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Sang Ketut Suratna
Universitas Indonesia, sangketut@gmail.com

Liem Jen Fuk
Department of Occupational Health and Safety, Faculty of Medicine and Health Sciences, Universitas Kristen Krida Wacana.

Dian Kusumadewi
Division of Family Medicine, Department of Community Medicine, Faculty of Medicine, Universitas Indonesia.

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Original Article

Reaction Time Analysis on Female Workers with A Night Shift Work System at A Textile Factory in Sumedang: A Quasi-Experimental Study

Sang Ketut Suratna[1]*, Liem Jen Fuk[2], Dian Kusumadewi[3]
[1] Occupational Medicine Specialist Program, Faculty of Medicine, Universitas Indonesia.
[2] Department of Occupational Health and Safety, Faculty of Medicine and Health Sciences, Universitas Kristen Krida Wacana.
[3] Division of Family Medicine, Department of Community Medicine, Faculty of Medicine, Universitas Indonesia.
*Email: sang_suratna@yahoo.com

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ABSTRACT

Introduction Shift work is a common work system in textile factories. The shift system affects workers' diet and nutritional needs. Malnutrition has a high potential in causing fatigue. Thus, additional food recommendations and nutritional education for this population are needed. Linear Programming (LP) can be used to create a Food Based Recommendation (FBR) for textile industry owners who employ female workers with a shift system. Local food ingredients can be used to optimize nutritional content.
Objective To analyze the effect of additional food recommendations on reaction time in female night shift workers.
Methods This study analyzed the diet and reaction time of 100 female workers in Rancaekek, Sumedang Regency using a quasi-experimental design. The data was combined with 24-hour food recall and 5 FFQ (5-days food-frequency questionnaire). Reaction time was evaluated using lakassidaya. LP uses the Optifood system to formulate a Food-Based Recommendation (FBR).
Results The difference in reaction time between pre-and post-intervention in the intervention group was 12.97 milliseconds ($p = 0.006$), while the difference in reaction time between the combined group was 8.18 milliseconds ($p = 0.007$)**.**
Conclusion Adequate energy intake through recommended FBR was effective in reducing reaction time. Recommendations for additional food menus and nutrition education can be used by workers and company owners.

INTRODUCTION

Based on the data from the Central Bureau Statistics of Indonesia (BPS) in 2019, there were 52 million female workers in Indonesia, where 7.9 million of them worked in the manufacturing industry sector. According to the Central Bureau of Statistics of Indonesia, compared to the prior year in 2017, the percentage of female workers in 2019 slightly rose from 55.4% to 55.5%.[1,2]

In a recent survey conducted in Europe, 28 percent of labor had a variable working pattern. Ten percent of them had evening schedules, while 17 percent worked two or three shifts using a rotation system.[3] Based on the data from the 5th European Working Conditions Survey conducted on 34 countries in 2010, 17% of all working population used the shift system.[4]

Increasing the number of female workers of their productive age who work in a shift system may cause fatigue, which is a problem in work health and safety that may lead to injury and accidents. The management of work health and safety is important to achieve healthy, safe, and productive workers. Fatigue is caused by several factors, including job demands, type of work, work environment (noise, lighting, heat stress, vibration), changes in the biological clock of workers, and the need to adapt to their work.[5,6] Fatigue also has an impact on decreased motivation, quality of work, and work stress.[7]

Research conducted on American workers stated 37.9 percent of the total workers experienced fatigue.[8] Meanwhile, research conducted in Indonesia stated that the prevalence of fatigue in workers was high, reaching 65 percent.[9]

Occupational fatigue can be caused by many factors, including age, gender, length of work, dietary intake, disease, and health status.[10] Dietary intake can affect the availability of one's energy.[11] The energy needed by workers is normal nutritional needs, added with energy or calories needs to perform activities within their scope of work.[12] Energy intake that does not match the needs can be a cause of a non-proportional nutritional status. This can reduce health, especially in causing work fatigue.[12,13] A previous study stated that 77.8 percent of workers who experienced fatigue had insufficient energy intake.[14] Other factors related to health, such as the nutritional status of workers, have a high potential to cause work fatigue.[15] This is in line with previous research which states that 63.3 percent of work fatigue occurs in workers who have poor nutritional status.[16]

