EFFECT OF ALTERED BODY COMPOSITION ON MUSCULOSKELETAL DISORDERS IN MEDICAL PRACTITIONERS

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Abstract

Musculoskeletal disorders (MSDs) leads to loss of work efficiency which could have a negative effect on productivity as well as the quality of life. Excess fat in relation to lean body mass, known as altered body composition, can greatly increase the risks of MSDs. A significant positive relationship does exist between the probability of having MSD and altered body composition. A cross-sectional study with 108 medical practitioners was performed that comprised females (19.4%) and males (80.6%) to ascertain the body composition of medical practitioners to assess if they have an altered body composition and if it did indeed be associated with MSDs. The measures obtained were Nordic Musculoskeletal questionnaire and body composition by bioelectrical impedance analysis. The results revealed the overall prevalence of musculoskeletal symptoms was high (80.55%) with low back, neck and ankles/feet to be the most commonly affected body parts. The male participants prone to MSDs have a higher fat percentage (86.11%), BMI (66.66%) and WHR (87.5%). Similarly, the female participants having higher fat percentage (100%), BMI (53.33%) and WHR (66.66%), showed increased incidences of MSDs. Future studies may be undertaken to determine other ergonomic domains as precipitating factors for the etiology of MSDs in medical practitioners to set priorities, preventive strategies, and interventions in the attenuation of MSDs.

Keywords: *Musculoskeletal Disorders, Body Composition, Bioelectrical Impedance Analysis, Medical Practitioners*

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1. INTRODUCTION

Musculoskeletal disorders (MSDs) is described as a 'discomfort, impairment, disability or persistent pain in joints, tendons, muscles and other soft tissues with or without physical manifestations' (Kroemer 1989, Polanyi et al. 1997). Generally, the injury development process is initiated by discomfort and fatigue, and under certain conditions, the symptoms persist, possibly resulting the musculoskeletal structures to damage causing impairment or disability (Das et. al. 2015).

According to U.S Bureau of Labor Statistics, 2009; work-related musculoskeletal disorders (WMSDs) affect nearly a million workers in the United States alone each year. It can affect the capacity of the workers in executing the necessary occupational activities, which could have a negative impact on productivity. Economic loss due to WMSDs in the Korea is estimated to be about US$ 1 billion, which is approximately 0.3 % of GNP (Kee 2011).

An extremely important part of the healthcare system are doctors and nurses. In terms of employment and revenue, healthcare is one of India's largest and rapidly growing sectors. According to Indian Healthcare Trends, it is now a US $35billion industry in India and may reach over US$ 150 billion by 2017 (National Health Profile, 2008). Studies have revealed that the healthcare professionals are vulnerable to MSDs during the course of their work routine (Bork 1996; Russo 2002; Das et. al. 2015). In the healthcare industry, a wide variety of workers are affected by MSDs, but it appears to be an imperative problem for medical practitioners (Szeto et. al.2009).

Doctors working in hospitals have higher levels of burnout than those working in private practice, research institutions or in any other professional settings (Olkinuora et. al.1990). The Pune chapter of Indian Medical Association observed that an average lifespan of an Indian medical practitioner is 55-59 years which is around 10 years lesser compared to the general population. This analysis was based on the social security scheme of the Indian Medical association where 5,500 medical practitioners from Maharashtra and approximately 11,000 medical practitioners across India is registered (Das et. al., 2016). Prolonged posture, patient's expectations, demands of the job, practice administration, interruptions, dealing with death and dying, social life and work-home interface, medical responsibilities for relatives and friends, all these precipitate in abundant stress and strain among physicians (Sutherland, 1995). The doctors are considered to be lifesavers and if they come under stress, their efficiency is reduced, which may affect the lives of the large number of patients whom they treat (Sharma, 2005; Das et. al.2016).

