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Systematic Review of Subjective Tools Available to Investigate the Development of Work-related Musculoskeletal Disorders among Surgeons

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Abstract: Work-related musculoskeletal disorders (WMSDs) are prevalent among surgeons due to a variety of risk factors. Various subjective tools have been used to investigate the associations between these risk factors and their contributions to the development of WMSDs. This review aimed to provide a summary of a collection of popular subjective tools, including their applications and risk factors investigated using these tools, and to develop general guidelines to assist researchers to select tools based on their research interests. A systematic literature review was performed using six electronic databases. Inclusion criteria were as follows: (1) using questionnaires/surveys as data collection methods, (2) focusing on surgeons' discomfort, WMSDs and/or their awareness of ergonomic guidelines, (3) providing detailed questions. Articles that met inclusion criteria were investigated thoroughly.

Among 60 articles meeting inclusion criteria, 10 standard, 5 modified version, and 18 self-developed tools were recognized. The NASA-TLX and Nordic Musculoskeletal questionnaires were the most popular tools. Four groups of risk factors were identified: physical, cognitive, psychosocial, and individual factors. Almost half of the tools include questions regarding the physical and individual risk factors. Psychosocial and cognitive risk factors were investigated in 30% and 21% of them, respectively. It was also found that investigating the short-term outcome measurements, such as discomfort, got more attention comparing the long-term ones. Only few tools can be used to investigate risk factors from all four groups. Most of tools have limited applications. Moreover, among 33 tools, risk factors from different groups got different levels of attention, e.g. physical risk factors received the most attention. Since most of risk factors included in these tools are very common among various occupations, the general guidelines developed in this paper can be used by researchers who are interested in reducing the risk of the development of WMSDs among surgeons and workers in other occupations.

Keywords: ergonomics, questionnaire, surgeons, survey, work-related musculoskeletal disorder

1. Introduction

Musculoskeletal disorder is defined as "damage caused by physical trauma sustained by tissues of the body" (Whiting & Zernicke, 2008). Workplace design plays an essential role in the development of musculoskeletal disorders. When the work design forced a worker to do a task outside his/her body's capabilities and limitations, he/she is going to be at risk of work-related musculoskeletal disorders (WMSDs). Surgeons' demanding jobs impose various physical and psychosocial stress on them and put them at risk of developing WMSDs (Szeto et al., 2009; Wauben, Veelen, Gossot, & Goossens, 2006). Surgeons' injury can have adverse effect on surgeons' living, patients, and institutions in different ways (Davis, Fletcher, & Guillamondegui, 2014). Therefore, it is very important to recognize the risk factors contributing to surgeons' injury and use appropriate tools to assess these factors.

Physical, Cognitive, psychosocial, and individual factors are the risk factors contributing to the development of WMSDs (Bernard, 1997; Iwanaga, Saito, Shimomura, Harada, & Katsuura, 2000; Mehta & Agnew, 2011, 2011).Variety of subjective tools have been used to assess these risk factors and prevalence of WMSDs among surgeons. Physical risk factors of developing WMSDs among surgeons has been investigated by tools, such as NASA-Task Load Index (TLX), SURG-TLX, and Nordic. Subjective Mental Effort Questionnaire (SMEQ) has been used to assess cognitive risk factors, as well as NASA-TLX and SURG-TLX. In order to assess psychosocial factors, subjective tools, such as a modified version of workstyle short form questionnaire, has been used in previous studies. Questionnaires, such as Nordic and local experienced discomfort questionnaire (LED), contain questions regarding the individual risk factors and have been used to assess these types of risk

factors among surgeons. Furthermore, some tools, like SAGES and physical discomfort survey, have been used assess the short term and long term outcome measurements of performing surgical tasks, such as pain, discomfort, disabilities and WMSDs symptoms among surgeons.

It is challenging for researchers to select a subjective tool or to develop their subjective tool to satisfy their research needs. This review aimed to provide a summary of a collection of popular subjective tools, including their applications and risk factors investigated using these tools, and to assist researchers to select tools based on their research interests.

