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RESEARCH ARTICLE

THE IMPACTS OF BODY POSTURE ON OFFICE WORKERS HEALTH: HEART RATE AND BLOOD PRESSURE

[1]Hussein G. Bakheet and [2,*]Hani H. Alnakhli

[1]Human Factors Engineering
[2]Physical Therapy Consultant, Madinah General Hospital

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ABSTRACT

Recent data has shown increasing rates of disorders among the working community. These health-related complications are considered to be amongst the leading causes of disability within modern office workers. Many of these disorders are commonly caused by improperly accommodated or designed workplaces. However, these related disorders have not yet received the required attention in the Saudi Arabian working community. The importance of this study surfaces around the challenges that might be faced during the implementation of Saudi vision's 2030. The study aims to detect and prevent office related health issues by investigating their associations with improper workstation ergonomics. This was conducted within the framework of studying the current situation of office ergonomics with focus on sitting postures and mental workload. Proper design and healthy practices of the workstation were then advertised to minimize disabilities. The study conducted two randomized crossover trials (within-subjects trials) consisting of twenty-four individuals. These trials hypothesized that there will be significant variations of the subjects' heart rates and blood pressures in accordance with different sitting postures and mental workload. After filtering and analyzing the collected data, sitting posture was found to have a statistically significant effect on both the heart rate, and mean arterial pressure; their averages were decreased after the intervention by 4.08_{bpm} and 7.42_{mmHg}, respectively. Also, the mental workload was found to have statistically significant effects on the studied vital signs, as the average heart rate, and mean arterial pressure of the subjects differenced by 4.25_{bpm} and 3.14_{mmHg}. In conclusion, raising the awareness of the population regarding the importance of workplace ergonomics is proposed; after highlighting the risks of awkward sitting postures and psychological comfort. It is worth mentioning that the appropriate employment of office ergonomics requires the cooperation of both; employees and employers. Only by this alliance, ergonomics will contribute in increasing productivity, maintenance of healthy individuals, and maximizing organizations profits.

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INTRODUCTION

Recent data have shown increasing rates of disorders and psychological breaks amongst the working community (Hsin-Yi Kathy Cheng, 2016). Such disturbances include, low back pain, elevated blood pressure, and psychological stress (Wahlström, 2005; RolandZemp, 2016). Many of these complications can be caused by a workstation that is improperly set-up or occupied. Office-based work has no exception of having occupational risk factors in the development of physical injuries or mental breaks, even with its genesis of confined motion nature (Morten Wærsted et al., 2010).

Corresponding author: **Hani H. Alnakhli,**
Physical Therapy Consultant, Madinah General Hospital.

Thus, there is an assertiveness on balancing between dynamic activities and performing office-work tasks (Wim Grooten, 2014). With workers experiencing concurrent occupation of workstations and mental demands in their daily jobs, it is clear that these exertion types affect their overall task achievements and productivity, not to mention the associated increase of expenses cost; if the work environment, is not properly designed (Vimalanathan, 2017; Wilson, John, 2000). Ergonomic seeks to prevent and reduce such deficiencies along with their associated health-care costs by studying the relationship between the workplace and workers; in order to improve comfort and overall efficiency; as it has been proven that practicing good ergonomics increases productivity, improves health and safety, and raises job satisfaction of workers (Wilson, John, 2000).

Objective

It has been acknowledged that psychological and physiological pain can generate injuries, which may eventually lead to disability and limitation of one's normal activities, if not properly addressed in a timely manner (Ming-Lun Lu, 2014; Stanyar, 2014). The purpose of this research was to study and minimize office work-related pain and subsequently injuries and disabilities; by employing, where applicable, proper ergonomics techniques that concerned cognitive and physical ergonomics; represented by mental workload and body postures ergonomics. This scope was set due to the paucity of research studies on the population of office workers in Saudi Arabia.

