Research Article CODEN: IJPRNK Impact Factor: 5.567 ISSN: 2277-8713
G. Biswas, IJPRBS, 2016; Volume 5(3): 129-141 IJPRBS

INTERNATIONAL JOURNAL OF PHARMACEUTICAL RESEARCH AND BIO-SCIENCE

OCCUPATIONAL HEALTH RISK OF CONSTRUCTION WORKERS: A SAMPLE BASED STUDY

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Accepted Date: 11/06/2016; Published Date: 27/06/2016

Abstract: Building construction workers are casual, poor and migratory. They are unaware about their health status. Due to wrong body postures and prolonged work, they suffer from Musculoskeletal disorder. A study is conducted to investigate the occupational health hazard on mason workers at different construction sites of Murshidabad and Nadia district of West Bengal. 124 working postures of four major construction activities i.e. brick carrying, cement mixing and carrying, mason work and roofing are analyzed by OWAS method. About 37.5%, 24.2%, 38.2% and 78% working postures related to brick carrying, cement mixing and carrying, mason work and roofing are fall in the action category 4 causing harmful effect on the musculoskeletal disorder. In addition environmental stress for working under open sky and socio economic conditions are responsible for their ill health. A modification of awkward body posture along with other preventive measures are suggested which will be beneficial to reduce their musculoskeletal pain.

Keywords: Construction workers, musculoskeletal disorder, BPD scale, OWAS method

PAPER-QR CODE

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Access Online On:

www.ijprbs.com

How to Cite This Article:

G. Biswas, IJPRBS, 2016; Volume 5(3): 129-141

INTRODUCTION

Building construction is badly needed for the development and industrial growth of a country. In India about 170 million workers are associated with construction industries. But most of them are unorganized and migratory in nature. They travel from one city to another for searching a job. Hence the relationship between employer and employee are casual. They are not enjoyed or aware about different security schemes [1-3].

Injury and illness rate of construction workers are significant among the major industries according to US Department of Labor [4] and UK Government's Health and Safety Executive [5].

In addition to daily work load they have to face environmental stresses because most of the time they have to work under open sky. Heat stress has significant impact on cardiovascular and thermoregulatory systems of the worker. They are not clothed properly and maintain work – rest cycle [6-8]. Therefore environmental stress may affect their efficiency.

Construction work related risk factors were first pointed out by Snook [9]. Award posture, repetitive action, working on elevated surfaces, manual handling of raw materials etc are the major factors for the mason workers. Musculoskeletal disorder is one of the occupational problems of the construction workers causing reduced productivity and poor living quality [10].

Many scientists and researchers have reported about different occupational health hazards among construction workers [11-20]. Due to very low cost of manpower in developing countries, manual handling of different objects are seen almost every construction site which caused most of the industrial injuries [21].

METHODOLOGY

Study area:

Murshidabad district of West Bengal is situated in the eastern part of India, is 182 km away by road from the state capital Kolkata. It is located on the left bank of the river Ganga and separated into two distinct halves by the river Bhagirathi. It has a population of 71, 02, 430 according to 2011 census with covering area of 5341 square km which makes it the 9th most population district in India. This district has a male-female ration 957:1000 with 67.53% literacy rate. This region lies under the tropical wet and dry climate according to Koppen Climate Classification. The annual temperature ranges from 12ºC to 40 ºC with a mean temperature of 27 ºC. Most of people of this district belong to lower socio-economic classes and it is now under the Backward Regions Grant Fund Programme (BRGF) as Murshidabad marked as one of the 250 most backward districts of India [22]. Most people of this region are engaged in agricultural activities, metal and brass work, Silk woven activities and construction works.

Nadia district of West Bengal is about 112km away from the city Kolkata and it is surrounded by Bangladesh, North 24 Parganas and Hooghly districts, Bardhaman and Murshidabad to the East South, West and North respectively. The population of Nadia district is about 5,168,488 according to the 2011 census. This district has a male-female ration 1000:938. Moreover the line of cancer 23½˚N is passing through this district. So the climate of Nadia district is characterized by hot summer; high humidity all the year round and well distributed rainfall during the south west monsoon season having on an average 125 rainy days. The cold season is from about the end of November to the end of February. Most people of this region are engaged in agricultural and handloom related works.

