Work-related Factors affecting the Sustained Attention among Production Workers in a Pharmaceutical Company in the Philippines

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Abstract
World population is rapidly increasing over time along with the people's demands in terms of health. Pharmaceutical companies in the Philippines continue to produce medicines to accommodate the demands nowadays. They assure that every product is in good quality and meeting the customer's expectations and standards. Thus, Philippine pharmaceutical companies focus on the workers' sustained attention resulting to be as efficient and effective in doing their job. Through assessing the workers' attention level, approximately sixty percent (60%) fall under 9,200ms which is considered to be low attention level that results to a high number of non-conformity products. To lessen this, researchers identified the significant factors affecting the workers' sustained attention. Sustained attention to response task (SART) was used in measuring the workers' attention level. The collected data were found normally distributed through the normality test, having a p-value of 0.095. Significant factors were identified with the use of multiple regression; however, BMI (0.237), working years (0.854) and noise (-0.724) were found to be positively weak, positively strong and negatively strong correlated with the sustained attention level. The recommendation presented in this research is ergonomic based intends to improve production workers' sustained attention in pharmaceutical companies in relation to the abovementioned significant factors.

Keywords
attention, pharmaceutical, SART, ergonomics, multiple regression

1. Introduction

The Philippines is ranked as the third-largest pharmaceutical market in the Association of South-East Asian Nations (ASEAN) and has a worth $3.6 billion in the year 2016. The Filipino pharmaceutical market is predicted to exceed $4 billion by the year 2020, expanding at a compound annual growth rate of over 3.5% [1]. In a pharmaceutical company in the Philippines, approximately sixty percent (60%) of the production workers experience low attention level of eight (8) with a time of 9,200 ms and below as stated in the sustained attention to response task (SART) activity resulting to non-conformity of products. Meanwhile, sustained attention plays an important role and has a significant impact in any type of work especially to those health-related jobs like drug manufacturing [2]. Not only is the health of the consumers being at stake but also the well-being of the workers [3]. One of the top problems experienced by a pharmaceutical company is the struggle of meeting and exceeding the customers' demand and its relationship to the quality of medicines. Nowadays, consumers are knowledgeable about their rights and demand a high-quality product that could satisfy their needs as side effects and dosage issues may lead not only expensive lawsuits, which directly affects people's lives [4]. Department of Health (DOH) reported that in the year 2013, there are five hundred thirty-one thousand two hundred eighty (531,280) registered deaths caused by bacteria in all ages [5]. There are various pharmaceutical manufacturers that produce anti-bacterial medicine that could reduce the percentage of mortality caused by bacteria-related diseases. According to Ongoagchai, S., et al (2011), poor quality of medicines is considered to be hazardous that may result in health implications, treatment failure and adverse effects [6]. This proves that sustained attention is significant in drug manufacturing because taking medicines are people's way to maintain and improve their health from any sicknesses they have. In order to solve the problem, it is relevant to assess and identify the significant factors that affect the sustained attention among pharmaceutical production workers and its effect on

their performance. In order to recommend an ergonomic solution to enhance the sustained attention level of the workers that results to a lesser quantity of non-conformity products being produced. The study will limit its focus on addressing some factors that can affect the attention span of the workers using sustained attention to response task (SART) in the production area of a pharmaceutical company in the Philippines –which are classified into four (4) factors: individual, psychological, working condition and environment.

2. Literature Review

Production workers are responsible for the completion of seven (7) processes – dispensing, sifting, compounding, filtration, filtered liquid, filling and packing that require enough level of attention. Each of these workers is handling delicate substances used in manufacturing their products. These people are said to have a possible exposure to active pharmaceutical ingredients (APIs) which could have an undesirable result if failed to handle cautiously.

