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Original Research Article

Comparative study of morbidities in sawmills workers from central India: a cross sectional study

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ABSTRACT

Background: The main problem encountered in the sawmill environment is the respirable dust (<10 µm) which may be a cause of respiratory diseases. Further the sawmill workers are also exposed to other health hazards such as injuries from handling wood logs, high noise exposure etc. There are few studies who have studied respiratory health of sawmill workers in India but there is paucity of studies on sawmill workers and their health problems in India. So the study has been undertaken to find out the chief morbidities among sawmill workers by comparing them in control group.
Methods: A cross sectional study was conducted among sawmill workers in Nagpur city in central India from September 2013 to December 2015. Information regarding socio-demographic characteristics collected using predesigned proforma by interview technique. Thorough general, systemic examination and anthropometry was done to assess health status.
Results: Majority of the study subjects were males and belonged to younger age group (28-37 years). Most common morbidity among sawmill workers was musculoskeletal disorder (Table 4) and it was significantly more than comparison group ($p<0.05$). Some of the other significantly common morbidities among sawmill workers ($p<0.05$) were conjunctivitis, rhinitis, injuries, hearing impairment, ARI's, bronchial asthma, chronic bronchitis, contact dermatitis, abdominal hernia, varicose veins and pulmonary tuberculosis.
Conclusions: Musculoskeletal disorders were the commonest morbidity among sawmill workers. Respiratory morbidities and other allergic effects of wood dust were other common morbidities among sawmill workers.

Keywords: Sawmill workers, Health profile, Wood dust, Morbidities

INTRODUCTION

Wood has been harvested and processed for centuries all over the world for various purposes.[1] In India it is used mainly as a fuel and construction material but before it can be used as a construction material it is subjected to sawing. Sawmill is a facility where logs are cut into boards.[2]

Large population is employed in sawmill industry in India. The main problem encountered in the sawmill environment is the respirable dust (<10 µm).[2] Around 2 million people are exposed to the wood dust every year.

Though there are many varieties of wood but commonly sawed are teak (*Tectona grandis*), seesam (*Dalbergia sisso*), mango (*Magnifera indica*) etc. Bhattacharjee et al have studied the toxicity of these types of wood species through animal studies and reported their chemical

constituents. Rastogi et al have reported restrictive type of respiratory impairment in workers exposed to sawdust of mango and seesam. Occupational exposure to wood dust may be a cause of respiratory diseases such as hypersensitivity pneumonitis (allergic alveolitis), rhinitis, asthma and chronic obstructive lung disease.[3,4]

Further the sawmill workers are also exposed to other types of health hazards such as injuries from handling wood logs, saw blade and unguarded machine parts, high noise exposure etc.

There is paucity of studies on sawmill workers and their health problems in India. This study therefore aimed at studying various morbidities in sawmills workers by comparing them in control group.

METHODS

A cross sectional study was conducted among Sawmill workers in Nagpur city in central India. Study duration was from September 2013 to December 2015. Inclusion criterion was saw mill workers exposed to saw dust as study group. Log transporters in sawmills whose exposure to wood dust is minimal were excluded.

Approval from the Institutional Ethics Committee was sought before the start of study. List of registered sawmills was obtained from the department of forest. A pilot study was carried out on 50 sawmill workers to assess the feasibility; test the proforma and get an idea about the prevalence of common morbidities in sawmill workers.

Musculoskeletal disorder (MSD) was found to be the most common morbidity in workers. (69%)

- Prevalence (p) = 0.69
- Relative error (d) = 10% of p. = 0.069
- Z (1-α) = 1.96 for 95% confidence interval.
- Sample size (n) of the study = $z\ (1-\alpha)^2 \times p \times (1-p) \div d^2$
  $= 3.84 \times 0.69 \times 0.31 \div 0.07^2$
  $= 172.52$

Based on the prevalence of MSD (69%) in the pilot study which was the commonest morbidity among sawmill workers, the estimated sample size was 172.52.

Two sawmills were selected randomly. All the workers in selected sawmills except log transporters were enrolled in the study i.e. 180.

Large homogenous group of local government workers were purposively selected by matching them with the selected sawmill workers in terms of socio-demographic characteristics such as age, sex (frequency matching).

So 180 sawmill workers and 180 comparison group (SRPF) workers were selected.

The necessary permission for carrying out the study was obtained from the owner of the sawmill and appropriate authority in case of local government workers after apprising them about the nature and purpose of the study.

After obtaining the necessary consent and explaining the nature and purpose of the study, data was collected as per the guidelines of international labour organization, at suitable timings convenient to both workers as well as the appropriate authority in order to seek their maximum co-operation.

