

ENVIRONMENTAL ERGONOMICS AS CORRELATE OF JOB PERFORMANCE OF EMPLOYEES IN SELECTED WORKPLACES IN LAGOS, NIGERIA

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Abstract

A factory or a workshop is often configured to maximize employees' interaction and collaboration in order to become an integral part of every workday. It is noted that factors like office or factory design, machinery and workshop tools, workspace availability, light intensity, weather, temperature ventilation, humidity, noise, vibration, hygiene and welfare facilities which are ergonomic factors affect performance and productivity of employees. It is against this background that this research looked into the correlation between environmental ergonomics and office employees. The descriptive survey research design of ex-post facto type was used for the research. A multi-stage sampling technique was used for the study. First, a purposive sampling technique was used to select all the office staff of Winners Golden Chance Venture Limited, Sheraton Hotel Ltd, and Bradford Pharmaceutical Company all in Lagos state. Secondly, the office staffs were clustered into senior, junior and casual workers. Three hundred (300) respondents took part in the research. A questionnaire tagged "Environmental Ergonomics and Job Performance Questionnaire (EEAJPO)" ($r = 0.86$) was used for data collection for the five hypotheses raised. Demographic variables were analyzed using frequency counts and percentages while Pearson Product Moment Correlation (PPMC) was used to analyse the research hypotheses at 0.05 level of significance. Finding showed that there was a positive significant correlation between room temperature and job performance ($r = .299$, $n = 300$, $p < 0.05$); there was a positive significant correlation between indoor air quality and job performance ($r = .365$, $n = 300$, $p < 0.05$). It was revealed that there was a positive significant correlation between illumination and job performance ($r = .526$, $n = 300$, $p < 0.05$); and that there was a positive significant correlation between noise and job performance ($r = .845$, $n = 300$, $p < 0.05$). It also showed that there was a positive significant correlation between furniture/tools and job performance ($r = .260$, $n = 300$, $p < 0.05$). It was recommended that Industrial Social Workers should advocate with decision-makers in the workplace to plan new work processes with the knowledge of ergonomics principles so as to

reduce or eliminate job risks in order to improve job performance and the sustenance of the workplace.

Key Words: *Environmental ergonomics, job performance, employees, workplaces*

Introduction

Features of an office such as people, building space, equipment, furniture and the environment, must fit together well for workers to feel healthy and comfortable and to be able to work efficiently and productively. The performance study of office workers' productivity is necessary for productivity improvement in a developing economy, like Nigeria (Vimalanathan & Ramesh, 2017). A factory or a workshop is often configured to maximize employees' interaction and collaboration in order to become an integral part of every workday (Yankson, 2012). It is noted that factors that affect performance and productivity arise from the work premises which include: office or factory design, machinery and workshop tools, workspace availability, light intensity, weather, temperature ventilation, humidity, noise, vibration, hygiene and welfare facilities (Ajala, 2012; Humphries, 2005; Veitch, Charles, Newsham, Marquardt & Geerts, 2004). Roelofsen, (2002) established that improving the working environment leads to a reduction in the number of complaints and absenteeism, but it results in an increased productivity. However, working conditions in many organizations may present lack of safety, health and comfort issues such as improper lightening and ventilation; and excessive noise (Leblebici, 2012). Employees working under undesirable workplace conditions might turn out to be less productive. This may be so as the employees have to contend with many hazards and other issues that endanger their safety such as excessive

noise, operating on dangerous/complex machines and conditions that cause injury to employees (Yankson, 2012). Therefore, there is the need to study the effect of ergonomic factors on the performance, health and productivity of office workers.

Ergonomics as a concept is initially introduced by Jastrzebowski in 1850s in his book titled "The Science of Work". It is, generally, defined as a study of fit between tools and workplace designs and their respective users to ensure that tasks could be carried out efficiently and safely (Wilson, 2014). According to International Ergonomics Association (2015), ergonomics could be categorized into physical, cognitive and organizational ergonomics. Physical ergonomics refers to human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity, which include posture, material handling, repetitive movements, musculoskeletal disorders, workplace layout, safety and health. Cognitive ergonomics is related to mental processes such as perception, attention, and reaction as it involves human interaction and other elements in a system. Cognitive ergonomics includes mental workload, decision making, human-computer interaction, work stress and training. Organisational ergonomics, on the hand, focuses on optimization of subsystems such as organizational structure, mission and processes. Organisational ergonomics involves communication, human resource management, work design, working hours and teamwork, new work paradigm, virtual organisation and quality management.