This study focuses on addressing some factors that can affect the attention span of a worker in the production area which is classified into four factors: individual, psychological, working condition and environment. The individual factor is consisting of age of the workers, sleeping hours, transportation time, gender, working years and the workers' body mass index. Current researches revealed an age-related reduction in errors on sustained attention task, this recommends that sustained attention abilities tend to improve as the person ages [7]. Sustained attention can also be associated with the sleep quality which is affected by the circadian rhythm constituted with the length of sleep. Sleep is the way of an organism to cope with and supply the lost energy [8]. This loss can also be linked with long commutes which are linked to the sustained attention experienced by the commuter. Linking to this matter, long commutes are found to have a negative impact on different aspects of life, from mental health and blood pressure [9]. Another factor that could influence the sustained attention of a person is their gender. With the aid of gender equality indices, a study found that overall sustained attentional control performance was lower in countries with less equality and that there were greater gender differences in performance in countries with less equality [10]. The working experience could also have a significant effect with respect to sustained attention by means of work performance. It is found out that work experience has the highest correlation with the measure of job performance and helps employees under stressful conditions to direct their attention to well-learned and familiar tasks [11]. Last amongst the individual factors is the body mass index of a person. It is indicated in a study that BMI has a relevant effect with respect to cognitive functioning. This result suggests that as BMI increased, modestly attenuate concomitant grey matter volume decline. [12].

Psychological factors refer to factors that affect human behaviour and the human mind to perform well in a certain activity or task. This includes why the workers in a certain job are being distracted. Manufacturing medicines require enough attention needed to accomplish the process precisely. Since medicines are composed of different chemicals and substances, the worker's psychological aspect gives a significant effect on the worker's attention. Fatigue and sleep work hand in hand in terms of the person's working performance. Fatigue results from a lack of sleep and can be heightened from prolonged mental activity [13]. Studies suggest that adults' ranges from eighteen to sixty-four (1864) years old must sleep between seven to nine (7-9) hours but six to eleven (6-11) hours may be appropriate. [14]. Along with this, quality of sleep directly affects the mental and physical health of an individual including worker's productivity, emotional balance, brain and heart health, immune system, etc. [15]. The workers can affect their teamwork and communication and other corporate environments. It was proved that lack of sleep fostered tiredness between individuals that also put a big strain on social relationships in the workplace. In the study, over half of the respondents reported experiencing higher levels of stress, anxiety, and feelings of frustration when deprived to sleep [16]. When an individual tends to experience constant tiredness with their work, their satisfaction with the job is also being affected. As mentioned in an article, worker's satisfaction in their job is equal to the increase in productivity – because a satisfied employee is a productive employee [17]. Employees who are satisfied with their work are well motivated to do the job properly and well. It was stated in a study that when employees are motivated, they are enjoyable and become more interested in their jobs [18].

Meanwhile, the sustained attention of the employees can also be affected by the environmental factors present in the workplace. This includes light, temperature and noise. Workplace lighting's biggest concern is the occupational health and safety requirements for the comfortability of the employees while doing their work [19]. In the pharmaceutical industry, proper lighting for every process is essential and significant. It is because chemical substances are delicate in terms of compounding that also requires a certain amount of attention along with the proper lighting. Likewise, the

need for proper lighting is the same with the balance of temperature in a workplace. In a pharmaceutical industry, medicines are stored with a temperature requirement [20]. It is because the storage temperature may alter the medication. Medicines can either lose potency, physically change and even threaten the health of the consumers [21]. Noise, on the other hand, affects the employees themselves. A study proves that noises can lower the ability to concentrate which is constituted with the sustained attention of an individual. Research has also shown that noisy workplaces are less productive and have higher accident rates that quieter workplaces [22].

Working condition indicates the working hours of the workers and workload experienced by the workers in the workplace and the assigned step-by-step processes to the workers. Working hours are found to have an impact with respect to the working performance productivity of the workers. An increase in effective working time by one percent (1%) is said to be leading to an increase in output which corresponds to moderately decreasing returns to hours [23]. Work performance is also associated with mental workload, whereas working performance declines when the mental workload is too high or too low [24].

