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Original Research

Effect of three different sitting postures on disability in diamond workers: A cross-sectional study

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ABSTRACT

Aim: Diamond making industries are one of the widespread industries of Gujarat and Maharashtra. According to their nature of work, large number of diamond workers acquires different sitting position. We analyzed three different sitting positions depends upon their need in the profession. Thus in this study, we want to analyze the area specific symptoms according to the working posture and their impact on function. **Materials and Methods:** In this cross- sectional study, 754 diamond workers aged between 30 and 60 years were selected through quota sampling from Visnagar, Gujarat, India. The subjects were allocated in 3 × 3 factor grouping design, i.e., three age groups and 3 sitting postures. The age grouping variables were 30-39, 40-49, and 50-60 years. Grouping variable for posture were, without back supported sitting, back supported sitting and tailor sitting. Analysis of posture related disability was done by the standardized Nordic questionnaire and other four area-specific questionnaires such as neck disability index, revised oswestry disability index, disability arm shoulder and hand, and lower extremity functional scale. **Results:** Descriptive analysis was done using MS Excel 2007 to analyze the data. Results revealed that without back support group had highest disability across all three groups amounting to 48.82%, followed by the back supported group with 32.12%. Interestingly tailor sitting position groups accounting for least disability with 29.86%. **Conclusion:** Without back supported sitting was the worst posture attained during work. Tailor sitting revealed the lesser amount of disability when compared to both with or without back supported sitting for the diamond workers.

KEY WORDS: Diamond workers, disability questionnaire scales, sitting posture

INTRODUCTION

Sitting has now become the most common posture in today's workplace, which is determined by both the design of the seat and task to be performed [1,2]. Sitting for long duration produced higher pain or discomfort of the low back, neck, upper extremity, and lower extremity [2,3], heavy physical work, heavy or frequent lifting, nonaligned postures (i.e., trunk rotation, forward bendin g), pushing and pulling, and exposure to whole body vibration (WBV) (i.e., motor vehicle driving) also cited as a risk factor [4].

Diamond making industries are one of the widespread industries of Gujarat and Maharashtra. Approximately 3 lakhs workers alone in Surat city involved in it [5]. They are working in different sitting position like-without back support, back support and tailor sitting specific to the need of their work. They require continuous upper limb movement in constraint fixed sitting posture. Hence, the disability involved in diamond industries are totally of a different pattern in comparison to the hazards involved in other industries, where heavy machine are moved, or dangerous chemical are involved [6]. Around one-third of musculoskeletal disabilities are occurred due to the work-related environment in North America, Nordic country, and Japan [7]. We found a dearth of literature disabilities due to a different sitting position that cause a major problem to the diamond workers; also we want to design a proper ergonomic program to prevent the disabilities due to wrong sitting position. Diamond workers commonly accommodate with three sitting postures like sitting with back support, sitting with no back support and tailor sitting. Thus, the objective of this study was to find out different disabilities on three different postures like back supported sitting, with no back support sitting and tailor sitting.

MATERIALS AND METHODS

Study Design

The study was designed as a cross-sectional study. The study was performed in accordance with ethical considerations of the institute, and their consent was taken prior to study. Male Diamond workers residing from Visnagar area between the ages of 30-60 year were screened and included in the study on the basis of inclusion and exclusion criteria. The inclusion criteria was all the diamond workers utilizing any one of the sitting position like without back support, supported sitting, tailor sitting; a duration of working more than 5 year, at least 8 month a year or working 6 h per day were the prerequisite for the study. Exclusion criteria was any subject who had any history of musculoskeletal surgery, fracture of leading to any change in work posture, any injury within last 6 month, neurological disorders and subject involved in repeated twisting body work like labor work [Figure 1].

Participants

A survey was carried out at a different diamond factory in Visnagar, Gujarat, India in December 2012. A total of 754 subjects were selected through quota sampling on the basis of inclusion and exclusion criteria. All subjects were divided into three groups - W group (without back support) (n = 256), S group (supported sitting) (n = 277) and T group (tailor sitting) (n = 221). All the three groups further divided according to the age group *viz*. 30-39, 40-49 and 50-60 year.