Some individuals consume excess food because of stress, which may culminate into gaining weight and obesity. Obesity is associated with additional disorders such as coronary heart disease, hypertension, type 2 diabetes and dyslipidemia (Rippe et. al.1998). The development of abdominal obesity has been found to have a linkage with stress reactions. The HPA axis is repeatedly activated by stress and with the increase in cortisol it leads to an activation of adipose tissue lipoprotein lipase leading to the buildup of abdominal fat mass (Bjorntorp, 2001). The

cortisol secretion induced by stress has been found to be greater among both men (Rosmond et. al.1998) and women (Epel et. al. 2000) with abdominal obesity.

For good health and longevity, there should be a normal balance of body fat. The fat excess in relation to lean body mass is known as altered body composition, which may increase the risks of many ailments and even MSDs. It may also cause strain and progression of musculoskeletal conditions over hips, knees, ankle, foot, lower back and shoulder leading to pain (Wearing et al. 2006). A significant positive relationship prevails between the probability of having MSD and altered body composition (Kortt and Baldry, 2002).

Studies focusing on medical practitioners though are rather scanty, have indicated the serious prevalence of WMSDs in them. Few studies have attempted to associate physical and psychosocial factors with WMSDs in medical practitioners but no studies have been conducted in India; that ascertain the body composition of medical practitioners and their possible association with MSDs.

2. METHODOLOGY

2.1 Study Design and Selection of Subjects

A cross-sectional study with 108 medical practitioners comprising females (19.4%) and males (80.6%), randomly selected from different medical institutions located in Mumbai and Kolkata, India was conducted. Practitioners working at least for one year at the present workplace were included in the study. The consent was taken from all the respondents as well as the ethics approval was obtained, prior to the commencement of the study. The details of the study were explained to the participants who were selected based on purposive sampling technique, whereas the hospital's selection had been a mix of convenience and chance.

2.2 Measures

Questionnaires were used to find out the risk factors. Questionnaires were completed through face to face interviews. The height was measured with the help of stadiometer, weight was recorded with the help of weighing machine respectively. The waist and hip circumference were taken by measuring tape. This phase is subdivided into sub-phases viz., **(**i) MSD Assessment ii) Body composition assessment.

- **Musculoskeletal Disorder Assessment**
  Nordic Musculoskeletal Questionnaire (NMQ) (Kuorinka et.al.1987) was used to measure the incidences of WMSDs in nine anatomical regions. These are three upper limb segments (wrist/hands, elbows, shoulder), three lower limb segments (ankle/feet, knees, hip/thighs) and three trunk segments (lower back, upper back, neck). The questionnaire had information regarding the location of symptoms in the past 1 week, past 12 months and whether it interfered with daily activities in the previous 12 months. The structured questionnaire was employed during a personal interview. NMQ has been widely used as a work-related musculoskeletal system screening tool and found to have good reliability and validity (Das and Mukhopadhyay, 2014).

- **Assessment of body composition by Bio-impedance Analysis**

  Bioimpedance Analysis or Bioelectrical Impedance Analysis (BIA) is a method of assessing the body composition. It is an integral part of health assessment. BIA (Quadscan4000, Body stat Ltd., British Isles) shown in fig 1, used in this study comprised a sophisticated, computerized analysis system. Following the input of the data like gender, age, height, weight, activity level, waist and hip size, the analyzer calculated and estimated the tissue and fluid compartments using an imperceptible electrical current (800 mA at 50 kHz), which is made to pass through pads placed on hand and foot as the individual sat comfortably in chair and posed long sitting with a support under the legs. As the current passed through the body, it faced varying degrees of resistance, depending on the relative distribution of muscle and fat tissue. Lean (muscle) tissue contains more water and electrolytes than adipose (fat) tissue thus it offers less resistance to the current. The impedance method is quick in body composition assessment which comprised fat mass, lean mass, fat%, body mass index (BMI) and waist-hip ratio (WHR).

