antyzmęczeniowe, krzesła ergonomiczne) oraz wdrożenie rozwiązań organizacyjnych (rotacje między stanowiskami pracy, system monitorowania dobrostanu pracowników). Do głównych ograniczeń badań należy zaliczyć skupienie się wyłącznie na jednym przedsiębiorstwie produkującym makaron, co może ograniczać możliwość generalizacji wyników oraz ograniczony czas trwania badań (miesiąc), który może nie uwzględniać długoterminowych efektów ergonomicznych.

Słowa kluczowe: ergonomia, dobrostan pracowników, małe i średnie przedsiębiorstwa, produkcja makaronu, REBA, Strain Index