There were various departments with different job descriptions in sawmills. When the tree logs transported from the forest, the log loaders transport the logs to the milling machine (log transporters); after the logs are cut into wide planks by the machine operators (cutters), stacked directly (stackers). There were laborers who assist in various operations (helpers). There was also an administrative staff that serves as the supervisor /manager /clerk / technician of the sawmill industries.

Information regarding socio-demographic characteristics collected using predesigned proforma by interview technique. Thorough general, systemic examination and anthropometry was done to assess health status.

Height of the subjects was measured using stadiometer (Seca) to the nearest 0.1 cm.[5] Body weight was measured in light clothing, without shoes to the nearest 0.1 kg using the electronic weighing machine.[6]

Hearing function assessment done by Rinne's test and Absolute bone conduction test using tuning fork.[7]

Operational definition of some important terms

*Physical deformity***:** Acquired loss or malpositioning of finger, toes, limbs or other body parts.

*Musculoskeletal disorders***:** Person with symptoms as myalgia, pain in the limbs/back/joints is labelled as having musculoskeletal disorders.

*Bronchial asthma***:** Recurrent episodes of wheezing, breathlessness, chest tightness with or without cough particularly at night or in the early morning with or without decrease in FEV_1or known cases those who are taking asthma medication.

Chronic bronchitis: This is a productive cough that lasts for three months or more per year for at least two years.

*Varicose veins***:** Dilated and tortuous veins. Brodie tredelenberg test used to confirm diagnosis.

*Abdominal Hernia***:** Protrusion of whole or part of viscous through the abdominal wall that contains it. Expansile cough impulse, reducibility and other test such as

Ziemans technique, ring occlusion test were used as necessary to confirm diagnosis.

Respiratory morbidity: If any one of asthma, chronic bronchitis, T.B., rhinitis and acute respiratory infection is present among study subjects then respiratory morbidity is said to be present.

Cardiovascular morbidity: Any one of hypertension, ischemic heart disease, piles and varicose veins is present among study subjects then cardiovascular morbidity is said to be present.

Statistical analysis

The data was analyzed using Epi info 7.0.1. The quantitative variables were expressed in terms of mean and standard deviation and the qualitative variables were expressed in percentages. Chi square test was used to find the difference between two proportions. Fischer exact test and chi square test for trend was used wherever applicable. Unadjusted odd's ratio was calculated for various morbidities.

RESULTS

Sawmills were located in the outskirts of Nagpur city. Main wood species used for sawing was *Tectona grandis* (Teak). In total, 360 workers were employed in the study, 180 of them sawmill workers (study group) and 180 local government workers as a control group.

Socio-demographic characteristics of study subjects mentioned in the Table 1. It shown that majority of the study subjects were males (87%) and belonged to younger age group (28-37 years). But the two groups differ in socioeconomic status and education. Most of the sawmill workers were from lower socioeconomic class and had low level of education as compared to control group.

Table 1: Distribution of study subjects according to socio-demographic characteristics.

Socio-demographic characteristics		Sawmill workers		Comparison group	
		No.	%	No.	%
Age group (Years)#	18-27	46	25.55	46	25.55
	28-37	88	48.88	88	48.88
	38-47	25	13.89	25	13.89
	48-57	18	10.00	18	10.00
	58-67	03	00.00	03	00.00
Gender#	Male	157	87.22	157	87.22
	Female	23	12.78	23	12.78
Socioeconomic status*	I	05	02.78	120	66.66
	II	39	21.66	47	26.11
	III	50	27.78	07	03.89
	IV	77	42.78	05	02.78
	V	09	05.00	01	00.56
Education	Illiterate	18	10.00	01	00.56
	Primary	57	31.67	06	03.33
	Middle school	71	39.44	30	16.66
	High school	23	12.78	75	41.67
	Diploma	03	01.67	40	22.22
	Degree	08	04.44	27	15.00
	Postgraduate	00	00.00	01	00.56

*As per the B.G. Prasad Scale[24] # Age and gender were matched.

Table 2: Distribution of sawmill workers according to category of work.

Category of work	Study group	
	No.	%
Cutter	57	31.66
Helper	103	57.22
Stacker	12	06.67
Clerk	03	01.67
Technician	02	01.11
Supervisor	03	01.67
Total	180	100

Table 3: Distribution of sawmill workers according to duration of work.

Duration of work (years)	Study group	
	No.	%
<5	86	47.78
6-10	51	28.33
11-15	27	15.00
>16	16	08.89
Total	180	100

Mean duration of work (years)= 7.59±5.89.

Table 4: Distribution of study subjects according to morbidities.