Vimalanathan and Ramesh (2017) in their study found a distinct group from the occupational ergonomics and called it environmental ergonomics with specified consideration for room temperature, illumination, noise and indoor air quality. Since employees spend 80-90% of their time in office indoors, indoor environment has important effects on human health and work efficiency (Vimalanathan & Ramesh, 2017). The factors affecting indoor environment mainly include temperature, relative humidity, indoor air quality, illumination, ventilation (Graudenz, Oliveira, Tribess, Mendes, Latorre & Kalil, 2005). Also, Wong, Mui, & Hui (2008) identified room temperature, indoor air quality, noise and illumination as factors having effects on overall performance, health and productivity of office workers.

Very low and very high indoor room temperature and humidity can dissatisfy the workers and also create health problems. Air conditioned office aims to provide a thermally accepted environment for office worker's comfort and health. Niu (2014) stated that thermal comfort is affected by many factors, which mainly include air temperature, air humidity, air velocity, mean radiant temperature, human clothing, and activity levels. The control of local thermal environment is needed for the comfort and satisfaction of workers. Fountain, Brager, de Dear (1996); Leaman, & Bordass, (2000) found that the control of room temperature is one of the main issues that improved the working condition and productivity. Skyberg, Skulberg, Eduard, Skaret, Levy, et al. (2003) found that the degree of perceived control of room temperature influenced satisfaction of workers with the indoor environment and subsequent job performance. Also, productivity loss can be minimized by achieving the improved

thermal comfort (Kosonen, & Tan, 2004). Fisk and Rosenfeld (1997) found that improved thermal environmental increased employees' productivity. Lan, Lian, and Pan, (2010) found that thermal discomfort caused by high or low air temperature had a negative influence on office workers' productivity. Mak, and Lui, (2012) found that sound and temperature were the principal factors affecting employees' office productivity. Berglund, Gonzales, and Gagge (1990) also found that performance of employees reduces over a range of increase in indoor room temperature.

Also, indoor air quality is probably the most important aspects of environmental ergonomics but has been relatively overlooked. Employees spend more than eight hours per day working inside buildings. Therefore, poor indoor air quality will not only reduce their productivity, but also contribute to higher medical costs. In the developing countries, indoor air quality is claimed to be major cause of allergies, other hypersensitivity reactions, airway infections, and cancers (Sundell, 2004). Indoor air quality negatively impact employees' physical health such as asthma exacerbation, respiratory allergies and complications (Sundell, 2004). Bruce, Perez-padilla, and Albalak (2000) confirmed that indoor air pollution had significant effect on the health of employees in developing countries. Employees who are exposed to various types of pollutants including gaseous particles, tend to increase their health risks which consequently affect their productivity and performance (Yu, Hu, Liu, Yang, Kong, & Liu, 2009; Bernstein, Alexis, Bacchus, Bernstein, Fritz, Horner, Li, Mason, Nel, Oullette, Reijula, Reponen, Seltzer, Smith, & Tarlo, 2008). Roelofsen (2002) found that 10% of office worker's productivity increased by achieving the improved indoor

environmental quality. So also, indoor environmental quality influences office worker's productivity (Li, Wargocki, & Zhiwei (2011). Charles, Reardon, & Magee (2005) found that indoor air quality and thermal comfort are most important factors for the worker's performance, satisfaction and well-being. It is found that productivity of employees can be maximized by achieving improved indoor environmental quality and climate (Skaret, 1992).

Furthermore, the effect of increased or decreased illumination affects the job performance of employees as well as their psychological and biological well-being. Henri, Marius, and Tenner (2007) stated that proper lighting was an important factor that has influence on the productivity and performance of workers. Dianat, Sedghi, Bagherzade, Jafarabadi, & Stedmon, (2013) found that lighting is vital to improve employees' performance as well as improve their health. Lighting, ergonomic furniture, and other factors have been found to have positive influence on employees' health and consequently on employees' job performance (Ajala, 2012; Dilani, 2004; Milton, Glencross & Walters, 2000; Veitch & Newsham, 2000). Furthermore, Ajala (2012); Ajala & Adediran (2014); and Moloney (2011) confirmed the importance of natural light and room temperature to workers' productivity.

It is also noted that noise affects the performance of employees. Noise refers to unwanted sound, outside the comfortable hearing range of humans. Noise originates from various sources, such as workplace machineries, office equipment, appliances and electronic devices and could affect both the physiological and psychological comfort of employees (Stansfeld & Matheson 2003; Passchier-Vermeer & Passchier 2000). Studies have found that noise influences

productivity (Kirk, 1998), employee's concentration (Banbury & Berry, 2005) and performance (Siskova & M. Juricka, 2013). Sundstrom, Town, Rice, Osborn, and Brill, (1994) found that disturbance by noise correlated with dissatisfaction with the environment and job which subsequently affects performance. Banbury and Berry (2005); Mak and Lui (2012) found that noises from conversation, ringing phones, machines, background noise, closing doors, and human activity, as well as those coming from both inside and outside the office easily influence low-productivity of employees.