Assessment Tools

Generalized musculoskeletal symptoms or disability in diamond workers were assessed by Standardized Nordic questionnaire, which was developed by a Nordic group [8]. In this questionnaire, the human body is divided into 9 anatomical regions like neck, shoulder, elbow, wrist/hand, upper back, lower back, one or both hips/thigh, one or both knee, and one or both ankle/feet. The verbal questions deal with each anatomical area in turn and inquire whether subject has or had trouble (pain, ache or discomfort) in the respective area due to his working sitting posture during the preceding 12 months and on-going last 7 day. Any subjects found a disability in 7 days in the standardized Nordic questionnaire was further analyzed by other area specific disability scale like neck disability index (NDI), back-revised oswestry disability index, upper limb-disability arm shoulder and hand (DASH) and for lower limb-lower extremity functional scale (LEFS).

Figure 1: Without back supported sitting posture in diamond industries

The NDI is a condition-specific instrument for self-report of disability which consists of 10 items referring to various activities (personal care, lifting, driving, work, sleeping, concentration, reading, recreation) and pain (pain intensity, headache) with 6 possible answers for each item. Subjects were instructed to choose only one answer that most closely suits their condition at the present time. The score of each item varies between 0 (no pain and no functional limitation) and 5 (worst pain and maximal limitation) resulting in a total score of 0 (no disability) to 50 (totally disabled) [9]. In the present study, revised oswestry disability scale was used to a person affected with upper and lower back disability in last 7 days in the Nordic questionnaire. The questionnaire was originally described in 1980, it consists of 10 items addressing different aspects of function and each item is scored from 0 to 5, with higher values representing greater disability [10].

DASH were used for a subject with present shoulder, elbow, and wrist/hand problem in last 7 days in the Nordic questionnaire. In 1996 Hudak *et al*. [11] published their approach to the evaluation of disability: The DASH score, a self-administrated questionnaire which includes 30 items related to functional activities and symptoms in activities of daily living. The subject was asked to attribute a score of 1-5 on all 30 items. Scores rise with increasing disability [12] and subjects had disability in thigh/hip, knee, and ankle/feet in last 7 days in the Nordic questionnaire were also screened by LEFS. In this scale 20 functional activities were rated on a 5-point scale, from 0 (extreme difficulty/unable to perform activity) to 4 (no difficulty) and the score was carried out of the 80 point, higher the score related to the good functional activity [13].

Data Analysis

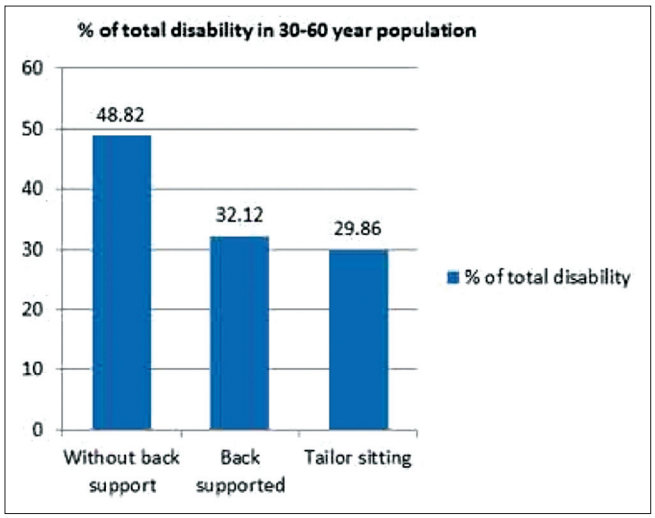
The data were analyzed by using MS- Excel 2007 tool specially designed for data entry from the assessment tools and was presented in the form of percentage, calculate the total disability, and highest and lowest disability in area specific functional activity.

