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ABSTRACT

This project studied the rice packing process in community rice milling plant. The objectives of this study were to improve working postures in packing process and measure productivity. The apparatus used in this study were 1) camera for recording pictures and video, 2) stopwatch, and 3) Abnormal Index. Working posture was changed from sitting on a mat to sitting on an adjustable chair. Results showed that changing working posture resulted in lower AI score, indicating lower fatigue. Furthermore, productivity increased since cycle time was decreased by 18.4%.

Keyword: Ergonomics, Workstation, MSD

1. INTRODUCTION

Thailand has earned reputation in producing rice and rice seed, especially Khao Dawk Mali 105 and KD15 which are most famous in the country. Surin province is a main source of Khao Dawk Mali 105 and the manufacturers of rice in this province are both corporates and SMEs. Nowadays, rice production in corporatesin this province use machine and automation system. However, SME rice milling plants still require human to perform tasks. Furthermore, statistics shows that elderly labors worked in farming sectors increased from 13% in 2003 to 19% in 2013 which was greater than the average labor population of 14% in 2017 (Jantarat et al., 2019). Workplace has to be well managed to accommodate elderly workers. This project studied work method of rice packing in a community rice milling plant in Surin province. This process required elderly workers filling rice in package. They worked in sitting posture on a mat throughout the day. This resulted in discomfort in lower back and neck area (Department of Labour Protection and Welfare, 2008). Furthermore, to the customers, sitting on a mat while working would affect food safety concept. Therefore, it was necessary to improve work method in rice packing process for ergonomics and food safety reasons. The objectives of this project were to improve working postures in packing process and to measure productivity.

2. EXPERIMENT

2.1 Experiment apparatus

This project collected data of workplace and work method in community rice milling plant as shown in Figures 1 and 2. Equipment used were: 1) camera for recording pictures and video, 2) stopwatch for recording time both before and after improvement, and 3) Abnormal Index (Intaranont and Vanwonterghem, 1993). Abnormal Index was a tool for assessing physical and mental fatigue subjectively by the workers after work period. The questionnaire consisted of questions regarding 8 work factors including 1) basic fatigue, 2) injury risk, 3) interest of work currently performing, 4) complication of work, 5) ease of work, 6) work rhythm, 7) responsibility, and 8) freedom of work. The scale of answer ranged from 0 (minimum) to 9 (maximum). Then, the scores of each factor were summed and analyzed to estimate fatigue.

Figure 1. Community rice milling plant.

Figure 2 .Work area in a community rice milling plant.

2.2 Data acquisition

Collection of data

In rice packing process, there were 4 workers. They worked in seated position on a mat, which was on the floor. The first worker manually sorted seed contamination from normal seeds. The second and third workers put rice in a plastic package using scoop. The fourth worker sealed the package using a sealing machine. The second and third workers were selected into this study since they worked for whole day. From Figure 3, it is obvious that the worker bent her neck and back during work. Stopwatch was used to record cycle time of the second and third workers.

For improvement of work, table and adjustable chair were given to the workers. The height of chair was adjusted according to each worker popliteal height and made reach comfortable. Moreover, the height of rice container was adjusted to eliminate neck bending (Figure 4). During work in improved workstation, cycle time of each worker was recorded and used to compare between before and after workstation improvement. After that, the workers performed subjective ratings of 8 factors in Abnormal Index questionnaire for further analysis

Figure 3. Rice packing workstation before improvement.

Figure 4 .Rice packing workstationafter improvement.

3. ANALYSIS

The cycle times of putting rice in a bag for each worker were recorded for 30 cycles both before and after improvement. Then, statistical analysis was conducted to determine a significant difference between cycle time before and after improvement. At the same time, subjective ratings of 8 factors in Abnormal Index questionnaire was used to compute AI as follows.

$$AI = \frac{\sum[1,2,4,5,6,7] - \sum[3,8]}{8}$$

The results of AI score was interpreted as the following.

AI ≤0 = No problem.

0<AI ≤2 = Few problem, but still acceptable.

2<AI ≤3 = Must be careful.

3<AI ≤4 = Unacceptable.

4>AI = Definitely unacceptable. Immediate correction measure is needed.

4. RESULTS AND DISCUSSION

Time recorded for the workers 2 and 3 show in Table 1 and 2, respectively. It can be seen that the worker 2 was slower than the worker 3. Moreover, cycle time after improvement was less than before improvement

Table 1. Cycle time of packing rice for the worker 2.