ICD codes	Morbidities	Sawmill workers		Comparison group		χ^2	P value	OR (95%CI)
		No.	%	No.	%			
M13.9	Musculoskeletal disorders	139	77.22	57	31.67	75.31	<0.001	7.32 (4.58-11.69)
H10.4	Conjunctivitis	81	45.00	04	02.22	91.31	<0.001	36 (12.81-101.21)
J30.3	Rhinitis	75	41.67	07	03.89	73.02	<0.001	17.65 (7.84-39.75)
	Injury	72	40.00	02	01.11	83.35	<0.001	59.33 (14.27-246.76)
H91.9	Hearing impairment	66	36.67	16	08.89	39.48	<0.001	5.93 (3.27-10.77)
J00-J22	Acute respiratory infection	55	30.56	38	21.11	04.19	<0.05	1.64 (1.01-2.65)
I10	Hypertension	54	30.00	57	31.67	0.12	0.73	0.92 (0.59-1.44)
J45	Bronchial asthma	33	18.33	10	05.56	13.97	<0.001	3.81(1.82-8.01)
J41	Chronic bronchitis	25	13.89	04	02.22	16.54	<0.001	7.10 (2.42-20.84)
L23.8	Contact dermatitis	23	12.78	07	03.89	09.31	<0.05	3.62 (1.51-8.67)
K64.9	Haemorrhoids	19	10.56	13	07.22	01.23	0.27	1.52 (0.72-3.17)
K40, K46	Abdominal hernia	17	09.44	07	03.89	04.46	<0.05	2.58 (1.04-6.38)
I83	Varicose veins	11	06.11	1	00.56	08.62	<0.05	11.65 (1.49-91.22)
A15.0	Pulmonary tuberculosis	09	05.00	02	01.11	04.59	<0.05	4.68 (0.99-21.99)
A09.0	Acute gastroenteritis	08	04.44	11	06.11	0.50	0.48	0.71 (0.28-1.82)
E14.9	Diabetes mellitus	03	01.67	19	10.56	12.39	<0.001	0.14 (0.04-0.49)
I20, I21, I25	Ischemic heart disease	03	01.67	07	03.89	*	0.34	0.42 (0.11-1.65)
M20	Physical deformity	03	01.66	02	01.11	*	1	1.51 (0.25-9.14)

*Fisher exact test for two categorical variables.

Table 5: Distribution of sawmill workers according to morbidities and duration of work.

Morbidities	Duration of exposure (Years)								Total	
	≤5 n=86		6-10 n=51		11-15 n=27		≥16 n=16		n=180	
	No.	%	No.	%	No.	%	No.	%	No.	%
Respiratory	69	80.23	39	76.47	20	74.07	11	68.75	139	77.22
Cardiovascular	24	27.91	23	45.10	17	62.96	10	62.50	74	41.11
Hernia	03	03.49	06	11.76	05	18.52	03	18.75	17	09.44
Musculoskeletal	70	81.40	36	70.59	21	77.78	12	75.00	139	77.22
Skin	12	13.95	06	11.76	04	14.81	01	06.25	23	12.78
Injuries	38	44.19	14	27.45	12	44.44	08	50.00	72	40.00
Hearing impairment	22	25.58	17	33.33	16	59.26	11	68.75	66	36.67

χ^2 trend (cardiovascular)= 13.23; p<0.001; χ^2 trend (hernia)= 6.79; p<0.05; χ^2 trend (hearing impairment)= 15.95; p<0.001.

Table 6: Distribution of sawmill workers according to morbidities and category of work.

Morbidities	Category of work								Total	
	Cutters (n=57)		Helpers (n=103)		Stackers (n=12)		Supervisors and others (n=8)			
	No.	%	No.	%	No.	%	No.	%	No.	%
Respiratory	48	84.21	76	73.79	11	91.66	04	50.00	139	77.22
Cardiovascular	26	45.61	40	38.83	04	33.33	04	50.00	74	41.11
Hernia	06	10.53	07	06.80	03	25.00	01	12.50	17	09.44
Musculoskeletal	44	77.19	79	76.70	09	75.00	07	87.50	139	77.22
Skin	07	12.28	14	13.59	01	08.33	01	12.50	23	12.78
Injuries	30	52.6*	37	35.92	04	33.33	01	12.50	72	40.00
Hearing impairment	22	38.60	38	36.89	05	41.67	01	12.50	66	36.67

*Injuries significantly more in cutters than others [χ^2=5.55; df=1; p=0.01; OR=2.14 (1.13-4.06)].

Most of the sawmill workers working in cutters (31.66%) and helpers (57.22%) section while least (around 5%) were employed in the administrative section (Table 2). Study of distribution of sawmill workers according to duration of work (Table 3) shown that mean duration of work (years) was 7.59 with standard deviation of 5.89. Majority of the workers (47.78%) from our study had work exposure less than 5 years. 8.89% of the workers had work exposure of more than 16 years.