In addition to nutritional status, another nutritional problem that occurs in female workers is iron deficiency (Fe), which can cause anemia. Based on Basic Health Research data from 2013 to 2018 the number of people with anemia has increased. The proportion of anemia in the Indonesian female population aged 15-54 years in 2013 was 23.97% and increased to 48.9% in 2018.[17] Observational research at a company in Kudus shows that 33.4 percent of female workers experience iron deficiency.[18]

Iron deficiency in women will lead to various health problems, mainly anemia. Anemia is caused by iron deficiency needed for the formation of Hemoglobin (Hb). Lack of Hb in the blood leads to a lack of oxygen transported to the cells in the body and the brain, which disrupts muscle function. This may result in symptoms such as weakness, tiredness, lethargy, fatigue, and even a decrease in work capacity.[19,20]

The results of research conducted in Klaten-Central Java, at a textile factory, showed that there was a very significant relationship between anemia and work fatigue in women who worked at night measured by reaction time indicators and feelings of work fatigue.[21] The primary requirement for workers to do their jobs is an adequate energy intake with the proper nutritional composition. A person's capacity to engage in activities is significantly impacted by their energy intake.[22] Unmet nutritional intake obtained from the workplace will be at risk by increasing the number of workers who experience fatigue.[23] Workers who work at night shift have a heavy workload and long working hours require good energy intake to avoid fatigue and physiological disturbances of the body.[24,25]

Nutritional intake is one aspect of occupational health that has an important role in increasing work productivity and factory productivity.[26] The nutritional intake provided by the factory is in the form of snacks, the menu lacks the value of energy intake and is not fulfilled. The implementation of proper work nutrition has an impact on the health and welfare of the workforce.[27] In general, proper nutritional intake for shift workers is food with a balanced nutritional composition that prioritizes complex carbohydrates, is low in fat, high in fiber and antioxidants, and high in micronutrient content.[28]

Therefore, our study aims to analyze the effect of additional food recommendations on reaction time in female night shift workers.

METHODS

This study and sample collection were conducted in the spinning division of a textile factory in Rancaekek, Sumedang Regency. From August 2018 – to April 2019 phase one of data collection was held in August-September 2018 after receiving approval from the ethical committee of Faculty of Medicine Universitas Indonesia. The FBR *(Food-Base Recommendation)* intervention was conducted for 24 weeks, i.e., from September 2018 – to March 2019. This study analyzed pre-and post-intervention; thus, it used a quasi-experimental design with pre-test and post-test with the control group. This design was chosen because it uses a proportional number of treatment groups and control groups.

Determination of the sample size of respondents to assess the effectiveness of supplementary feeding on the incidence of fatigue using the formula for the difference in the mean of 2 paired groups with a significant degree of 5%, 80% power, and two-tailed hypothesis testing.

In our study population, the shift group was divided into groups A, B, and C, each group working for 8 hours per day and 6 days per week with the same shift rotation pattern; 1 week of night shift, 1 week of day shift, then continued with 1 week of morning shift, with shift changes on every Sunday. In this study, group A were those who worked night shifts in the first week followed by day shifts in the second week, then morning shifts in the third week, then returned to working night shifts following the same pattern. Group B are those who work day shifts in the first week followed by morning shifts in the second week, then night shifts in the third week, then return to work day shifts following the same pattern. Group C are those who work the morning shift in the first week followed by the night shift in the second week, then the day shift in the third week, then return to work the morning shift following the same pattern. Each worker is off for 1 day a week with an alternating schedule set by the company.

Subjects were divided into two groups; the intervention group and the control group based on the shift work group that had been determined by the factory. The intervention group was the workers of group A. The control group was the workers of groups B and C. The selection of the groups of workers was carried out by adjusting the shift work schedule between groups, aiming to facilitate the process of data collection and intervention. The intervention group was the research subject who received treatment in the form of providing FBR nutrition education and changing the factory's food menu. The number of the intervention group was 49 people while the control group was 51 people, the numbers in the first and second phases were different because 6 people dropped out of the study.