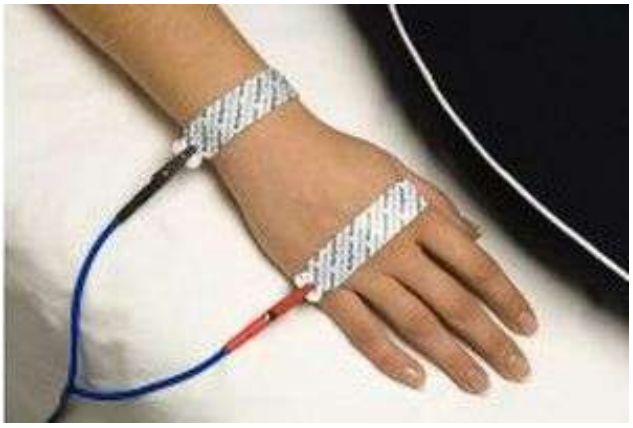

Fig 1: Bioelectrical Impedance Analyzer and placement of electrodes

3. RESULTS

3.1 Characteristics of MSDs in Medical Practitioners

The medical practitioners reported high incidences of musculoskeletal symptoms. The 12-month and 7-days prevalence rates of MSDs reported by medical practitioners are presented in Figure 2.

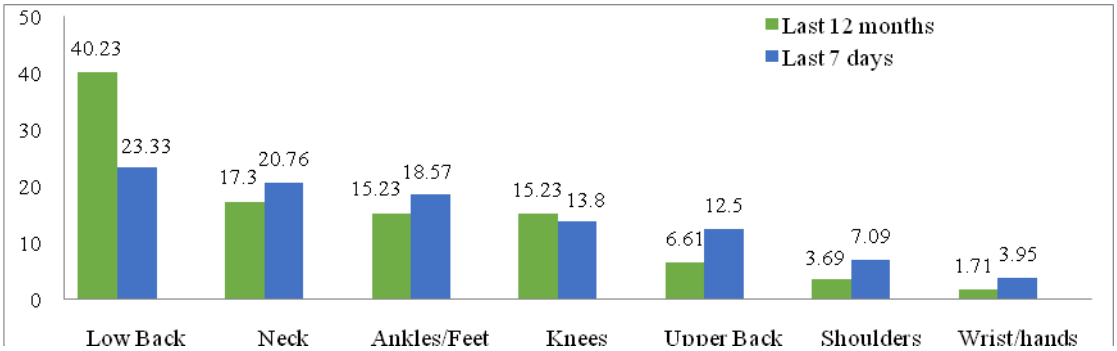

Fig 2: Prevalence of symptoms in last 12months and last 7 days

The above figure shows that most of the respondents have reported low back trouble (40.23% and 23.33%) in last 12-months and last 7-days, followed by neck (17.3% and 20.76%), ankles/feet (15.23% and 18.57%), knees (15.23% and 13.8%), upper back (6.61% and 12.5%), shoulders (3.69% and 7.09%) and finally the wrist/hands (1.71% and 3.95%).

3.2 Assessment of Body Composition Analysis of Medical Practitioners

The mean values of fat mass, lean mass, fat%, body mass index (BMI) and the waist-hip ratio (WHR) of male (n=90) and female participants (n=18) are represented in the table 1.

Table 1: Analysis of body composition measured by bioelectrical impedance

N(108) Males(90) Females(18)	Categories	Fat Mass(kg)	Lean Mass(kg)	Fat%	BMI	WHR
Mean	N(108)	18.52	55.46	24.56	26.45	.944
	Males	17.72	55.38	22.57	26.48	.958
	Females	22.56	53.88	34.51	26.27	.873
Std. Deviation	N(108)	6.45	10.79	7.51	3.64	.068
	Males	6.47	11.44	6.13	3.72	.060
	Females	4.73	6.87	5.66	3.19	.060

The mean fat mass of male and female medical practitioners was 17.72±6.47kgs and 22.56±4.73kgs, mean lean mass of male (55.38±11.44) kgs and female (53.88±6.87) kgs, mean fat percentage of male (22.57±6.13) % and female (34.51±5.66) %, mean BMI of male (26.48±3.72) kg/mt^2 and female (26.27±3.19) kg/mt2, mean waist-hip ratio of male (0.958±.060) and female (0.873±.060) respectively.