METHODOLOGY

The relationship between mental workload and workers' health are to be determined, and the current situation of office ergonomics and practices must be defined, in order for this research study to successfully achieve its objective. Therefore, conducting a randomized crossover trial was considered a method of interest for the prosperity of this research study. The details of this method was executed as follows:

Randomized Crossover Trial: In this study, two randomized crossover trials (within-subjects trials) was conducted to evaluate the effects of mental workload and body posture, separately, on the heart rate and blood pressure (which will be referred to as vital signs). Hence, twenty-four subjects were randomly chosen to participate in these two experiments, which resulted in ninety-six measurements. The details are as follows:

PROCEDURES

Sitting Posture Trial: In this trial, the subjects were asked to perform their daily sitting habits, and their vital signs were recorded twice. Between each recording, a period of ten minutes was taken into account. The average of these records was computed and considered pre-intervention (awkward sitting posture) results. Then, the subjects were given a washout period of thirty minutes after taking part in an awareness session on how to ergonomically occupy their workstations. The subjects were asked to apply what was advertised in the awareness session, then their vital signs were also recorded twice and the average of these records was computed and considered post-intervention.

Mental Workload Trial: The subjects of this trial were observed during their normal working day and their vital signs were recorded twice during the observation and considered pre-intervention results. After a thirty minutes period, their superiors were instructed to overload them with work; in an attempt to induce acute mental stress. The subject's vital signs were also recorded twice during this stage and the average was computed and compared with the pervious stage's results. The recorded measurements of these trials were analyzed using Paired Samples T-test to draw the conclusions.

Subjects

The first within-subject trial was designed to examine the correlations between the subjects' sitting habits and their vital signs, while the second trial concerned with the correlations of mental workload on the vital signs. Twelve healthy subjects (six female and six male) participated in each trial and were randomly assigned to one of the two trials. Their demographics are summarized in (Table 1).

Data analysis: Statistical analysis involved the calculation of means and standard deviations, where applicable. Due to the type of data collected, Paired t-test was used to determine whether the difference between two means is statistically significant. Statistical analysis was performed using PASW Statistics version 18.0.0 (2009) (SPSS, Inc., Chicago, IL), and Microsoft Excel 2010 (Microsoft, Redmond, WA). The level of significance was set top≤ 0.05.

RESULTS

Impact of Sitting posture on Vital Signs: Both the heart rate and mean arterial pressure were found to be significantly affected by sitting postures ($p < .01$). The trial revealed that the average heart rate of all twelve subjects before intervention was 77.83_{bpm}, with male average of 78.3_{bpm} and female's at 77.3_{bpm}.After the intervention, the overall average was reduced by 4.08_{bpm}(the male and female averages were reduced by $3_{bpm}$and 5.13_{bpm}, respectively). Further, the mean arterial pressure average was recorded at 98.56_{mmHg}, and after the intervention dropped to 91.14_{mmHg}. The male mean arterial pressure average before intervention was 98.8_{mmHg} and the female's 97.3_{mmHg}, where both of them dropped to 93.1_{mmHg} and 89.2_{mmHg}, respectively.

Impact of Mental Workload on vital signs: The mental workload was also reported to have statistically significant effects on both of the studied vital signs ($p < .05$). The average heart rate and mean arterial pressure under normal workload were recorded at 71.75 $_{bpm}$ and 90.56_{mmHg}, respectively, both of which had jumped to 76_{bpm} and 93.69_{mmHg} after inducing acute workload. The male heartbeat increased by 4.2 $_{bpm}$ after inducing stress on them while the female increased by 4.33 $_{bpm}$. The male's mean arterial pressure had increased by 2.6_{mmHg} and the female's increased by 3.7_{mmHg}).