The inclusion criteria of the research subjects were female workers aged 20-50 years old, who worked night shifts at the textile factory spinning section, were willing to participate in the study, and had signed the informed consent. Women who are pregnant and breastfeeding during recruitment as well as those who experienced severe anemia (Hb < 8 g/dl) were excluded. Subjects who did not complete the study protocol were classified as drop out.

The independent variable in this study is the intervention treatment. The intervention treatment was a group of respondents who were given an FBR (Food-Based Recommendation) intervention in the form of nutrition education and changes to the factory's additional food menu. The dependent variable is the reaction time in female workers who work night shifts. The other variables in this study were age, marital status, education level, nutritional status, and length of work.

The reaction time was analyzed using Lakassidaya and recorded in milliseconds. Demographic data were obtained using a questionnaire. Age was grouped into ≤ 30 and >30 years, while the length of work was classified into < 3 and ≥ 3 years based on the median value, and marital status was grouped into married and not-married (single and widow). The level of education is grouped into high (diploma, undergraduate), medium (junior high school, high school), and low (elementary school / not educated). Body Mass Index (BMI) was grouped as < 23 kg/m2 and BMI ≥ 23 kg/m^2.

Data during the intervention were obtained using a questionnaire, food scales (Weighed Food Record), *SECA scale,* microtoise, Lakassidaya, and those data were analyzed using SPSS version 22.

The FBR intervention was carried out for 24 weeks, in the form of recommendations for messages/education on daily food consumption given to respondents in the form of leaflets, and in the form of changes to the company's food menu that was used to fill the unmet daily nutritional needs (nutrient gap). Changes in the company's food menu that are used as FBR interventions are the evening snack menu (during night shifts) and additional fruit provided on the lunch menu (during morning shifts). According to the intervention group's shift work schedule, the duration of FBR supplementary feeding at the factory was 16 weeks. The intervention scheme was previously preceded by the preparation of FBR recommendations. The following is the implementation scheme for the pre-post-intervention phase of research.

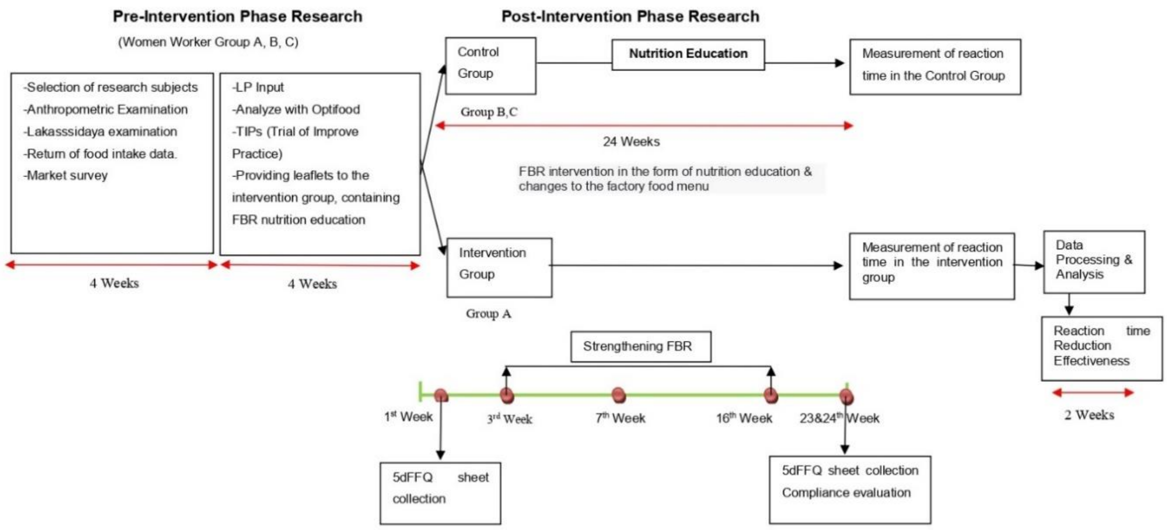

Figure 1. Pre-Post Intervention Phase Research Implementation Scheme

The characteristics of the research subjects consisted of sociodemographic characteristics, occupational characteristics, and hemoglobin characteristics. These characteristics were analyzed using Chi-square test analysis and Fisher's exact test.