RESULTS

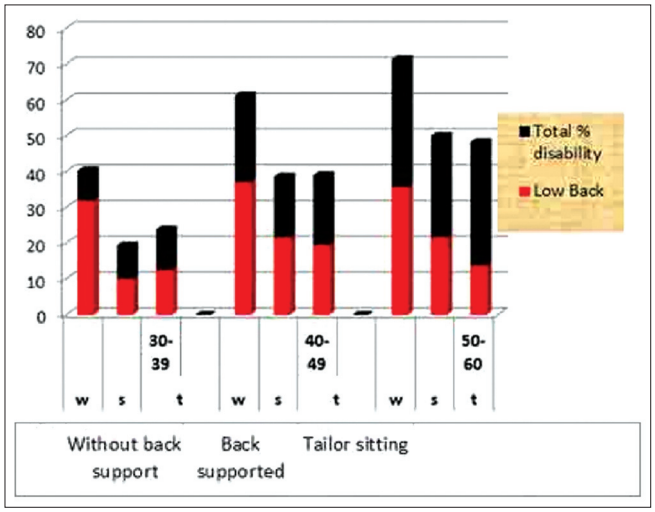
Descriptive analysis revealed that without back support group had highest disability across all three groups amounting to 48.82%, followed by the back supported group with 32.12%. Interestingly tailor sitting accounting for least disability with 29.86% in 30-60 year age group (Graph 1).

Low back accounted for most of the disabilities in all the age groups across all the work postures, and neck disability was highest in the back supported group. Upper extremity disability was the least in all groups, and lower limb disability was seen most in tailor sitting postures (Graph 2).

The age group of >50 years had a maximum disability with 71%. Disability percentage comparison in between group of 30-39, 40-49 and 50-60 year were shown in Tables 1-3. Also,



Graph 1: % of total disability in 30-60 year diamond worker population



Graph 2: % of disability in different age group in different sitting posture among diamond worker

Tables 4-6 show the maximum level of functional disability in diamond workers.

DISCUSSION

The use of constrained awkward posture is the greatest risk factor for those in the diamond field, due to its high demand on skillful and precision movement, the workers flex his body and neck over the diamond table and use upper extremity for cutting, shining and shaping of the diamond. The result obtained in this study indicates that without back support working posture are worse than two other posture in the diamond worker. Low back pain was found common in all age group in different working posture. Ergonomic review by Lueder states that unsupported sitting involves the worst all worlds, [14] because it is difficult to sit upright and unsupported for very long, most people would rather slump than perform the muscle work needed to sit upright [14]. According to the European population data, higher annual prevalence rate for those occupational groups that spend more than half their working day in a sitting position [5].

Our result also shows that back pain was predominant in all three groups. The main risk factors for back pain associated with diamond work are the sustained awkward postures and poor seating. Most individuals with low back pain do not simply injure their back in one incident but rather gradually overtime repeated stresses from over the years begin to add up and slowly cause degeneration of various parts of the spine, resulting in low back pain [15]. According to Punnet *et al*. study back problem increase with age and attributable to 37% of occupational risk factors [4]. More than 70% of people older than 40 years experiences intermittent back pains [14]. Another study showed that the physical stressor's affecting the back was as high as 66% for manual material handling and 80% for WBV among exposed group [7]. Several studies have indicated an increased risk for back pain in people with predominantly seated working postures [16,17]. Our result also showed that the back problem was higher in unsupported sitting group, because several things happen when we maintain unsupported posture, we tend to slumps forward, reversing the lumbar curve (lumbar kyphosis) produces stresses on the lumbar discs, posterior ligament and spinal nerve [2,18]. Nachemson (1981) stated that unsupported sitting does not allow the thigh torso angles that are large enough the reinstate the natural curve of user's lumbar spine [19].

The present study showed that back supported sitting and tailor sitting reported the almost same level of back disability but neck pain was predominant in the supported group and

Table 1: Disability in 30-39 year age group in different sitting posture

Working posture	Age group	Total population	Different disability			
			Maximum area disability	Second maximum are	Others *n* (%)	Total disability *n* (%)
Without back support	30-39	166	Back *n* (%)	Back and LL *n* (%)		
			53 (31.92)	5 (3.01)	9 (5.42)	67 (40.36)
Supported sitting	30-39	129	Back *n* (%)	Neck *n* (%)		
			13 (10.07)	4 (3.10)	8 (6.20)	25 (19.37)
Tailor sitting	30-39	151	Back *n* (%)	LL *n* (%)		
			19 (12.58)	7 (4.63)	10 (6.62)	36 (23.84)