Table 1. Demographic data of the participants

Demographic	Male	Female	Overall
Average Age	31.8	28	29.9
Average Height	171.5	165.8	168.7
Average Weight	82.2	55.3	68.75
Average BMI	25.5	20.1	22.8

DISCUSSION:

In this research study, it was confirmed that sitting positions affect an individual's heart rate. However, it is possible to control this change by practicing good ergonomics, and healthy sitting habits. The results of this trial were in alignment with previous researches. For example, Anderson et al. identified that "A significant difference was found to suggest there is a difference in heart rate as a result of the different poses". They also stated that "Significant differences were found in the systolic and diastolic blood pressures indicating that the differences seen between the poses were not due to random chance" (Ryan Anderson). Even though, this research cannot aver that neither long period sitting nor awkward sitting postures leads to illness of the circulatory system, other

researches have suggested that there is evidence of such risk associated with excess sitting periods. Petersen et al. reported that their results "Suggest that a higher amount of daily total sitting time is associated with all-cause mortality", particularly among inactive adults. In relation to coronary heart disease, results were less clear. This paper adds new evidence to the limited data on the evidence of sitting time and cardiovascular disease and mortality (Christina Bjørk Petersen, 2014). Similarly, it has also been concluded by Chrysant et al's. that too much sitting can be lethal (Steven et al., 2015). Sitting posture affects the heart rate as well as the blood pressure, as per the findings of this research's experiments. It was theorized in the sitting posture trial that practicing good ergonomics would help prevent the abnormal acceleration of heart rate and blood pressure. Like any other trials, this trial has set considerable number of assumptions, where some were more significant than others. It was assumed that the subjects' stress level was of no existence. Subjects' history was assumed to be consistent across all individual and unremarkable. The subjects' means of transportation factor was assumed to have no effect; as all subjects were given a rest period of ten minutes before taking part in the trial. Dietary habits, such as drinking coffee prior or during the trial, may have artificially elevated the subjects' measurement values, however it was considered irrelevant to the trial's scope. These assumptions were used previously by Anderson R. et al. (2015).

With these assumptions being made, the trial conveyed its examinations to each individuals body position while occupying their workstation, since the sitting habits were found to be: sitting crossed legged, sitting with foot not supported on the floor, long sitting with heels supported on the ground, or sitting with deviation to one side. These findings led to the fact that there is a lack of knowledge when it comes to healthy practices in regards to ergonomics and human factors science.
The mental work trial had the same assumption as the sitting posture trial. It was evaluated to be having a statistically significant effect on the heart rate and blood pressure. Unlike the females, it was noted that the male mean arterial pressure average was high during their normal activities which supports Pickering's conclusion, who reported that "Blood pressure tends to be highest at work", where studies using ambulatory monitoring have shown that occupational stress, measured as job strain, can raise blood pressure in men, but not women (Pickering, 2010).

It is worth mentioning that the mental workload post-intervention stage wasn't exaggerated, and similar to the regular workload the subjects should have, suggesting that the workload in most of the Saudi environments can be easily handled. This study revealed that Workstation ergonomics and sitting postures were affecting the workers job satisfaction. If, for example, the workers do not feel comfortable with their chairs or desks, they would not be satisfied with their job. Our study verified this fact as was the case in Ikonne's study, who concluded that " Suitable workstation and equipment designs as well as condition of work posture are aspects of ergonomic factors that contributed significantly in attaining a higher level of job satisfaction"(Ikonne, Chinyere, 2014). Miles has also stated that "Good ergonomic designs have shown to improve employee well-being, satisfaction and productivity" (Miles, Angela Kennedy, 2000). It is safe to conclude that suitable workstations and equipment designs, as well as the condition of work posture, are aspects of ergonomic factors that contributed significantly in attaining a higher level of job satisfaction for the employees who spend long hours in front of computer screens (Ikonne, Chinyere, 2014; Miles, Angela Kennedy, 2000; Brief, 2002).

Limitations: This research study did not eliminate some uncontrollable factors; such as personal stress, psychological disorders, dietary habits, and other consumption related issues, in regard to the data collected in the randomized crossover trials.

Conclusion

In conclusion, raising the awareness of the population regarding the importance of workplace ergonomics is proposed; after highlighting the risks of awkward sitting postures and psychological comfort. It is worth mentioning that the appropriate employment of office ergonomics requires the cooperation of both; employees and employers. Also, instructions on how to properly occupy the given workplace is essential. Only by this alliance, ergonomics will contribute in increasing productivity, the maintenance of healthy individuals, and maximizing organizations profits.

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