Subject selection:

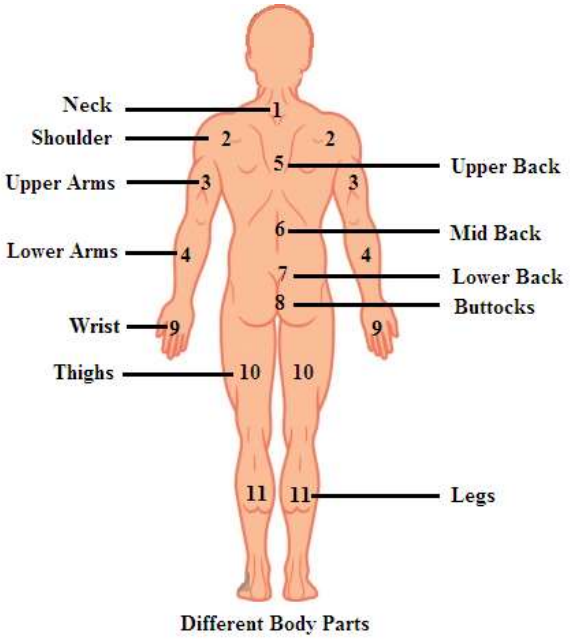
The survey is conducted at different building construction sites of Murshidabad and Nadia district in West Bengal. Four construction jobs i.e. (i) Brick carrying, (ii) Sand-Cement mixing and carrying, (iii) Mason work and (iv) Roofing of 100 mason workers are selected for video recording and posture analysis.

Physical and physiological parameters:

Height and weight of the construction workers are measured by an anthropmeter and weighing machine respectively and Body Mass Index (BMI) of the workers is calculated by using the following formula [23]:

Body Mass Index (BMI) = Weight (kg)/ Height (m^2)

Body Part Discomfort Scale:



Different Body Parts

Code	Intensity of Pain
1	Noticeable
2	Perceptible
3	Slight
4	Slightly High
5	Moderate
6	High
7	Very High
8	Severe
9	Threshold
10	Intolerable

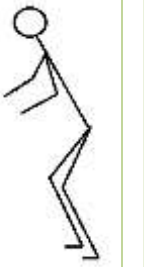
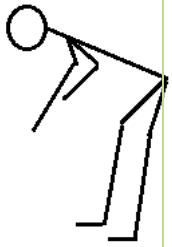
Figure 1: Pain Assessment Tools of different body parts

Discomfort or amount of pain feeling of the workers is measured by Body Parts Discomfort (BPD) scale proposed by Jacquelin *et. al.* (1994) [24] as shown in Fig. 1. It is a 10 point visual analog scale ranges from one to ten where one indicates slight pain or discomfortibility, five marks as medium pain and 10 shows very severe pain.

Working Postures:

Working postures are analyzed using OWAS method with the help of video recording process [25-27]. Then each task is taken at 10 second interval freeze frame video and posture codes are noted. Four main task of construction activity are selected for the posture analysis. Sample working postures of construction workers are given in Table 1.

Table 1: Working postures and action category for four construction tasks

Work	Photograph	Stick Diagram	Work	Photograph	Stick Diagram
Brick carrying	 OWAS 2,2,4,3=4		**Brick work**	 OWAS 3,1,5,1=4	
	 OWAS 2,1,4,1=3			 OWAS 2,1,4,1=3	
Sand-cement mixing and carrying	 OWAS 4,1,4,1=4		**Roof work**	 OWAS 4,3,4,2=4	
	 OWAS 2,1,4,1=3			 OWAS 2,1,4,1=3	

RESULTS AND DISCUSSION

Physical characteristics of the workers are presented in Table 2. From the survey it is observed that 11% mason workers have age below 30 years. 68% belong to mid age group i.e. 30 to 45 years and the rest are above 45 yrs. Workers are mainly the only earning member of the family. 62% have to maintain a family more than six members having monthly income about Rs. 500 per head. 96% of the workers live in slum area but most of them (85%) have normal BMI.