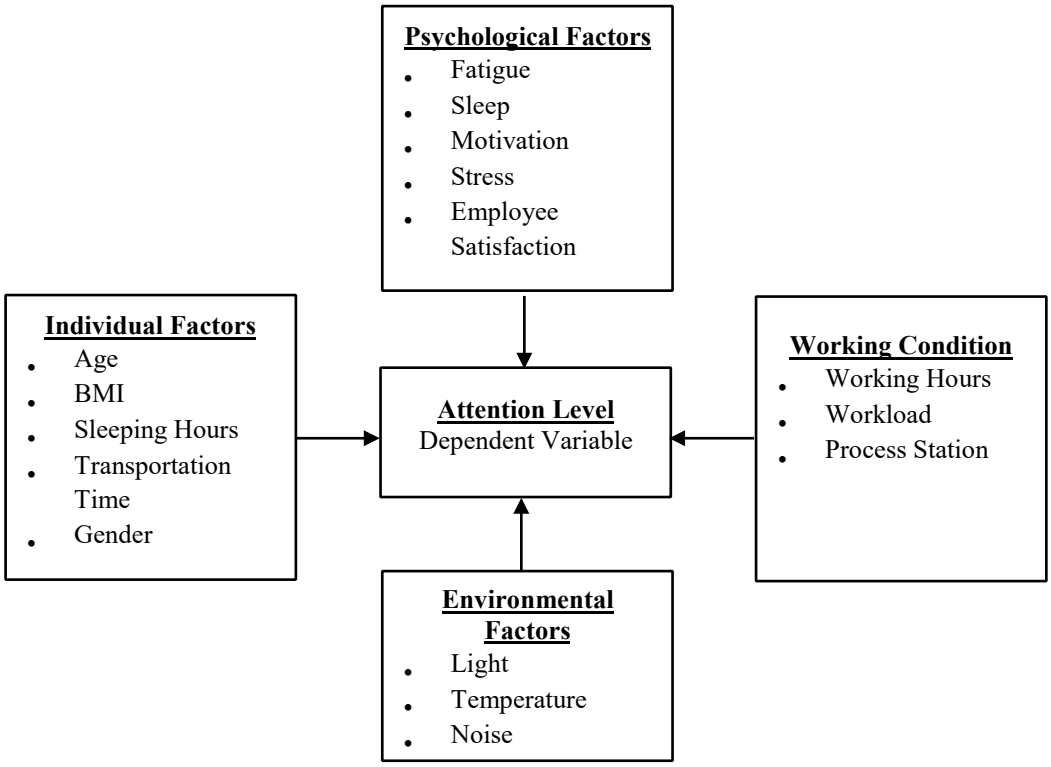

Figure 1. Conceptual Framework

3. Research Design and Methodology

3.1 Experimental Design

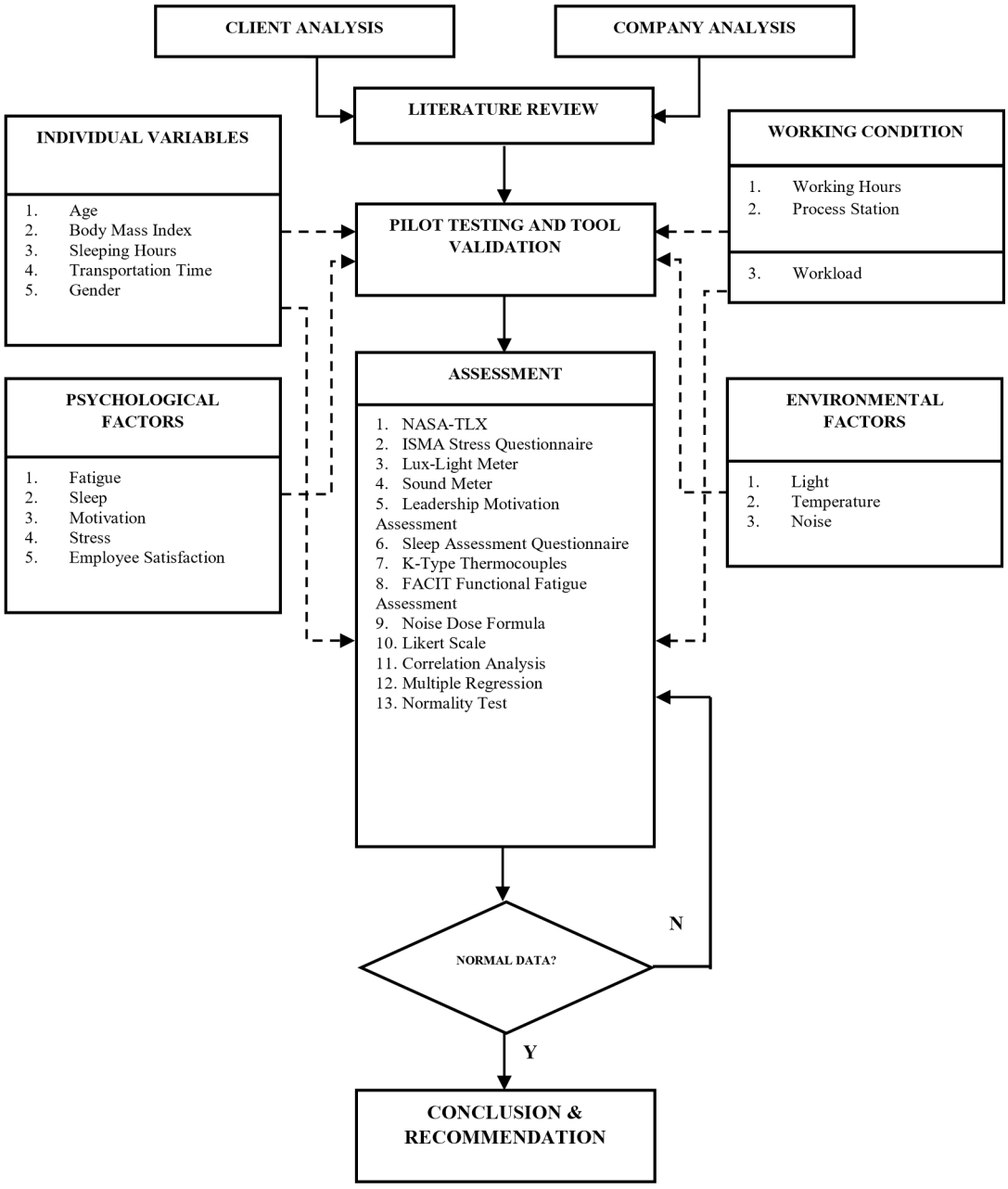

Figure 2. Model Framework

A. Individual Factors

Individual factors are about the fundamental information of the workers in the production area of a pharmaceutical company. It contains the age of the workers, sleeping hours, transportation time, gender and their body mass index. The said factors have an adverse effect on employee's working performance and will help to make a good suggestion for increasing the attention level of the workers.

B. Psychological Factors

Psychological factors are related to the mental and emotional state of the production workers in a pharmaceutical company. This is connected with behavior, worker's fatigue, sleep, motivation, stress and employee satisfaction towards the surroundings of how they work. These factors are important because it shows how the workers act in their respective work.

C. Environmental factors

Environmental factors are about the surroundings of the production area of a pharmaceutical company. It contains the light level of strength in the area, the temperature that the workers experienced, and the noise is heard in the process. These factors can be determined through the use of lux light meter, sound level meter, and k-type thermocouples.

D. Working Condition

Working condition is all about the physical state and mental demands that exist in the workplace. It contains the working hours of the workers, the workload, and the process station of the medicines. The said condition has an opposing effect on how the workers perform their task.

3.2 Sampling Frame

The respondents of the study were the production workers of the pharmaceutical company in the Philippines. Through the use of Cochran's formula, forty-two (42) workers were chosen to be the respondents of this study. The workers were observed and interviewed to come up with the necessary data and information. The data gathered will undergo normality test with the use of Minitab 17 software –this includes the use of correlation analysis to determine the relationship between variables and multiple regression to identify the factors that have a significant effect on the dependent variable which is the attention level of the respondents.