The dietary characteristics of the research subjects are needed to determine the intake of macronutrients and micronutrients before and after the intervention. The characteristics of the diet consisting of the nutritional intake of the research subjects, and the nutritional content of the workers' diets were analyzed using a system or application of Linear Programming (LP).[29,30] The LP analysis has been carried out using the two best diets on female workers undergoing shift work in the textile factory X Spinning section. That the intake of nutrients has met the Nutrition Adequacy Number except for the intake of micronutrients which are still a problem nutrient. These micronutrients are calcium and iron. Changes in food patterns per week were analyzed using the McNemar, while the average weekly intake was analyzed using the paired T-test and the Wilcoxon test.

The analysis of reaction time examination in both groups used a paired T-test. The average decrease in reaction time was used and the analysis of factors related to reaction time was analyzed using an unpaired T-test.

RESULTS

Demographic Characteristics of Subjects

The participants in this study were 100 female workers. Forty-nine were classified into an intervention group (group A), and 51 into a control group (the combination of groups B and C). Data were presented as percentages from both groups.

In Table 1, most subjects were within ≤30 years of age, comprising 88.24% more than the intervention group. Marital status was categorized into married and not married; those who were not married are single and widowed workers. Married workers are more dominant among the two groups. In terms of educational level, almost all workers in both the intervention group and control group had middle education.

Nutritional status was divided into two categories, i.e., BMI< 23 and BMI ≥ 23 Kg/m^2. The workers included in BMI< 23 were workers with low and normal nutritional status, while BMI ≥ 23 included workers with overnutrition and obesity. From the BMI characteristics table above, there were more workers with BMI < 23 in both groups.

Table 1. Characteristics of the subjects in both groups after intervention

Variable	Intervention (n=49)	%	Control (n=51)	%	p-value
Sociodemographic Characteristics					
Age (years)					
≤30	39	79.59	45	88.24	0.239[cs]
>30	10	20.41	6	11.76	
Marital status:					
Not married	22	44.89	26	50.98	0.543[cs]
Married	27	55.11	25	49.02	
Education					
Middle	48	97.96	51	100	0.490[fs]
Diploma	1	2,04	0	0	
Nutritional Status					
BMI<23	28	57.14	28	54.91	0.821[cs]
BMI ≥23	21	42.86	23	45.09	
Occupational Characteristic					
Length of work					
≥3years	9	18.37	9	17.65	0.925[cs]
<3 years	40	81.63	42	45.09	
Hb level characteristic					
Anemia (<12 g/dL)	19	38.8	33	64.7	0.009[cs]
Non-Anemia (≥12 g/dL)	30	61.2	18	35.3	

[cs] Chi-Square Test
[fs] Fisher's Exact Test

Table 2. Analysis of mean intake per week for each category of food in both groups

Intake	Intervention Group#		p-value*	Control Group#		p-value*
	Pre-intervention	Post-intervention		Pre-intervention	Post-intervention	
Staple food	26.9 ± 5.9	26.4 ± 3.9	0.316	26.4 ± 4.8	25.5 ± 3.5	0.036
Animal protein	21.9 ± 5	23.1 ± 3.2	0.021	21.2 ± 4.0	16.7 ± 2.5	<0.001
Plant protein	10.5 ± 3.9	13 ± 2.8	<0.001	11.7 ± 3.8	11.2 ± 1.9	0.555
Vegetable	7.7 ± 2.2	13.4 ± 1.2	<0.001	7.8 ± 2.1	7.8 ± 1.9	0.920
Fruit	4.1 ± 2.7	9.5 ± 1.2	<0.001	4.7 ± 2.3	6 (3.5-7.5)	0.148**

#: Mean ± SD of intake frequency per week
*: Independent t-test
**: Wilcoxon test

The length of work variable was divided into two, which were < 3 years and ≥ 3 years. There were more workers with < 3 years lengths of work compared to ≥ 3 years in the intervention group, reaching 81.6%. The same was found in the control group, in which there were more workers with < 3 years lengths of work, reaching 45.1%. Hb level differed between groups, where there were more workers within the no anemia category in the intervention group, which were 30 people (61.2%). Meanwhile, workers with anemia in the control group comprised 33 people (64.7%).

