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Application of Pressure Biofeedback Unit as Part of Ergonomics Assessment Tools for Assessing Back Pain among Computer Users

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ABSTRACT

The decrease in the back muscle strength, especially Transverse Abdominus (TrA) muscle can be an early symptom for the occurrence of back pain among individual. The Pressure Biofeedback Unit (PBU) was frequently used in the clinical setting to assess the TrA strength level among back pain patients. However, in the ergonomics setting, lack of studies available to look into the usefulness of the PBU to assess the back muscle strength level, especially the TrA among the working population who are having back pain symptoms. Therefore the current pilot study was conducted among ten computer users to look into the validity of the PBU in assessing the TrA strength level in identifying the early symptom of back pain. The validity of PBU results was compared with the Standardized Nordic Questionnaire results in identifying the back pain symptom among computer users. The chi-square analysis revealed that there was no any significant differences between PBU results and Standardized Nordic Questionnaire results in screening the early symptom of back pain. In conclusion, the current study revealed that the PBU can be an useful tool in the ergonomics assessment to identify the early symptom of back pain among computer users.

Key words: Back Pain, Ergonomics Assessment, Pressure Biofeedback Unit, Validity, Computer Users

1. INTRODUCTION

Recent research papers had identified that people with low back pain do encounter with neuromuscular dysfunctions and muscle fatigue [1]. Research into neuromuscular dysfunctions in people with low back pain had led to the extensive impairments in the deep trunk muscles around the spine joint especially in the Transverse Abdominus (TrA) muscle [2]. The TrA muscle is an important trunk muscle for the control of intervertebral movements and for the stability control of sacroiliac joint (SI) joint of pelvis [3]. Generally, the TrA muscle act as an independent muscle and commonly activated before movement of limbs and trunk [4]. However, in low back pain, the TrA muscle is delayed or reduced during the trunk movement, which compromise the stability of spine joint [4].

Past experimental studies had identified a significant loss of back muscle strength especially in the TrA muscle among low back pain subjects compared with those with no back pain [5, 6, 7]. A quasi-experimental study which has been conducted by Evans & Oldreive among the back pain subjects had found that the ability to control the TrA muscle unit was significantly reduced among back pain subjects compared to healthy subjects [5]. In addition to the above findings, another study which has been conducted by Hungerfors et al had found a delayed in the electromyography activity of the TrA muscles among low back pain subjects [8]. The delayed of muscle activity around the spine joint will lead to the failure in the stabilization of TrA muscle around the spine joint which eventually will increase the risk of getting back pain [8]. Therefore, the delayed movement of TrA muscle in an individual can be an early indicator for the development of low back pain.

In working population, low back pain is very common musculoskeletal disorders, whereby almost 70-85% of the working population were suffering from back pain at some point of time during their working phases [9,10,11]. The current prevalence rate of back pain among workers ranges

from 15% to 45% with the average prevalence rate of back pain among workers were almost 30% [10]. The ergonomists had used different type of approaches in order to reduce the occurrence of back pain among workers. One of the approaches is a continuous assessment of TrA muscle activity among the workers. In the ergonomics field, most of the researchers had used different type of direct measurement techniques such as electromyography and nerve conduction test to assess the TrA muscle activity [12]. However, the above-mentioned tools are extremely expensive and require technical expertise to perform the assessment. In addition, the procedures might be painful and uncomfortable for the workers [13]. An alternative technique that can be considered by the ergonomist to assess the back muscle activities (e.g. TrA muscle) among the workers might be the indirect measurement techniques such as a pressure biofeedback unit (PBU) [14]. The PBU is a tool developed to detect movements of the back muscles such as TrA in relation to an air-filled reservoir [15]. The use of the PBU can be an objective measure to evaluate the muscle contraction of deep abdominal muscles, specifically the TrA muscle [15]. In clinical practice, the PBU was proved to be a valid measurement tool to identify the presence or absence of low back pain among low back pain subjects [15]. However, in the ergonomics field, there were limited evidences available regarding the use of the PBU as part of ergonomics assessment tools in evaluating the early symptoms of back pain among industrial workers. Therefore, the objective of this study is to introduce a new tool as a part of ergonomics assessment tools, the PBU which is easier, cheaper and valid to assess the back muscle strength of back pain patients. A small case study was conducted among ten computer users in a manufacturing company to identify the validity of PBU in assessing the TrA muscle. This study hypothesized that the PBU can be used as an adjunct with an existing ergonomics assessment tools to evaluate the early symptom of back pain in a working population.

2. METHODOLOGY

A case study was conducted among ten computer users working in an office of a manufacturing company in Melaka, Malaysia. The workers who were having more than one year working experience with computer were included in the study. Workers who are suffering from abdominal surgeries, neurological diseases, having recent falls and fracture were not included in the study. The validity of the PBU in assessing back pain among the computer users were tested by using the Standardized Nordic questionnaire [16]. The Standardized Nordic questionnaire is a common screening tool which has been frequently used in the ergonomics field to identify and screen the early symptoms of back pain.