Table 2: Disability in 40-49 year age group in different sitting posture

Working posture	Age group	Total population	Different disability			
			Maximum area disability	Second maximum area	Others *n* (%)	Total disability *n* (%)
Without back support	40-49	62	Back *n* (%)	Back and LL *n* (%)		
			23 (37.09)	5 (8.06)	10 (16.12)	38 (61.29)
Supported sitting	40-49	88	Back *n* (%)	UL *n* (%)		
			19 (21.59)	3 (3.40)	12 (13.6)	34 (38.63)
Tailor sitting	40 to 49	41	Back *n* (%)	LL *n* (%)		
			8 (19.51)	3 (7.31)	5 (12.19)	16 (39.02)

Table: 3: Disability in 50-60 year age group in different sitting posture

Working posture	Age group	Total population	Different disability			
			Maximum area disability	Second maximum area	Others *n* (%)	Total disability *n* (%)
Without back support	50-60	28	Back *n* (%)	Back and LL *n* (%)		
			10 (35.71)	4 (14.28)	6 (21.42)	20 (71.42)
Supported sitting	50-60	60	Back *n* (%)	Back and LL *n* (%)		
			13 (21.66)	4 (6.6)	13 (21.66)	30 (50)
Tailor sitting	50-60	29	Back *n* (%)	LL *n* (%)		
			4 (13.79)	4 (13.79)	6 (20.68)	14 (48.27)

Table 4: Neck disability index result

Age group	Maximum level of functional disability in different working posture		
	Without back support	Supported sitting	Tailor sitting
30-39	lifting, driving and recreational	Lifting, driving and reading	Lifting and sleeping
40-49	Lifting and recreational	Lifting	Lifting and work
50-60	Recreational	Lifting and driving	Lifting

Table 5: Revised oswestry disability scale results

Age group	Maximum level of functional disability in different working posture		
	Without back support	Supported sitting	Tailor sitting
30-39	Lifting	Lifting and Sitting	Sitting
40-49	Sitting	Sitting	Sitting and lifting
50-60	Sitting	Sitting and lifting	Lifting and sitting

Table 6: Lower extremity functional scale result

Age group	Maximum level of functional disability in different working posture		
	Without back support	Supported sitting	Tailor sitting
30 to 39	Heavy activity	Heavy activity	Squatting
40 to 49	Stair climbing	Standing 1 h, stair climbing	Sitting 1 h
50 to 60	Standing 1 h	Standing 1 h	Sitting 1 h

lower extremity problem are higher in tailor sitting. There is still controversy about whether, the back support reduces the back pain symptoms or not, backrest stabilizes posture by relieving the amount of effort required to fight gravity. According to the Rohlmann *et al*., 2001, recommended that leaning against a backrest reduces both intradiscal pressures in the spine and loads at the back portion of the spine [20]. Theoretically leaning back reinstate the lumbar curve by two region, first as the weight of the torso shifts back against the backrest, second is the angle between torso and leg increase [14], So, this might reduce the back disability. Neck problem is second most in the supported group because worker is involving in diamond work, constantly require flex their head on the diamond table which, increased the static loading of neck muscle. Donald and Adams; 2001 noted that leaning back also has a disadvantage. Many computer users slumps against their backrest, locking in their pelvis and causing them to lose the natural curve of their low back and neck [21]. Loads on the shoulder and arms may increase if recline causes the users to move back against their work item.

Interestingly this study shows that tailor sitting posture has less disability than two other postures among diamond worker because it is generally a safe position for the hips and back also promotes a strong core by allowing the person to reach forward and side, but tailor sitting posture showed the greater disability of lower limb comparative than two other postures because more than 90° prolonged knee flexion impaired the normal circulation and produce patellofemoral joint compression, which accelerates the degenerative changes. Stressful environment of the working place also influence the disability.

Limitation

These data characterize only one working industries (diamond) and may not be representative of the situation occurring in a highly urbanized society or in a different climate. Our population sample may be biased because working station and environment were different in a different factory, which was not accounted for in data collection. In all of these studies, the lack of a specific dependent variable other than the subjective complaint of the intensity of disability is problematic.

Future Scope of the Study

A more rigorous methodology (like randomized controlled trial) could be employed. Ergonomic advice and follow up session could be assessed.

CONCLUSION

Prolonged use of different work postures leads different disabilities, however, low back ache seems to remain common in all age groups among all the work postures analyzed. Without back supported sitting was the worst posture attained during work. Tailor sitting revealed the lesser amount of disability when compared to both with or without back supported sitting.

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