From all subjects' characteristics after the intervention, only Hb had a statistically significant difference between the group of workers with anemia and without anemia, with a p-value of < 0.05 (p = 0.009).

Table 2 described that during the start of the intervention, the frequency of intake per week from five FBR food categories in the intervention group was overall better than in the control group. Between the pre-and post-intervention groups, there was an increase in intake frequency per week for all food categories in the intervention group, both in the morning and night shifts. An increase in intake frequency is more dominantly seen in animal protein, vegetables, and fruits. The percentage of frequency increase from these three food categories was higher in the morning shift compared to the night shift.

Table 3 showed the results of reaction time measured using mean reaction time with the Lakassidaya instrument. Both groups were measured pre-and post-intervention. There was also a mean reaction time obtained from the combination of both groups. Mean reaction time would determine whether the correlation between pre-and post-intervention was statistically significant.

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Table 3. Results of reaction time examination on both groups

Study Group	Pre-Intervention#	Post-Intervention#	95% CI (Lower ; Upper)	p-value*
Intervention (n=49)	239.29 ± 49.96	226.32±31.19	3.96 ; 21.99	0.006
Control (n=51)	236.99 ± 40.56	233.43±22.83	-4.10; 11.21	0.355
Combination	238.12 ± 45.24	229.94±27.34	2.30 ; 14.04	0.007

#: Mean ± SD in milliseconds
* Independent t-test

Table 4 described the analysis of factors related to reaction time. The characteristics were analyzed using Lakassidaya after intervention based on the reaction time. These variables were analyzed with an independent t-test to determine the mean value and mean difference between factors related to reaction time based on the reaction time of 100 subjects.

DISCUSSION

Optimal use of resources to improve production is demanded in the industry. The consequence of this is the extension of work hours. One of which is by employing workers beyond their working hours or using the shift system.

Working in shifts may cause fatigue, which is a problem in the field of work health and safety and can lead to injuries and accidents.[5,6] A textile factory in Sumedang implements the shift system, and most of its workers are women in their productive age.

Besides the shift system, other factors may also affect fatigue, including age, length of work, marital status, education, nutritional status, health status, and energy intake.[10,11] The energy needed by workers is their normal nutritional needs added to energy or calories needs to perform activities within their scope of work.[12] Energy intake that does not match the needs can be a cause of a non-proportional nutritional status. This can reduce health, especially by causing work fatigue.[12,13] A previous study stated that 77.8% of workers who experienced fatigue had insufficient energy intake.[14]

Table 4. Analysis of factors related to reaction time

Variable	Reaction time		Mean difference	95% CI (Lower ; Upper)	p-value *
	n	Mean±SD			
Age (years)					
≤30	84	229.98±26.54	0.24	-14.63 ; 15.12	0.974
>30	16	229.74±32.18			
Marital Status					
Not married	52	231.41±27.09	3.05	-7.85 ; 13.95	0.580
Married	48	226.36±27.81			
Education					
Middle	99	229.84±27.46	9.95	-44.82 ; 64.72	0.719
Diploma	1	239.80±0			
Nutritional status					
BMI < 23	56	223.88±27.12	-13.78	-24.41 ; -3.14	0.012
BMI ≥23	44	237.66±25.37			
Length of Work					
≥3 years	18	228.31±27.85	-2.00	-16.18 ; 12.20	0.781
<3 years	82	230.30±27.38			
Hb characteristic					
Anemia	52	228.04±26.07	3.96	-6.93 ; 14.85	0.472
Non-anemia	48	232.00±28.78			
Intervention					
Intervention group	49	226.32±31.19	-7.11	-17.93 ; 3.70	0.195
Control group	51	233.43±22.83			

*Independent t-test

Lack of energy due to lack of nutritional intake in workers who work in shifts should be in the interest of the workers themselves and factory owners. Lack of nutrition has a high potential to cause fatigue, which may require intervention in the form of food-based recommendations. Its context should consider local ingredients and costs. The recommendation, which is a formulation from linear programming, is expected to formulate additional food menus and nutritional education to reduce fatigue and increase the workers' Hb levels.[29,30]

According to the data collected using the 5dFFQ questionnaire, 24-hour food recall, market survey, considerations on local-based ingredients and costs through the linear programming approach, and Optifood analysis, the food-based recommendation included staple foods, foods containing animal and plant protein, vegetables, and fruits.[30,31] The mean frequency of intake per week for each category of foods in the intervention group was achieved, compared to the control group after the intervention. An increase in the mean intake frequency in the intervention group was seen in the animal protein, plant protein, vegetables, and fruits categories, each with a significant p-value ($p < 0.05$). The increase in mean intake frequency in the control group was seen only in the fruits category ($p = 0.148$).

