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Measuring and Analyzing Job Stress and Fatigue among Workers and Its Impact on Employee Productivity in a Pharmaceutical Factory: A Case Study

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Abstract

Too much stress in the job and occurrence of fatigue during working will cause an increase in loss of productive work hour. In this paper, the amount of stress that an employee of a manufacturing industry faces was measured. The working condition at the workplace was observed and the effect it had on fatigue among the employees were studied. The study was done based on questionnaires and interviews. The productivity of the employee was also measured using the ratio of quantity produced and man-hour used. It was observed that productivity level did not reach the standard value set by the management. The job stress and fatigue factors were related with the cause of low productivity. Based on the interview and response from the questionnaire of the employees, some methods to reduce job stress and fatigue were proposed to the management.

Keywords: Stress, labor productivity, fatigue, work environment

1. Introduction

The welfare of the employees is an important thing to be considered by the management of an organization. Too much stress related with job and such kind of job design that may cause fast fatigues among employees can hamper the productivity of both the individual and the organization. Stress is defined as an external force operating on a system [1]. Stress is normally seen in a negative manner. However, stress can have positive effects too [2].

Fatigue is difficult to define. Confusion may arise between fatigue and weakness. Both are two different things. The difference in short is, fatigue can be overcome after some rest. Muscio defined fatigue as a variety of unrelated phenomena. Form his point of view, fatigue should be excluded from scientific discussion as it cannot be measured directly [3]. Bartley suggested fatigue is a confusing concept and researchers should determine operationally the effect of various factors on work output [4].

Productivity is the ratio of output to input [5]. The measures of output can be either physical quantity or financial value. The measure of input can be labor, capital or any other intermediate input [6]. The selection should be made based on the key performance area and by setting a performance objective first. Weightage can be assigned to key factors if necessary [7].

2. Methodology

The data collection for job stress and fatigue were based on self-administrated questionnaires and visual investigation. A pharmaceutical factory was selected to conduct the study. 177 employees of the packaging section were interviewed. The questionnaire contained 3 parts. The first part consisted questions of basic information such as age, gender, education etc. The second part contained questions regarding job stress in the workplace. The third part was questions about fatigue. Previous studies on fatigue assessment were studied. Krupp et al. (1989) conducted a study to determine physical and psychological fatigue and the target population were patients. The impact and functional outcomes were assessed using a 7-point Likert scale over the span of 2 weeks. [8]. Monk (1989) worked on determining mood based fatigue on psychiatric patient using visual analogue scale [9]. Wood et al. (1990) conducted research on the severity of physical and mental fatigue among healthy volunteers using visual analogue scale [10]. Ashberg (2000) conducted his research on workers. His work measured the severity

of physical and psychological fatigue among the working population at the end of the work using a 7-point Likert scale [11]. Winwood et al. (2005) conducted his work on mental, physical, acute and chronic fatigue among the working population using 7-point Likert scale over a span of few months [12]. Cavuoto et al. (2017) studied general and physical types of fatigue on manufacturing workers using visual analogue scale over a time scale of one week [13].

Productivity measurement was conducted using physical quantity value as output and labor man-hour as input. The productivity data was taken for the month of April 2017. Total working days of that month were 24 days. So, the equation used to measure the productivity level of the employees under study was:

$$Productivity = \frac{Total\ units\ produced}{Man - hour\ of\ the\ employees} \quad (1)$$

The data of total units produced and man-hour required were a daily basis data.

3. Data Analysis and Result

The basic information of the workers is given in table 1:

Table 1. Summary of workers basic information

Total Employee Interviewed	177
Male Female	50 (28.25%) 127 (71.75%)
Age	Minimum 19, Maximum 43 1. 19-24: 37 (20.9%) 2. 25-29: 43 (24.3%) 3. 30-34: 52 (29.4%) 4. 35-39: 31 (17.5%) 5. 40-43: 14 (7.9%)
Experience	Minimum 0, Maximum 22 1. 0-4: 34 (19.2%) 2. 5-9: 54 (30.5%) 3. 10-14: 72 (40.7%) 4. 15-19: 11 (6.2%) 5. 20-22: 6 (3.4%)
Overtime	Yes: 149 (84.18%) No: 28 (15.82%)
Marital Status	Single: 45 (25.42%) Married: 132 (74.58%)

The labor productivity of the factory for April 2017 is shown in table 2:

Table 2. Labor productivity for April 2017.