Table 2: Physical parameters of the construction workers

Parameters	Mean±SD	Ranges
Age (years)	38.7±6.4	20-50
Height (m)	1.65±0.08	1.48-1.82
Weight (kg)	63.4±4.5	52-72
BMI	23.3±1.7	18.4-28.3

Total 124 frequently maintain working postures of four main construction activities are analyzed by OWAS method and frequency distribution of the detailed codes are represented in Table 3. It is seen that most frequent brick carrying posture codes for back and arm are 4 (37.5%) and 1 (54.2%) whereas most frequent leg and load codes are 4 (squatting with knees bent) and 1 (weight handled <10 kg) respectively. In case of sand-cement mixing and carrying, the frequently maintain back code is 2 (39.4%) i.e., back is bent forward or backward followed by most harmful back code 4 (30.3%). In this process, both arms are below shoulder level during most working postures with squatting legs with both knees bent (45.5%) and load handled is <10 kg (69.7%). Back code 4 (32.3%) is obtained most frequently during brick work activity whereas 50% squatting leg postures (with both knees bent) are also seen. In the roof working process, most of the workers (69.7%) maintain their back as bent and twisted position with both arms below the shoulder level (54.5%). Almost all the workers (94%) in roof working process maintaining their legs as squatting with bent knees position whereas in 33.3% cases they need to handled load between 10-20 kg. Average OWAS codes for back, arm, leg and load are presented in Table 4 and it is observed that highest average back and leg code score are found during roof work and sand-cement mixing carrying activities. Brick carrying process

Table 3: Frequency distribution of construction postures

OWAS codes	Brick carrying (n=24)	Sand-cement mixing and carrying (n=33)	Brick work (n=34)	Roof work (n=33)
Back				
1	5(20.8%)	8(24.2%)	7(20.6%)	2(6.1%)
2	7(29.2%)	13(39.4%)	7(20.6%)	8(24.2%)
3	3(12.5%)	2(6.1%)	9(26.5%)	0
4	9(37.5%)	10(30.3%)	11(32.3%)	23(69.7%)
Arm				
1	13(54.2%)	21(63.6%)	31(91.2%)	18(54.5%)
2	4(16.7%)	4(12.1%)	3(8.8%)	9(27.3%)
3	7(29.1%)	8(24.2%)	0	6(18.2%)
Leg				
1	0	0	0	0
2	4 (16.6%)	10(30.3%)	10(29.4%)	1(3.0%)
3	1(4.2%)	0	0	0
4	15(62.5%)	15(45.5%)	17(50.0%)	31(94.0%)
5	1(4.2%)	1(3.0%)	4(11.8%)	0
6	0	0	1(2.9%)	0
7	3(12.5%)	7(21.2%)	2(5.9%)	1(3.0%)
Load				
1	14(58.3%)	23(69.7%)	34(100%)	22(66.7%)
2	2(8.3%)	10(30.3%)	0	11(33.3%)
3	8(33.3%)	0	0	0

Shows the highest mean arm code scores with highest load handled scores. Figure 2 illustrates the frequency distribution of OWAS action category during four main processes of construction work. It is noted that 29.2%, 27.3%, 20.6% and 37.5%, 24.2%, 38.2% working postures of brick carrying, sand-cement mixing and brick work respectively are fall in the action category 3 and 4 which indicates these postures have distinct to extreme harmful effect on the musculoskeletal system of construction workers. As most of the roof works are done in squatting position, it is observed that 78.8% roof working postures are fall in the most severe action category 4. 23% and 45% postures of total construction work are also falling in

Table 4: Average OWAS codes for construction processes

OWAS codes	Brick carrying (n=24)	Sand-cement mixing and carrying (n=33)	Brick work (n=34)	Roof work (n=33)
Back (1 – 4)	2.66	2.42	2.70	3.33
Arm (1 – 3)	1.75	1.60	1.08	1.63
Leg (1 – 7)	4.04	4.06	3.76	4.03
Load/force (1 – 3)	1.75	1.30	1.0	1.33

The AC3 and AC4 (Fig. 3) indicating workers' wrong and harmful working postures in this sector. In general, the workers have to engage in their masonry work for more than 8 hrs per day with an interval of lunch break at about 13:00 hrs (IST). The work generally starts from 09:00 hrs (IST) and continues even after 18:00 hrs (IST) to complete the task for that day.

The prolonged working hours for days together give rise to musculoskeletal disorder and pain. Regarding the intensity of pain about 48% feel moderate pain provided they worked more than twenty years and belong to the age group above 45 years.