Based on the analysis of reaction time, there was a decrease in reaction time both in the intervention and the control groups. Mean reaction time decreased by 12.97 milliseconds pre-and post-intervention in the intervention group. This means that the food-based recommendation given to the intervention group after the intervention reduced reaction time by 12.97 milliseconds. The results of reaction time examination pre-and post-intervention in the intervention group differed significantly, with a p-value = 0.006. On the contrary, the mean in the control group only differed slightly compared to the intervention group, which was 3.56 milliseconds. This means that nutritional education given to the control group could reduce reaction time by 3.56 milliseconds, though the difference was insignificant, with a p-value > 0.05 ($p = 0.355$). The combination between both groups from reaction time measurement provided a difference in reaction time reduction of 8.18 milliseconds, with a p-value = 0.007. This means that there was a significant difference in the mean reduction of reaction time pre-and post-intervention.

Other than an individual's physical condition, work environment, and workload, fatigue is also affected by several factors, including age, marital status, education, nutritional status, length of work, and Hb characteristics. When analyzed with post-intervention reaction time measurement, there were 16 workers within 31-50 years of age with a mean post-intervention reaction time of 229.74 ± 32.18, while there were 5 times more workers within 20-30 years of age with a mean reaction time of 229.98 ± 25.54. The mean difference between the two age ranges was 0.244. The p-value of both age ranges on reaction time was insignificant after intervention ($p > 0.05$). Reflexes do slow with age, as the inability to analyze stimuli and plan motions or responses has changed in older persons, which can be the cause of their delayed response times.[32] However, this condition was not seen in our study, and therefore we assumed that other reaction time-related factors are more responsible for this phenomenon in our study population.

Marital status is divided into two categories, i.e., married and not married. The analysis of marital status factors and reaction time can be seen in Table 4. There were 52 married workers with a mean value of post-intervention reaction time of 231.41 ± 27.09 milliseconds, slightly higher than non-married workers (228.36 ± 27.81 milliseconds) with a mean difference of 3.05 milliseconds. The reaction time in the married worker's group may be caused by house chores that they must do before the night shift starts. There was an insignificant correlation between marital status and reaction time.

Out of 100 subjects, there were 56 workers with BMI < 23, more than workers with BMI ≥ 23 (44 workers). The analysis result of the mean post-intervention reaction time in workers with BMI < 23 was 223.88 ± 27.52 milliseconds, while workers with BMI ≥ 23 had 237.66 ± 25.37 milliseconds, with a mean difference of -13.77 milliseconds. This means that there was a difference of -13.77 milliseconds in reaction time between workers with BMI < 23 and workers with BMI ≥ 23. The analysis of nutritional status related to reaction time using an independent t-test resulted in a p-value = 0.012 ($p < 0.05$). This means that there was a significant correlation between nutritional status and reaction time. The nutritional status of workers with BMI < 23 based on the mean reaction time showed better nutrition compared to workers with BMI ≥ 23, which can affect the body's endurance to fatigue. Good nutritional status with the proper amount and timing of calorie intake has a positive effect on working performance. If the calorie intake of the workers does not match their needs, then the worker will feel fatigued compared to workers with sufficient calorie intake.[33] Sufficient calorie intake is represented by normal Body Mass Index (BMI), within the 18.5-25 range. Undernutrition or overnutrition in adults is an important problem because of not only poses a risk for certain diseases but can also affect work productivity.