Table 1. Summarized data of Demographics

Demographics	Frequency	Percentage
Gender		
Male	22	52
Female	20	48
Age		
24-29 y/o	22	52.38
30-35 y/o	16	38.10
18-23 y/o	3	7.14
48-54 y/0	1	2.38
Body Mass Index		
Normal Weight	23	55
Underweight	12	29
Overweight	6	14
Obese	1	2
Sleeping Hours		
Less than six (6) hours	26	61.90
Six (6) to eight (8) hours	15	35.71
Eight (8) hours or more	1	2.38

Transportation Time		
One (1) hour or less	22	52.38
One (1) to three (3) hours	16	38.10
Three (3) hours or more	4	9.52

3.3 Data Collection

The researchers used FACIT Fatigue Assessment and Sleep-Quality Questionnaire to assess the fatigue level and quality of sleep of the production workers respectively. For the motivation and workload, it was assessed through the use of Leadership Motivation Assessment and NASA-TLX. Meanwhile, International Stress Management Association (ISMA) UK Stress Questionnaire and Likert Scale were used to assess the workers stress level and satisfaction with respect to their jobs. On the other hand, workplace temperature, sound level and light inside the workplace were measured using K-Type Thermocouple, Sound Level Meter and Lux Light Meter respectively.

4. Results and Discussion

The researchers distributed the questionnaires to forty-two (42) production workers in the pharmaceutical company in order to gather the necessary data and information. With the use of statistical tools, researchers were able to identify the significant factors affecting the sustained attention level of the production workers. It is assessed that the body mass index, working years and noise has a significant effect on the attention level of the workers.

4.1 Normality Test

The graph and table below show that the sample data is normally distributed. The given data can be concluded a normal distribution if the p-value results to a greater alpha level than 0.05. As seen in the table below, the first normality test has a total of forty-two (42) respondents while the second normality test was obtained by removing the unusual observation descending to a total number of forty-one (41) respondents derived from Cochran's Formula. Resulting in having a p-value of 0.104 on the first and 0.095 on the second normality test which are greater than 0.05.

Table 2. Minitab Result- Normality Test Results (Tabulated)

SART	N	Mean	Std. Deviation	AD	P-Value
1	42	7.995	3.609	0.613	0.104
2	41	7.994	3.654	0.627	0.095

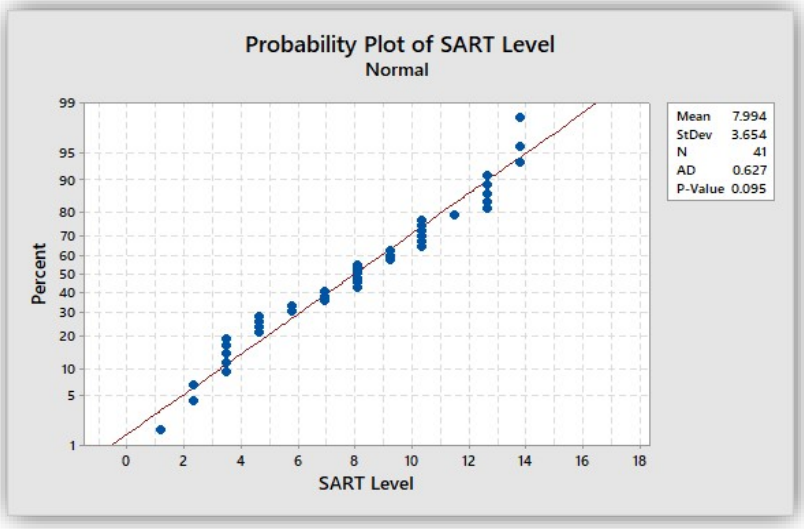

Figure 3. Normality Test Graph of SART of 41 Respondents

4.1 Spearman Correlation

The researchers used Correlation Analysis to show which of the independent variables affects the dependent variable. This analysis will also show how strongly the independent and dependent variables are related. The researchers will use Spearman correlation to measure the degree of relationship between the variables.