Day	Unit Produced (Regular time + Overtime)	Man-hour used (Regular time + Overtime)	Productivity
1	635643	1635	388.7725
2	756130	1754	431.0889
3	759232	1646	461.2588
4	634718	1606	395.2167
5	759941	1728	439.7807
6	658944	1799	366.2835
7	619935	1704	363.8116
8	658192	1796	366.4766
9	754341	1567	481.3918
10	706607	1552	455.288

11	784852	1662	472.2335
12	615474	1550	397.08
13	708574	1575	449.8883
14	662136	1629	406.4678
15	641473	1779	360.5807
16	754933	1550	487.0535
17	749086	1591	470.8272
18	648991	1680	386.3042
19	700825	1522	460.4632
20	629664	1706	369.0879
21	674046	1628	414.0332
22	714923	1768	404.3682
23	638537	1701	375.3892
24	625809	1614	387.7379

The stress of the workers was calculated based on self-administrative questionnaire. Each question had different point scale. The summary of the data is shown in below table 3:

Table 3. Summary of workers response to stress related questions.

Stress Factor	Response
1. Work environment	Very suitable: 19 (10.7%) Suitable: 8 (4.5%) Moderately Good: 26 (14.7%) Not Good: 107 (60.5%) Very difficult to work: 17 (9.6%)
2. Nature of the job	Not stressful: 0 (0%) Somewhat stressful: 33 (18.6%) Moderately stressful: 53 (29.9%) High stress: 67 (37.9%) Very high stress: 24 (13.6%)
3. Working hour	Highly favorable: 47 (26.6%) Suitable: 108 (61%) Too much extended: 22 (12.4%)
4. Production quota	Can be completed in time: 13 (7.3%) Sometimes cannot be completed: 78 (44.1%) Most of the time cannot be completed: 86 (48.6%)
5. Salary	Timely given: 152 (85.9%) Timely not given: 25 (14.1%)
6. Incentives and Rewards	Provided on a regular basis: 0 (0%) Sometimes provided: 11 (6.2%) Never provided: 166 (93.8%)
7. Workload	Tolerable: 42 (23.7%) High: 84 (47.5%) Very High: 51 (28.8%)
8. Interpersonal Relations	Very good relation: 118 (66.7%) Good relation: 38 (21.5%) Bad Relation: 9 (5%) Very bad/hostile relation: 12 (6.8%)

The summary of the results of fatigue factors from the questionnaire is shown in table 4:

Table 4. Summary of workers response to fatigue related questions.

Fatigue Factor	Response
1. Repetitive task	No variation: 148 (83.6%) Little variation: 29 (16.4%) High variation: 0 (0%) Very high variation: 0 (0%)
2. Breaks between tasks	No break at all: 0 (0%) Small breaks: 171 (96.6%) Good number of time on breaks: 6 (3.4%) Breaks at will:0 (0%)
3. Overhead Work	Yes: 91 (51.4%) No: 86 (48.6%)
4. Lighting Condition	Very good: 64 (36.2%) Good: 80 (45.2%) Moderately good: 33 (18.6%) Unsuitable: 0 (0%) Very unsuitable: 0 (0%)
5. Temperature and humidity	Very highly tolerable: 0 (0%) Highly tolerable: 0 (0%) Moderately tolerable: 21 (11.9%) Discomforting: 150 (84.7%) Very highly discomforting: 6 (3.4%)
6. Material handling manually	Yes: 59 (33.33%) No: 118 (66.67%)
7. Sound level	Very highly tolerable: 0 (0%) Highly tolerable: 0 (0%) Moderately tolerable: 43 (24.3%) Discomforting: 72 (40.7%) Very highly discomforting: 62 (35%)
8. Proper sitting arrangement	Yes: 25 (14.1%) No: 152 (85.9%)

4. Discussion

The standard productivity score set by the management was 600 units/man-hour. A chart of all the 24 working days in April 2017 is shown below in figure 1:

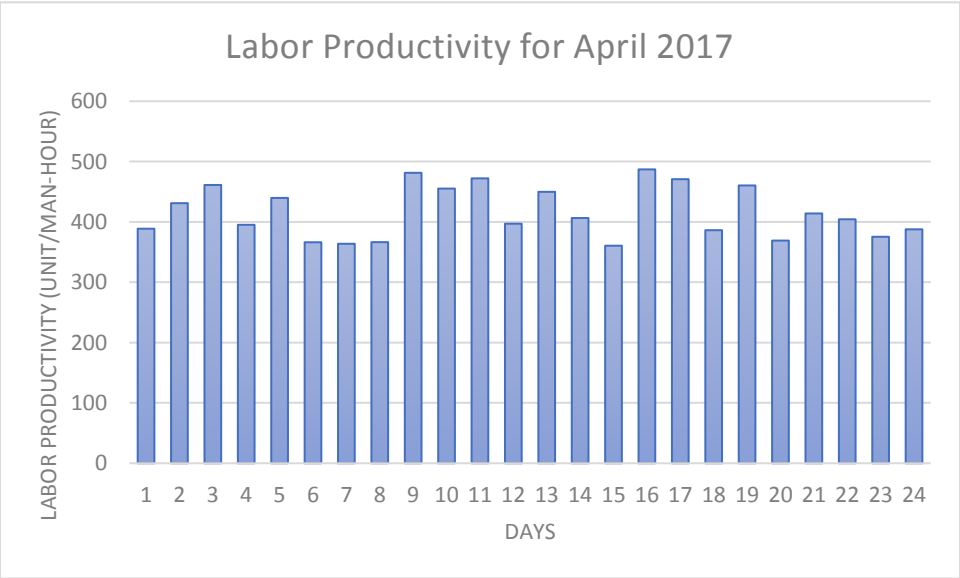

Fig. 1. Labor Productivity for April 2017

The standard productivity could not be reach during the time of study. From the stress factors, majority of the workers feel that the job is stressful. Most workers also think that the work environment is not good. Only 7.3% workers can complete the set production quota. As a result, the standard productivity could not be achieved. Most of the employees feel that the workload is high for them. Rewards and incentives can be used as motivation to overcome the stresses. However, at the time of the study it was found that 93.8% workers never received any kind of incentives or reward.

Fatigue can slow down the speed of work flow. It can cause bottlenecks in other workstations. The task in this factory is very repetitive and has no variation. This is one of the major reasons for quick fatigue among the workers. Break time between tasks is small and it has little effect on reducing fatigue by resting. Almost half the workforce is exposed in overhead work. It is also a reason for fatigue and half of the total workers are exposed in this situation. Temperature and humidity of the factory is not suitable to work without having physical problems. One third of the workers handle materials manually. It can cause physical problems on the workers. The sound level is not suitable to work and can cause hearing loss gradually. Most of the employees do not have proper sitting arrangement.

5. Reduce Stress and Fatigue

Stress and fatigue have negative impact on the productivity level. Reducing them may increase the employee productivity. Based on the interview with the employees and their response to the questionnaires, some steps that the management can take to reduce stress and fatigue is discussed below:

Work stress can be reduced by:

i. Making the work environment more suitable to work. It can be done by keeping the workplace neat and clean. Management can try to apply 5s. It will provide benefit in the process. Motivating posters and safety signs around the walls of the factory may have a positive effect.
ii. Job is stressful to most of the employees. Management can arrange training program so that employees will have more knowledge of the process and may feel less stressed.
iii. As most of the employees are unable to meet the production quota, the planning department of the factory can revise the set quota per day. If the workers can achieve the set lowered quota than management can set the quota higher gradually. If workers are being able to fill up the targeted quota they will feel confident and will be less stressed. It will also reduce the workload among employees.
iv. Incentives and reward can be a great motivating factor. Properly design reward system will make the employees more satisfied and it have a positive effect on reducing job stress.

Fatigue can be reduced by:

i. The planning department can shift the workers into different workstation so that employees should not have to do same kind of task for too long. Variation will help to increase the attention level of the employees.
ii. Properly planned and strongly monitored break cycle can be introduced. Fatigue decreases with rest. So, adequate amount of resting period should be provided. However, it should be strictly monitored otherwise unsupervised resting period will create unproductive work hours and low productivity.
iii. Half of the workers do overhead work. By level the floor with the overhead points, this problem can be reduced. Proper ergonomically planned workstation is necessary to reduce this problem.
iv. The temperature and humidity are not tolerable to most of the employees. Ventilation system should be upgraded and artificially induced humidifier can be introduced to solve this problem.
v. One third of the workers handles material manually. Automation can help to reduce fatigue among workers who does these jobs.
vi. The sound level in the factory is discomforting. Personal protective equipment should be provided to the workers to save their hearing from permanent damage.
vii. The sitting arrangement is not suitable for most of the employees. Proper sitting arrangement can reduce fatigue more effectively.

These solutions were based on the response of the workers. Management can try to apply these and monitor the job stress and fatigue level of employees along with the productivity level.

6. Conclusion

The paper presented the findings of the selected manufacturing factory for April 2017. Stress and fatigue related problems can have serious consequences on employee health and organization productivity. The focus of this

paper was to highlight the effects of stress and fatigue on productivity. The factors for stress and fatigue were given equal importance and management should try to minimize their effects on employees. The methods to reduce stress and fatigue can be beneficial for the organization if the management can implement them properly. Monitoring the stress and fatigue level continuously is crucial for developing the overall circumstances. There are limitations to the capability of the management personnel. Allocating resource and man power for monitoring this study continuously is not always possible. However, management personnel had gladly accepted the suggestions that were found out through this study and has agreed to implement some of them gradually with time. After implementing some of the methods and a follow up study will be beneficial to determine if the productivity level really increased or not. Most impactful fatigue factor and most stressful factors were not identified. Each factor was considered as equally important. This can be a scope for future study where most impactful fatigue factor and most stressful factor might be identified by further research on the employees.

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