Incorporating key ergonomics principles and practices into the design and selection of furniture and equipment is germane to minimizing the likelihood of musculoskeletal injuries and enhancing productivity. Furniture and tools design affect employees' health (especially musculoskeletal related illnesses), stress level and performance (Westgaard & Winkel, 1997; Yeow & Nath Sen, 2003). Hameed and Amjad, (2009) found that comfortable and ergonomic office design enhanced employees' performance. Also, Saleem, Shah, Zaman, Arif, Shehzad, and Ullah, (2012) affirmed that office design is very vital in terms of enhancing employees' productivity, and as such, comfortable and contented office design influences the employees to increase their performance. Asante (2012) found that ergonomic elements such as office design and furniture were negatively affecting the performance of employees.

The effect of the aforementioned factors brings to mind the efficiency and productivity of employees. In line with the review of the above literature, this paper focuses on the environmental interface of workplace which includes indoor air quality, lighting, noise, furniture and tools and room

temperature on the job performance of office employees in the workplace.

Statement of the problem

The performance observation of employees in Nigeria shows that the rate of absenteeism, increase in medical expenses by both workers and employers, have been associated with factors arising from workplace environmental factors. It is noted in Nigeria that factors that affect performance and productivity arise from the work premises such as office or factory design, machinery and workshop tools, workspace availability, light intensity, weather, temperature ventilation, humidity, noise, vibration, hygiene and welfare facilities. Employees working under undesirable workplace conditions turn out to be less productive. Therefore, there is the need to study the effect of ergonomic factors on the performance, health and productivity of office workers in Nigeria. The following hypotheses were raised and tested.

Research Hypotheses

1. There is no significant correlation between room temperature and job performance of office employees at workplace.
2. There is no significant correlation between indoor air quality and job performance of office employees at workplace.
3. There is no significant correlation between illumination and job performance of office employees at workplace.
4. There is no significant correlation between noise and employees job performance of office employees at workplace.
5. There is no significant correlation between furniture and tools design and job performance of office employees at workplace.

Methodology

The descriptive survey research design of *ex-post facto type* was used for the research. The descriptive design of *ex-post facto type* entails careful collection of data from the subjects of the study without manipulating any independent variable when finding its effect or outcome on any dependent variable. The study population comprises all office employees of firms within the service industry in Lagos State, Nigeria. The target population is the office employees in Winners Golden Chance Venture Limited, Sheraton Hotel Ltd, and Bradford Pharmaceutical Company. A multi-stage sampling technique was used for the study. First, a purposive sampling technique was used to select all the office staff of Winners Golden Chance Venture Limited, Sheraton Hotel Ltd, and Bradford Pharmaceutical Company in Lagos State. Secondly, the office employees were clustered into senior, junior and casual workers. A total of three hundred and thirty respondents were selected to take part in the research.

A questionnaire tagged “Environmental Ergonomics and Job Performance Questionnaire (EEAJPQ)” was used for the research. The questionnaire comprised three sections. Section A: This measured demographic variables such as sex, age, work experience and job category. Section B: This consisted of fifteen (15) items measuring the office ergonomic: room temperature, indoor air quality, lighting, noise, furniture and tools rated on a 4-point rating scale of Strongly Agree to Strongly Disagree. Items were adapted from Hedges, (2007) “Cornell Ergonomic Seating Evaluation v 21 Administration Instructions” and University of Aarhus (2008) “Physical-Ergonomic Workplace Evaluation”. Section C: This measured job

performance using ten (10) items. The performance rating scale was adapted from Goodman and Svyantek (1999) "Person-Organisation Fit and Contextual Performance". The items were rated on 5 point Likert Scale ranging from "Major improvement needed" to "Consistent Exceeds Expectation". The reliability of the research instrument was tested through a pilot test carried out among thirty (30) randomly selected participants from office employees of some companies in Ibadan. A

reliability coefficient value of 0.86 was obtained. Of the three hundred and thirty administered questionnaires, three hundred were returned and found usable for data analysis. Demographic variables were analyzed using frequency counts and percentages while Pearson Product Moment Correlation (PPMC) was used to analyse the research hypotheses at 0.05 level of significance.