3.3 Association of MSDs and body composition

The variables of the body composition are associated with the MSDs. Table (ii) shows the association between reported 12-month prevalence of MSDs and the fat %, BMI, WHR among the male and female medical practitioners. The rates of MSDs were significantly associated with fat% ($\chi2 = 4.98$; $p= 0.015$), BMI ($\chi2 = 4.67$; $p= 0.030$) and WHR ($\chi2 = 6.86$; $p= 0.008$) in males and fat% ($\chi2 = 5.29$; $p= 0.021$), BMI ($\chi2 = 9.25$; $p= 0.002$) and WHR ($\chi2 = 4.5$; $p= 0.033$) in female respondents.

Table 2: Association of MSDs and variables of body composition among the medical practitioners

Independent Variables	Gender	Categories	Incidence of WMSDs	WMSDs Percentage	Chi-square (χ^2)	p-value
Fat Percentage (ACE standards)	Male	≤17%	10/72	13.88	4.98	0.015*
		>17%	62/72	86.11		
	Female	≤24%	0/15	0	5.29	0.021*
		>24%	15/15	100		
Body Mass Index (WHO standards)	Male	18.5-24.9	24/72	33.33	4.67	0.030*
		>24.9	48/72	66.66		
	Female	18.5-24.9	7/15	46.66	9.25	0.002*
		>24.9	8/15	53.33		
Waist hip ratio (WHO standards)	Male	≤0.90	9/72	12.5	6.86	0.008*
		>0.90	63/72	87.5		
	Female	≤0.85	5/15	33.33	4.5	0.033*
		>0.85	10/15	66.66		

*Significance at the level of $p<0.05$

The prevalence rate of MSDs was observed to be higher amongst both the male and female medical practitioners with altered body composition. The male participants were prone to MSDs have a higher fat percentage (86.11%), BMI (66.66%) and WHR (87.5%). Similarly, the female participants having higher fat percentage (100%), BMI (53.33%) and WHR (66.66%), showed increased incidences of MSDs.

4. DISCUSSION

The study was designed to study the incidences of WMSDs experienced by medical practitioners and to ascertain the body composition of medical practitioners and their possible association with MSDs. In the present study comprising 108 medical practitioners, the percentage of overall prevalence of MSS in at least one anatomic segment ever to have occurred in last 12 months, was high (80.55%). The study showed that low back and neck were the most commonly affected body parts among the medical practitioners which corroborated the findings of a previous MSC study conducted across a cross-section of Chinese hospital physicians (Smith et al., 2006a) and in a study conducted by general surgeons in Hong Kong (Szeto et. al. 2009). Physicians had either prolonged sitting posture or constant bending over the bed while physically examining patients in indoor, ICU and outpatient departments. While physically examining patients in outpatient/inpatient or constant monitoring in ICU may lead to constant bending over the bed, which may be associated with considerable physical stress resulting in complaints predominantly of back and neck pain (Long et. al. 2011). 67% of surgeons reported that their major part of the time were carried out by the activities in standing posture. The participants who complained of shin pain due to prolonged standing activities were considered and taken into account as the painful region of the ankles/feet. Physical workplace tasks of the surgeons also included regular walking from ward to ward, observing/ attending and assisting seniors in OPD for prolonged duration may load forces over knees and ankle/feet. Surgeons worked exclusively in the standing position with mild to moderate bend trunk and neck over operation table for prolonged periods, especially in long duration surgeries which may have precipitated significant strain on the lower back and neck (Szeto et. al. 2009). Studies have reported that low back pain was found to be the most prevalent MSD in adult and about 60-80% of all individuals might experience the condition at some stage in their life (Waddell and Burton, 2001).