2. Methods

Electronic databases, such as PubMed, Medline, Web of Science and ScienceDirect, and Google Scholar were used for article collection. Articles were exported to Zotero reference management tool. Articles were collected using "workload", "musculoskeletal disorders", "posture", "ergonomic guideline", "awareness", "questionnaire", "survey", "subjective", "surgeon", "general surgeon", "pediatric", "orthopedic", "laparoscopic", "robotic" as keywords in mentioned electronic databases. Various combinations of key words were used as search queries, such as "discomfort AND (survey OR questionnaire)". After removing the duplicate items and reviewing the abstracts, full articles were examined to find papers to create a comprehensive question pool based on the following inclusion criteria: (1) using questionnaires/surveys as data collection methods, (2) focusing on surgeons' discomfort, WMSDs and/or their awareness of ergonomic guidelines, (3) providing detailed questions.

Full text of the selected articles were reviewed and questions addressed in the selected studies were categorized into four main groups of risk factors of developing WMSDs: (1) Physical factors, (2) Cognitive factors, (3) Psychosocial factors, and (4) Individual factors. Physical risk factors are characteristics of the work environment that put workers at risk of developing WMSDs. Repetition, force, posture, vibration, statistic posture, and workstation configuration are commonly cited in literature (Bernard, 1997; Malchaire, Cock, & Vergracht, 2001; Wærsted, Hanvold, & Veiersted, 2010). Cognitive factors are characteristics of the tasks that represent their load on individuals' cognitive systems and their cognitive demand to accomplish goals (Danili & Reid, 2006; Paas & Merriënboer, 1994). In addition, awareness of ergonomics guidelines is another parameter of psychosocial risk factors. Psychosocial risk factors are characteristics of the work organization that can increase workload as one the groups of the contributing factors to the development of WMSDs (Bernard, 1997; Bourbonnais, Comeau, Vezina, & Dion, 1998). Individual factors are related to surgeons' genetic and demographic characteristics as well as the surgeons' medical history that indicate individual's vulnerability to developing WMSDs. Individual factors, such as body mass index (BMI), experience, gender, and previous health condition, have been reported to significantly influence workload and risk of WMSDs (Houvet & Obert, 2013).

3. Results

A total of 60 articles were selected based on the inclusion criteria. In these articles, 10 standard tools, 5 modified version of the standard tools, and 18 self-developed tools were used to examine WMSDs among surgeons. The NASA-TLX and Nordic Musculoskeletal questionnaires were the most popular tools. NASA-TLX tool asks questions regarding cognitive, physical , and psychosocial factors (Hart, 2006). Nordic questionnaire is another subjective tool that has been used to analyze musculoskeletal symptoms asking questions about experience of musculoskeletal trouble in nine parts of body, in addition to individual and psychosocial risk factors (Kuorinka et al., 1987).

Approximately half of the identified tools had questions regarding the physical and individual risk factors. Psychosocial and cognitive risk factors got less attention, as they were investigated in 30% and 21% of the tools. Among all of the psychosocial factors, ergonomic guidelines awareness got the least attention and only three of the identified tools had question regarding this factor. It was also found that short-term outcome measurement of the surgical task on body, such as pain and stiffness, were examined in approximately 73% of the existing tools. However, the long-term outcome measurement, such as disability and musculoskeletal disorders, were investigated in approximately 33% of the identified tools.

3. Discussion

Four groups of risk factors got different levels of attention in identified tools. Physical and individual factors received more attention than cognitive and psychosocial factors. In addition, only few of the tools considered all of the risk factors. In investigation of the effects of the performing surgical tasks on the surgeons' body, most of the tools asked questions regarding

short-term outcome measurements, like experience of the pain and stiffness due their job. However, fewer studies asked questions to investigate the symptoms of disability and musculoskeletal disorders. Among the psychosocial factors, ergonomic guidelines awareness got the least attention in the previous tools. There is a need to pay more attention to this group of risk factors, as it has been shown that surgeons find ergonomic guidelines very helpful in decrease of physical discomfort (Wauben et al., 2006).

This paper can help the researchers to identify potential risk factors regarding the development of WMSDs among surgeons. In addition, they can observe the level of attention to each of the risk factors in previous studies to examine the gap in previous investigations. This paper can guide the investigators to use suitable tools based on their goal of study. Since the most of the risk factors are not only limited to surgeons' work environment, researchers investigation the WMSDs among other occupation can use this paper to investigate the risk factors and improve the work environment.

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