Results and Discussion of Findings

TABLE 1: Analysis of Demographic Characteristics of respondents

VARIABLE		Respondents (%)
SEX	Male	126 (42.0%)
	Female	174(58.0%)
	Total	300(100%)
AGE	18 – 25	78 (26.0%)
	26 – 35	125 (41.67%)
	36– 45	65 (21.67%)
	46 and above	32 (10.67%)
	Total	300(100%)
WORK EXPERIENCE	Less than 10	217 (72.33%)
	11 – 15	47 (15.67%)
	16 -20	27 (9.0%)
	Above 21	9 (3.0%)
	Total	300(100%)
Job Categorisation	Senior	157 (52.34%)
	Junior	118 (39.33%)
	Casual	25(8.33%)
	Total	300(100%)

The statistics shown in Table 1 revealed that 124(41.33%) of the respondents were males while 176(58.67%) were their female counterparts. This shows that there are more females in this study than males showing a reflection of the nature of service industry. Furthermore, data collected

showed that 78(26.0%) of respondents were within the age bracket of 18-25 years, while 125(41.67%) respondents were within the age bracket of 26-35 years. Also, the table revealed that 65(21.67%) respondents were within the age bracket of 36-45 years and 32 (10.67%) of respondents were within 45 and

above years. The implication of this age distribution is that they were all matured and within the main work force supply range. In case of work experience, the study discovered that 217(72.33 %) of the respondents had less than 10 years work experience, while 47(15.67%) respondents had 11-15 years work experience. The data further revealed that 27(4.0%) respondents had 16-20 years work experience and 9(3.0%) respondents had 21 and above years

work experience. In the area of job categorisation, Table 1 revealed that 157(52.34%) were senior staff category, 118(39.33%) were in the junior category while 25 (8.33%) were casual workers.

Results

Hypothesis One: There is no significant correlation between room temperature and job performance by employees

Table 2 Showing correlation between room temperature and job performance by employees

Variables	Mean	Std. Dev.	N	R	P	Remark
Room Temperature	8.7833	1.9681	300	.299	.000	Sig.
Job Performance	28.4800	6.2786				

Table 2 showed that there was a positive significant correlation between room temperature and job performance ($r = .299$, $n = 300$, $p < 0.05$). The null hypothesis is rejected meaning that room temperature has significant influence on job performance of employees. The finding is in line with the finding of Brager, de Dear, 1996; Leaman, & Bordass, (2000) that controlled room temperature improves the working condition and productivity of workers. Also, the finding confirms the finding of Skyberg, Skulberg, Eduard, Skaret, Levy, et al. (2003) that the degree of perceived control of room temperature influences satisfaction of workers with the indoor environment and subsequent job performance. Furthermore,

the finding is line with the finding of Kosonen and Tan, (2004) that productivity loss is minimized by achieving the improved thermal comfort. Similarly, this finding corroborates the finding of Ajala (2012); Ajala and Adediran (2014); Moloney (2011) that room temperature has a significant influence on workers' performance and productivity. The finding further confirms the finding of Lan, Lian, and Pan, (2010) that thermal discomfort caused by high or low air temperature has a negative influence on office workers' performance and productivity.

Hypothesis Two: There is no significant correlation between indoor air quality and job performance by employees

Table 3 Showing correlation between indoor air quality and job performance by employees

Variables	Mean	Std. Dev.	N	R	P	Remark
Indoor Air Quality	9.4933	1.8855	300	.365	.000	Sig.
Job Performance	28.4800	6.2786				

Table 3 showed that there was a positive significant correlation between indoor air quality and job performance ($r = .365$, $n = 300$, $p < 0.05$). The null hypothesis is rejected, meaning that indoor air quality has significant influence on job performance of employees. This finding is in line with the findings of Yu, Hu, Liu, Yang, Kong, & Liu, (2009); Bernstein, Alexis, Bacchus, Bernstein, Fritz, Horner, Li, Mason, Nel, Oullette, Reijula, Reponen, Seltzer, Smith, & Tarlo, (2008) that exposure of employees to various types of pollutants including particles and gaseous increases their health risks and consequently affects their productivity and performance. Also, the finding confirms the finding of Roelofsen

(2002) that office workers' productivity increases by achieving the improved indoor environmental quality. The finding further confirms the finding of Li, Wargocki, and Zhiwei (2011) that indoor environmental quality influences office workers' productivity. Similarly, this finding corroborates the finding of Charles, Reardon, & Magee (2005) that indoor air quality significantly affects workers' performance. Therefore, productivity of employees can be maximized by achieving improved indoor environmental quality and climate (Skaret, 1992). Improved indoor environmental quality achieves job satisfaction and retention of employees (Carlopio, 1996).