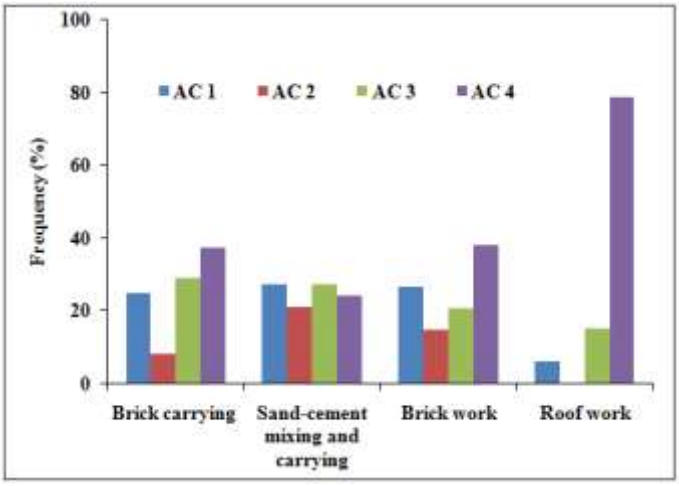


Figure 2: Frequency distribution of action category of different construction processes

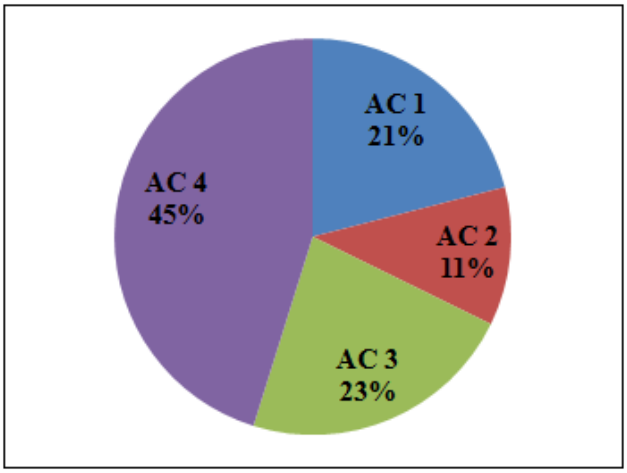


Figure 3: Frequency distribution of OWAS action category of complete construction process

CONCLUSIONS

33% brick carrying postures are found severe to very severe action category (3 and 4) due to workers' lifting high load with bent and twisted back and squatting leg positions. Bent and twisted back, both knees bent squatting leg position with raised arm makes 25% sand-cement mixing and carrying postures extremely harmful for the musculoskeletal system. More than 38% brick work postures are also found in OWAS action category 4 due to frequently maintain wrong back and leg positions. As 94% workers done the roof work in very harmful squatting with knees bent position and it is interesting to observed that about 79% roof working postures are fall in the most sever action category 4. It is found that about 45% working postures of whole construction process are in the OWAS action category 4, it suggests corrective measure should be taken immediately as these postures have extreme harmful effect on the

musculoskeletal system. Only 20.9% working postures are found as normal postures without harmful effect on the musculoskeletal system of the workers.

83% of the workers have experienced musculoskeletal related discomfort and pain after daylong hard work. It is noticed that workers having age about 30 years with less than five years experience have no musculoskeletal problem. Upper body pain is the major discomfort reported by 68% workers. Intensity of pain of ~48% workers fall in the range moderate to high according to BPD scale.

Sitting support in all types of squatting leg position in construction work has a positive feedback in lowering the risk of musculoskeletal disorders. It is observed that over Kalyani, Nadia more than 41% days of summer and 70% monsoon days are fall in discomfort zone. Therefore proper work-rest cycle and adequate fluid intake following ACGIH guidelines [28] and USARIEM [29] may help to overcome health problem related to environmental stress. In addition some modification of awkward body posture will be beneficial to reduce musculoskeletal pain as shown in Table 5.

Table 5: Suggested Control measure to reduce health problems

Posture	C1	C2	C3	C4	C5	C6	C7	C8
Brick carrying	+		+	+		+	+	+
Sand-cement mixing	+		+				+	+
Brick work	+		+		+	+	+	+
Roof work	+	+	+		+	+	+	+

C1 – Stop twisting of back, C2 – Use arm support, C3 – Stop squatting of legs, C4–Reduce of load, C5 – Use sitting support,C6- proper work rest cycle, C7- Fluid intake and C8 - Regular health check-up

ACKNOWLEDGEMENTS

Authors are thankful to the University Grants Commission, New Delhi and University of Kalyani for the financial support. Authors are also grateful to all the workers of the study for their active participation and co-operation.

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