The tabulated data below indicates the correlation coefficient and strength obtained through the practice of Minitab. The result descends from positively strong correlation to negatively strong correlation.

It shows the obtained factors that considered as positively weak correlation, factors that considered as positively moderate correlation, factors that considered as positively strong correlation, factors that considered as negatively weak correlation, factors that considered as negatively moderate correlation and factors that considered as negatively strong correlation to the variation of the dependent variable as well as their p-value with the use of Minitab software. A positive correlation indicates that a certain factor is directly proportional while Negative correlation indicates that a certain factor is inversely proportional with the sustained attention level of the workers.

Table 3. Minitab - Correlation Result

	FACTORS	P-VALUE
POSITIVELY WEAK CORRELATION	BMI	0.237
	Working Hours	0.247
	Transportation Time	0.317
	Employee Satisfaction	0.210
	Sleep Quality	0.284
POSITIVELY MODERATE CORRELATION	Age	0.448
	Motivation	0.617
	Stress	0.588
	Temperature	0.496
	Lighting	0.588
POSITIVELY STRONG CORRELATION	Working Years	0.854
	Fatigue	0.928
NEGATIVELY WEAK CORRELATION	Gender	-0.203
NEGATIVELY MODERATE CORRELATION	Workload	-0.408
NEGATIVELY STRONG CORRELATION	Noise	-0.724

4.3 Multiple Regression Analysis

Table 4. Minitab Result – Multiple Regression

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Source           DF  Adj SS   Adj MS  F-Value  P-Value
Regression        4   365.59   91.397    19.52    0.000   BMI
1   52.87   52.868    11.29    0.002   workload         1
17.95   17.946     3.83    0.058   Noise            1  260.30
260.303   55.59    0.000   working years   1   20.48   20.485
4.37    0.044
Error            36  168.57    4.683
Total            40  534.16
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The tabulated data above shows the three significant factors affecting the sustained attention of the pharmaceutical production workers. The outcome was obtained through the aid of Multiple- regression in Minitab. As per the result, body mass index, working years and noise got a p-value lower than 0.05. Consequently, these three factors are considered as significantly affecting the sustained attention of the respondents.

Table 5. Minitab – Multiple Regression Model

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Model Summary

      S    R-sq  R-sq(adj)  R-sq(pred)
2.16392  68.44%     64.94%      58.35%
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The result from Minitab Multiple Regression shows the Analysis of variance which is analyzed to identify the significant factors affecting the sustained attention. It is manifested above that the value of r-squared (R^2), r-squared (R^2) adjusted, and r-squared (R^2) predicted are sixty-eight-point forty-four percent (68.44%), sixty-four-point ninetyfour percent (64.94%), and fifty-eight-point thirty-five percent (58.35%) respectively. A high obtained r-squared (R^2) value is believed to be more reliable in terms and precise

Table 6. Minitab –Variance Inflation Factors

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Coefficients

Term              Coef  SE Coef  T-Value  P-Value   VIF
Constant         43.07     4.11    10.47    0.000 BMI
-0.3008   0.0895   -3.36    0.002  1.12 workload      -
0.0543   0.0278   -1.96    0.058  1.08 Noise         -
0.3037   0.0407   -7.46    0.000  1.08 working years
-0.452    0.216   -2.09    0.044  1.11
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The VIF-Value implies whether the data have a high multicollinearity. As shown in Table 9, it was determined using the variance inflation factor formula. Through the use of Minitab 17 software, these factors –BMI, workload, noise, working years were identified as significant results to a VIF value of 1.12, 1.08, 1.08 and 1.11 respectively. It was interpreted having no multicollinearity among factors which means the data is in good shape and can proceed to regression.