The computer users (subjects) were positioned on supine position with knee flexed to 90 degrees and the inflating air bag of PBU unit was placed between the anterior superior iliac spine and navel as shown in Figure 1. Before starting the procedure, the subjects were familiarized with the abdominal drawing techniques. The subjects were asked to contract the muscles like how he or she will contract to hold the urine. After the subjects were familiarized with the abdominal drawing techniques, the air bag was inflated to a pressure of 70 mm Hg with the valve closed and the subjects were instructed to breathe deeply using the main abdominal wall, then the inflatable bag was adjusted to 70 mm Hg again. The subjects were requested to perform three TrA muscle contractions with following verbal commands by the assessor: *"Contract in your abdomen muscle like how you control the urine without moving the spine or pelvis and try to maintain these contractions for ten seconds"*. At the same time, the researcher will check by palpation if the subjects were moving the spine or pelvis. Based on the previous studies, a pressure reduction of at least 4 mmHg during 10 seconds from an average of three trials can be indicated that the patient is having back pain [17]. The results were recorded and the subjects who are having reduction of 4 mmHg or below was categorized as poor, and the subjects who are able to hold 70 mm Hg or above were categorized as good. The validity between the results of Nordic questionnaire and the PBU results were analyzed by using chi-square analysis processed by Statistical Package for the Social Sciences (SPSS) software.

Figure 1: The Researcher using PBU to Assess the TrA Muscle Strength Level of a Computer User

3. RESULTS

Table 1 tabulates the numbers of subjects who have reported with and without back pain symptoms (screened by the Standardized Nordic questionnaire) and the numbers of subjects classified as 'good' and 'poor' back muscle strength level (measured by PBU). The results revealed that half of the subjects (five out of ten) who were suffering from back pain were also categorized under the 'poor' muscle strength. To support these findings, Table 2 shows that there was no significant difference ($p > 0.05$) between the Standardized Nordic questionnaire findings and PBU results in screening the early symptom of back pain among the computer users.

Table 1: Classification of Back Strength Level among the Subjects With and Without Back Pain Symptom

	Back Strength Level		
	Good	**Poor**	**Total**
Subjects Without Back Pain Symptom	2	1	3
Subjects With Back Pain Symptom	2	5	7
Total	4	6	10

Table 2: Association between the PBU Results and the Results of Standardized Nordic Questionnaire

	Value	**df**	**Asym. Sig (2 sided)**	**Exact Sig. (2 sided)**	**Exact Sig (1 sided)**
Pearson Chi-Square	1.270	1	0.260		
	0.179	1	0.673		
	1.265	1	0.261		
Fisher Exact Test				0.500	0.333
Linear-by-linear Association	1.143	1	0.285		
N of Valid cases	10				

4. DISCUSSION

The results of this study showed that the classification of computer users in 'good' and 'poor' back muscle strength based on the results of PBu measurement has no any significant difference with the results from the Standardized Nordic questionnaire. The use of the PBU by clinicians as an assessment tool for the evaluation of low back pain patients has increased over the last decade [17,18,19]. However, in ergonomics practice, as per researcher knowledge, there were no studies available regarding the use of this tool in evaluating the symptoms of back pain among industrial workers. Therefore, it is important to know the validity of the instrument in screening the low back pain among the working population.

The current study results were not able to be compared with other ergonomics studies as till now there were no any studies were conducted to test the back muscle activity especially the TrA muscle among low back pain workers. However, in contrary to the above mentioned statement, numerous research studies have been conducted to test the activity of back muscle by using PBU among low back patient in clinical studies. Example, a study conducted by Cairns et al among low back patients, had summarized that the PBU might be considered as a useful tool to identify and screen the change in the TrA muscle activity among low back patients [19]**.** In supporting to the previous author, another study [15] had concluded that the assessors can reliably used the PBU unit to assess the lumbar pelvic stability in chronic low back patients, in which lumbar pelvic stability is merely depends on the movement of TrA muscle. Although the previous findings can summarize the usefulness of PBU in screening the development of low back pain among clinical patients, however, as per authors' concern none of the previous study had used the PBU in ergonomics setting to screen the early symptoms of low back pain among industrial workers. Therefore, the findings of the current study can be a good start to look into the usefulness and importance of the PBU unit in the ergonomics field for screening the low back pain among industrial workers. In addition, the use of the PBU unit in an ergonomics field can reduce the dependency to technical expertise and expensive instruments such as electromyography and nerve conduction test to screen the early symptom of back pain.

5. CONCLUSION

The current study was conducted to assess the validity of the PBU in assessing back pain among computer users as a part of the ergonomics assessment techniques. This study found that there was no difference between the Standardized Nordic questionnaire results and the PBU results in identifying computer users with symptoms of low back pain. The

usefulness of an instrument or device in ergonomics studies depends on how much we can rely on the accuracy of the data as indicators of the behavior or the phenomenon assessed. Ideally, any instrument should be practical, easy to use and able to produce valid data to prevent from the erroneous conclusions of the ergonomics assessment. Therefore, the PBU can be hypothesized as one of valid tools in assessing symptom of back pain among computer users.

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