Cycle	Cycle time before improvement (s.)	Cycle time after improvement (s.)	Decrease of cycle time(s.)	Decrease of cycle time (%)
1	64	52	12	18.75
2	70	48	22	31.43
3	65	50	15	23.08
4	67	51	16	23.88
5	59	53	6	10.17
6	63	49	14	22.22
7	68	52	16	23.53
8	70	49	21	30.00
9	72	51	21	29.17
10	63	52	11	17.46
11	68	53	15	22.06
12	62	47	15	24.19
13	73	49	24	32.88
14	59	42	17	28.81
15	65	45	20	30.77
16	64	52	12	18.75
17	60	53	7	11.67
18	62	50	12	19.35
19	66	52	14	21.21
20	67	54	13	19.40
21	59	53	6	10.17
22	58	52	6	10.34
23	65	47	18	27.69
24	66	48	18	27.27
25	70	55	15	21.43
26	65	50	15	23.08
27	69	47	22	31.88
28	66	49	17	25.76
29	67	48	19	28.36
30	71	51	20	28.17
Total	1963	1504	459	692.9
Average	65.43	50.13	15.3	23.10

Table 2. Cycle time of packing rice for the worker 3.

Cycle	Cycle time before improvement (s.)	Cycle time after improvement (s.)	Decrease of cycle time (s.)	Decrease of cycle time (%)
1	44	40	4	9.09
2	43	38	5	11.63
3	41	36	5	12.20
4	46	34	12	26.09
5	45	41	4	8.89
6	42	35	7	16.67
7	39	38	1	2.56
8	44	39	5	11.36
9	40	38	2	5.00
10	45	35	10	22.22
11	43	38	5	11.63
12	41	36	5	12.20
13	39	34	5	12.82
14	42	39	3	7.14
15	45	40	5	11.11
16	38	35	3	7.89
17	51	39	12	23.53
18	46	42	4	8.70
19	48	37	11	22.92
20	52	33	19	36.54
21	39	36	3	7.69
22	46	41	5	10.87
23	40	36	4	10.00
24	40	37	3	7.50
25	41	35	6	14.63
26	42	38	4	9.52
27	48	36	12	25.00
28	45	37	8	17.78
29	42	34	8	19.05
30	46	40	6	13.04
Total	1303	1117	186	415.2
Average	43.43	37.23	6.2	13.84

Table 3 shows the average of cycle time after improvement was less than that before improvement for both workers. For the worker 2, the reduction of cycle time was 15.3 s or 23.1%, whereas it was 6.2 s or 14% for the worker 3. On average, cycle time reduction was 18.4%, indicating that productivity increased by 14%.

Table 3. Average cycle time before and after improvement.

Worker	Average cycle time before improvement (s.)	Average cycle time after Improvement (s.)	Average of cycle time reduction (s.)	Average of cycle time reduction in percent (%)
2	65.4	50. 1	15. 3	23.1
3	43.4	37. 2	6.2	14
Total	54.4	43. 6	10. 7	18.4

Fatigue assessed by workers is shown in Table 4. It was obvious that before improvement, general fatigue was high, and decreaseddrastically after improvement.It might be because neck and back were in upright posture after improvement, resulting less discomfort in those areas. AI score for the worker 2 was 2.625 and 0.875, before and after improvement, respectively. At the same time, AI score for the worker 3 was 2.125 and 0.5, before and after improvement, respectively. From the AI score after improvement, it is interpreted that the workers had no fatigue problem.

Table 4. Result of AI score assessed by workers.

Task Factors	Worker 2		Worker 3	
	Before improvement	After improvement	Before improvement	After improvement
1.Basic fatigue	**8**	**3**	**7**	**2**
2.Injury risk	**4**	**2**	**3**	**1**
3.Interest of work currently performing	**2**	**3**	**0**	**0**
4.Complication of work	**3**	**1**	**2**	**1**
5.Ease of work	**3**	**3**	**2**	**1**
6.Work rhythm	**5**	**3**	**5**	**2**
7.Responsibility	**7**	**7**	**7**	**7**
8.Freedom of Work	**9**	**9**	**9**	**9**
AI Score	**2.625**	**0.875**	**2.125**	**0.5**

5. CONCLUSIONS

This project used Ergonomics principle to improve rice packing process. It is concluded that changing working posture from sitting on the mat to sitting on a chair resulted in lower AI score since discomfort level in neck and back area was decreased. Furthermore, on average, cycle time was decreased by 18.4%.

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PHOTOS AND INFORMATION

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