5. Conclusion

The researchers applied an ergonomic approach in order to recommend a solution to improve the sustained attention level of pharmaceutical production workers. Obtaining the basic information from the respondents is necessary to come up with a beneficial and appropriate recommendation that will not only improve the workers' sustained attention but also lessen the quantity of non-conforming medicines which also varies with the cost of the company, enhance the performance of production workers, and increase the productivity and profit of a pharmaceutical company in the Philippines. The collected data were found to be normally distributed with the use of the statistical tool, having a pvalue of 0.095 which is greater than the alpha level of 0.05. Through the aid of Multiple Regression in Minitab, three factors were found to be significantly affecting the sustained attention of the production workers namely: body mass index (BMI), working years and noise having a p-values of 0.02, 0.044 and 0 respectively. Body mass index and working years were found to be positively correlated to the dependent variable that is Sustained Attention to Response Task (SART) Level. On the other hand, the noise was found to be negatively correlated to it. This relationship of the significant factors to the dependent variable implies that when it is negatively correlated, it means that the pair is inversely proportional with each other and if it is positively correlated to each other, both are directly proportional with one another. To expound, working years contributes a huge impact to the changes of sustained attention level.

As the respondents' years of working increases, the familiarity with tasks also increases resulting to a high probability of fewer errors when it comes to working. Expanding the years, they have been working shows that they are satisfied with their job. This proves that experiencing constant satisfaction with the scope of activities have an impact on the quality of work-related actions, work environment and social relations. As per the body mass index, as calculated, there is a weak effect with the attention level. The changes it exerts was enough to see the variation of the attention level it resulted. To interpret, the normal the body mass index is, the better the sustained attention level. Furthermore, it was assessed that as the noise increases, the sustained attention level decreases. Noise affects the concentration that the brain provides. This results in deflecting of sustained attention level when focusing on the assigned job.

6. Recommendation

After a direct observation and data collection from production workers experiencing low attention level in the Philippines, the researchers found out that the significant factors affecting the sustained attention level are body mass index, noise and working years. These factors have a significant impact in producing medicines resulting to a high number of non-conformity products. The researchers will recommend an ergonomic solution to enhance the sustained attention level of the workers that will result to lesser quantity of non-conformity products being produced by the company. (a) The company should execute and organize seminars and workshops discussing the significance of an individual's sustained attention to their work. It is also vital to inform them of how much attention they should put in their assigned tasks. With these seminars and training, the workers will be able to regulate their workload and do their jobs properly and efficiently. The company could require their workers to attend a workshop called "Attention to Detail Workshop" depending on the time available for the workers. It is a two (2) to four-hour (4) workshop with exercises and lessons about attention to detail and five (5) fundamental elements as well as discussion and practice regarding how you can improve your attention whether individual or organizational. This workshop can be delivered at the location of the company's choice, whether in an event or at a conference or training facilities. (b) In terms of improving their attention span, the company may also suggest a proper exercise to improve the attention of the workers. Lotus pose from yoga helps in improving the concentration of an individual, moreover, "Name that Colour test" exercise is used in neuropsychological evaluations to measure mental flexibility and help to train one's attention and concentration as well. One's attention can also be developed with reading long stuff slowly such as novels, books, articles and journals –it is claimed that reading can help boost and gain people's sustained attention since books work for the circulation of the memory and brain. Reading increases the work capacity of the working memory including the visual, auditory processes, phonemic awareness, fluency, and comprehension and so, it increases the attention span of the reader. (c) Nonetheless, working years also contributes to the changes in an individual's attention level in their work. It is claimed that being well-learned and familiar to tasks gives a significant impact on an individual's working performance. This will result to a high probability of fewer errors in the job. The company should consider the length of years the workers have been working –because it is also a factor of how a worker is well-trained and know the job well. This will result to less quantity of non-conformity products. (d) In addition, the researchers recommend having a certain place or room for every process that uses machines. Noise provides an impact to the production workers' attention level resulting in the change in concentration while doing their assigned work.

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