Due to a lack of nutrition, the nutrition stored in the body will be used to fulfill the needs. If this keeps going on, then the nutrition stored will be depleted and there will be a decrease in tissue function. Increased nutrition deficiency will cause biochemical changes and low nutrients in the blood, including low Hb levels, vitamin A serum, and carotene. An increase in metabolism results such as lactic acid and pyruvate with a decrease in thiamine. Fat mass accumulates in the body due to the high consumption of high carbohydrate and high-fat foods. If the consumption is higher than what is used, the body cannot store nutrients, thus it is stored in a place that it should not be or become an accumulation of fat in several body organs, such as the body's vital organs. Accumulation of fat can reduce the normal function of organs and can cause an accumulation of lactic acid as a byproduct of energy metabolism. Pyruvic acid that was broken down without oxygen can contribute to lactic acid in the blood and muscles.[34] This accumulation will cause pain and fatigue. If this condition occurs for a long time, there will be changes in the body's function, including weakness, headache, fatigue, etc.[25]

The occupational characteristic of the workers was seen from the length of service, which was divided into < 3 years and ≥ 3 years. There were more workers with < 3 years of service than those with ≥ 3 years in both groups. There were 82 workers with < 3 lengths of service with a mean reaction time of 230.30 ± 27.38. Meanwhile, the post-intervention reaction time of workers with ≥ 3 years of services was faster, with 228.31 ± 27.85 and a mean difference of -2.0 milliseconds. The correlation between years of service and reaction time was statistically insignificant, with a p-value > 0.05 (p = 0.781). Because the nature of reaction time examination better describes the current condition of workers, or in a further sense, acute fatigue,[35] this result is understandable and as expected.

Based on Table 4, the mean reaction time of anemic workers was 228.04 ± 26.07, with a mean difference of 3.96 milliseconds. Both variables were analyzed by independent t-test to determine the mean value and mean difference between Hb characteristics and reaction time of the 100 subjects. The correlation between Hb and reaction time was not significant. This means that anemic and non-anemic workers who received supplementary food and education interventions had no effect on reaction time or fatigue. This is in accordance with research conducted in the United States. The percentage of subjects reporting fatigue was significantly high in iron-deficient and non-iron-deficient subjects in this age group. There was no statistical difference in self-reported fatigue in iron-deficient and non-iron-deficient women of childbearing age.[36]

Analysis of factors related to reaction time based on intervention and control groups showed a lower mean reaction time of 226.32 ± 31.19, lower than the mean of the control group with a mean difference of post-intervention reaction time of -7.11 milliseconds between the intervention group and the control group. We found that the control group was more prone to slower reaction time compared to the intervention group. However, the correlation between the two groups related to reaction time was insignificant (p = 0.195).

The FBR intervention is a recommendation in the form of education for female workers in consuming food per day as well as changes to the factory food menu given to meet the daily nutritional needs that have not been met. Changes in the company's food menu that are used as FBR's recommendations are the evening snack menu (during night shifts) and additional fruit provided on the lunch menu (during morning shifts). Along with being given additional food menus, pre-and post-intervention reaction time tests were carried out.

Reaction time was analyzed using Lakassidaya.[25] The results of the examination showed that the average reaction time in the pre-intervention and post-intervention groups, during pre-intervention the average reaction time was 239.29±49.96 while post-intervention was 226.32 ± 31.19 with a mean difference of 12.97±31.38 milliseconds. It means that there is a decrease in the reaction time of 12.97 milliseconds. Statistically, there was a significant difference in the average pre-and post-intervention reaction time with p<0.05 (p=0.006). In contrast to the control group, although there was a decrease in reaction time of 3.55 milliseconds, it was not statistically significant (p=0.355)

The researcher realizes that this study has several limitations that may affect the results of the study. Limitations are building the discipline of research subjects in filling out and returning the 5dFFQ form, and limited time in the interview process so workers can't wait to go home early. Data collection using Lakassidaya, when examining many research subjects who couldn't wait to get their turn so that it affected the concentration of the subject being examined, in response to this the researcher provided more than one examination tool so that the queue could be unraveled.

CONCLUSION

Despite the above limitations, the provision of additional food menus in the form of nutrient-dense foods that were selected as FBR recommendations for female workers with a night shift work system is a mixture of several food groups; fruits, vegetables, fish meat, eggs, nuts, seeds, wheat, and their products, are selected to meet the daily nutritional needs of workers. Additional food menus as a recommendation for FBR and nutritional education provided can reduce reaction time, i.e., positive impact, for the two study groups, during pre-intervention and post-intervention.

DECLARATION

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