Hypothesis Three: There is no significant correlation between illumination and job performance by employees

Table 4 Showing correlation between indoor illumination and job performance by employees

Variables	Mean	Std. Dev.	N	R	P	Remark
Illumination	9.3433	2.0213	300	.526	.000	Significant
Job Performance	28.4800	6.2786				

Table 4 showed that there was a positive significant correlation between illumination and job performance ($r = .526$, $n = 300$, $p < 0.05$). The null hypothesis is rejected meaning that illumination has significant influence on job performance of

employees. The result of the finding is in line with the finding of Henri, Marius, and Tenner (2007) that proper lighting has influence on the productivity of employees. Also, the finding corroborates the finding of Dianat, Sedghi, Bagherzade, Jafarabadi, and

Stedmon, (2013) that lighting is vital to improve employee's performance as well as their health. The finding also confirms the finding of Ajala (2012); Dilani, (2004); Milton, Glencross and Walters, (2000); Veitch and Newsham, (2000) that lighting is

not only vital to improve employees' performance but their health as well.

Hypothesis Four: There is no significant correlation between noise and job performance by employees

Table 5 Showing correlation between noise and job performance by employees

Variables	Mean	Std. Dev.	N	R	P	Remark
Noise	9.3467	1.9267	300	.845	.000	Sig.
Job Performance	28.4800	6.2786				

Table 5 showed that there was a positive significant correlation between noise and job performance ($r = .845$, $n = 300$, $p < 0.05$). The null hypothesis is rejected meaning that noise has significant influence on job performance of employees. The finding is in line with the findings of Passchier-Vermeer and Passchier (2000); Stansfeld and Matheson (2003); Siskova and Juricka, (2013) that noise influences productivity and performance. Furthermore, the finding confirms the finding of

Sundstrom, Town, Rice, Osborn, and Brill, (1994) that disturbance by noise correlates with dissatisfaction with the environment and job which subsequently affects performance. Moreover, this finding corroborates the finding of Banbury and Berry (2005); Mak and Lui (2012) that noise influences low-productivity of employees.

Hypothesis Five: There is no significant correlation between furniture/tools and job performance by employees

Table 6 Showing correlation between indoor furniture/tools and job performance by employees

Variables	Mean	Std. Dev.	N	R	P	Remark
Furniture/Tools	7.3333	2.2042	300	.260	.000	Significant
Job Performance	28.4800	6.2786				

Table 6 showed that there was a positive significant correlation between furniture/tools and job performance ($r = .260$, $n = 300$, $p < 0.05$). The null hypothesis is rejected meaning that furniture/tools have significant influence on job performance of

employees. The finding confirms the findings of Westgaard and Winkel, (1997); Yeow and Nath Sen, (2003) that furniture and tools design affect employees' health, stress level and performance. Also, the findings confirm the finding of Hameed and

Amjad, (2009) that comfortable and ergonomic office design enhance employees' performance. Similarly, this finding corroborates the finding of Saleem, Shah, Zaman, Arif, Shehzad, and Ullah, (2012) that office design enhances employees' productivity and performance. This finding is in line with the finding of Ajala, (2012); Dilani, (2004); Milton, Glencross and Walters, (2000); Veitch and Newsham, (2000) that ergonomics furniture has positive influence on employees' health and consequently on employees' job performance.

Conclusion

From the above analysis, ergonomics greatly benefit the productivity of employees in Winners Golden Chance Venture Limited, Sheraton Hotel Ltd, and Bradford Pharmaceutical Company. The provision of environmental ergonomics in terms of room temperature, indoor air quality, illumination, noise and the design of furniture and tools are significantly central to office employees' performance and improvement of productivity level which will eventually sustain the existence of both the organisation and the employees.

Recommendations

1. Management, Supervisors and Industrial Social Workers should ensure that they neutralize distracting noise from employees by using ear plugs, playing soft music, or turning on fan. This will ensure concentration and improved job performance.
2. Management, Supervisors and Industrial Social Workers should maintain a comfortable workplace temperature by using layers of clothing or a fan. This provision will allow employees to adapt to friendly workplace environment and ensure better job performance.
3. Industrial social workers should work with decision-makers in the workplace to plan new

work processes with the usage of knowledge of ergonomics principles so as to reduce or eliminate job risks.

4. Industrial social workers should advocate with organisations management to provide comfortable working environment in terms of proper lighting, good air quality for employees so as to save them from reaching burnout stage soonest. The enhancement of improved general working environment within the workplace will make employees happy and comfortable for the full utilisation of their potential in the workplace.

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