Greater body weight may result in greater demands on the joints of the spine and lower limbs leading to structural degeneration and pain (Christensen et al., 2011). Body Mass Index (BMI) is the ratio of person's weight by his or her height that is associated with body fat and health risk. According to Word Health Organization (WHO), normal BMI is 18.5 to 24.9 and 25-29.9 is considered to be overweight but the normal BMI limit for Indians is 18.5 - 22.9 and 23 - 24.9 as overweight. The guidelines were released jointly by the Indian Ministry of Health, the Diabetes Foundation of India (DFI), Indian Council of Medical Research (ICMR), the All-India Institute of Medical Science (AIIMS), the National Institute of Nutrition (NIN) as Indian bodies and genetics are different from their western counterparts. The findings of our study revealed that the mean BMI of the medical practitioners (n=108) were 26.45 which exceeds both the normal limits of WHO and Indian standards. Statistical test results also revealed that BMI had a significant contribution to the prevalence of WMSDs in medical practitioners. Hence, it can be conjectured that one of the reasons for the prevalence of MSS in the lower back, neck, ankles/feet, and knees in medical practitioners may be because of increased BMI.
However, current evidence indicates that body weight may be only a weak risk factor for musculoskeletal pain. The measures of body weight do not take into account an individual's body composition, which has differential effects on pain. Kesavachandran et. al. (2012) in his study, conducted on 1111 Indian volunteers (18-69 years) concluded that the subjects who showed higher body fat percentage had risk factors like type 2 diabetes and

hypertension even at normal BMI range, as per WHO guidelines. The altered body composition puts Indian at a higher risk for diabetes and hypertension. Bio-impedance analysis performed in the present study also revealed that fat% and waist-hip ratio were significantly associated with the prevalence of MSDs among both male and female medical practitioners. There are different classifications of body fat percentage based on gender, age, and groups or categories. According to American Council on Exercise (ACE), body fat % for fit males ranges from (14–17) % and females (21–24) %. Based on the study of Lohman and Going, (1993) body fat% in an average population of males, ranges from (11-17) % and females (15-23) % in the age range of 30-50 years, whereas our study reports mean fat% of males were observed to be 22.57% and for females 34.51%, for the mean age of 34.78±9.19 years which exceeds both the recommended values of ACE and Lohman and Going, (1993).

Waist-Hip Ratio (WHR) is the ratio of the circumference of the waist to that of the hips which are a good indicator of cardiovascular risk factors (Dobbelsteyn et. al. 2001), body fat distribution (Ketel et. al. 2007) and hypertension in type 2 diabetes (Picon et al. 2007). According to WHO, abdominal obesity is defined as a WHR above 0.90 for males and above 0.85 for females whereas the National Institute of Diabetes, Digestive and Kidney Diseases (NIDDK) states that women with WHR of more than 0.8 and men with more than 1.0 are at increased health risk because of their fat distribution. The finding of the present study reveals that the mean WHR in males were 0.958 and females 0.873 which exceeds the recommended limit of WHO in both males and females whereas according to NIDDK, only the females exceeded the accepted levels, which may, to some extent, platters the reason of those research studies where it has been commonly reported that females had higher prevalence rates of MSDs than males in general (Hooftman et. al. 2005).

5. CONCLUSION

The present paper ascertains the body composition of medical practitioners and shows that the altered body composition is associated with increased preponderance of WMSDs. The study reveals that Fat %, BMI, and WHR exceeds the standardized limits and appears to have a significant association with prevalence of MSDs in both male and female participants. Future studies may be undertaken to determine other ergonomic domains as precipitating factors for the etiology of MSDs in medical practitioners to get concrete results. This article may help medical practitioners and ergonomists to give better tools to set priorities, preventive strategies, and interventions in the attenuation of MSDs.

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