Most commonly sawmill workers were suffered from musculoskeletal disorders (Table 4) and it was significantly more than comparison group ($p<0.05$). Some of the other significantly common morbidities among sawmill workers ($p<0.05$) were conjunctivitis, rhinitis, injuries, hearing impairment, ARI's, bronchial asthma, chronic bronchitis, contact dermatitis, abdominal hernia, varicose veins and pulmonary tuberculosis.

When we studied the distribution of sawmill workers according to morbidities and duration of work (Table 5) we found that cardiovascular morbidity, hernia and hearing impairment had shown significantly ($p<0.05$) increasing trend with duration of work.

Study of morbidities according to category of work (Table 6), conclude that cutters were significantly ($p<0.05$) more prone to injuries than the workers in other section, while the other morbidities did not show any significant difference between various categories of work.

DISCUSSION

In our study workers employed in sawmills were exposed to high concentration of sawdust besides the other risk factors.

In the present study majority of the sawmill workers were young productive males in the age group of 28-37 years with mean age 33.60±9.53 years. These findings were in line with the findings of Hessel et al, Deshpande et al (38.1±8.1 years), Adeoye et al (34.53±11.01 years) and Ismaila et al, Bello et al found that majority of the participants were belong to the age group of 25-44 years.[8-12] It indicates that this occupation demands young productive workforce.

Most of the participants from the study group had low level of education. Similar findings were reported by Yusuff, et al and Wani, et al.[13,14]

Majority of the sawmill workers had low socioeconomic profile and were employed in the wood cutters or helper category so they were more consistently exposed to the sawdust than the workers in administrative category like technician, clerk etc. In our study most of the workers had sawdust exposure of $\leq$5 years with a mean duration of exposure (years)= 7.59±5.89 years. These findings are consistent with the findings of Oluwatosin et al, Ugheoke et al.[15,18] However contradictory observations were noted by Sakariya et al and Boskabady et al.[1,16] This could be due to the unskilled workers employed in unorganized sector with frequent job changing tendency in present study.

In the present study sawmill workers significantly suffered from musculoskeletal disorders than comparison group. [χ^2=75.31; $p<0.001$; OR=7.32; 95% CI (4.58-11.69)]. This could be due to the awkward posture of sawmill workers working for long hours and carrying excessive weight (wood logs). This finding was supported by Ismaila et al who found that musculoskeletal disorders were common among sawmill workers.[11]

Other common morbidities were conjunctivitis, rhinitis, hearing impairment, acute respiratory infection, bronchial asthma, chronic bronchitis, contact dermatitis in the sawmill workers and significantly more than in the comparison group [$p<0.05$]. Similar findings were reported by Wani et al, Fatusi et al.[14,17]

Ugheoke et al, Boskabady et al reported high prevalence of respiratory morbidities among sawmill workers than the control group.[15,16]

This could be due to chronic dust exposure which impairs the phagocytic activity of alveolar macrophages and also affects the mucociliary performance. When the dust particles are inhaled, scavenger cells like macrophages dissolve the dust by surrounding it, but if there is dust overload, the macrophages fail to completely clear the dust; consequently the dust particles lodge in and irritate the respiratory mucosa.[18-20]

Bello et al found high prevalence of injury i.e. 83%.[12] This may be due to sawmill in our study were large and most of tasks which prone to injury were mechanized so we may have found less prevalence of injury (40%) in our study.

In this study we found that cardiovascular morbidities [χ^2 trend = 13.23; p≤0.001], hernia [χ^2 trend=6.79; p≤0.05] and hearing impairment [χ^2 trend =15.95; p≤0.001] have shown significantly increasing trend with duration of work. Similar findings were reported by Shrivastava et al who found respiratory and gastrointestinal (hernia) morbidities had shown significantly increasing trend as the duration of work increased.[21]

Alamgir et al found significant negative trend for injuries i.e. injuries decreased as the duration of work increased.[22] Serious injuries decreases as the working duration increases as the skill increases but in our study most of the injuries were minor and occurred due to wood handling, that does not depend on skill, further skilful tasks were mechanized so we could not find any trend for injury.

Mandryk et al found significant dose-response relationships for respiratory morbidity but in our study we did not find significant trend for respiratory morbidities.[23] This may be due to that respiratory disorders discussed in our study take years to manifest and most of the subjects in our study had <5 years of work exposure.

Only injuries were found to be significantly more in cutters than others [χ^2=5.55; df=1; p=0.01; OR=2.14 (1.13-4.06)]. Also Bello et al reported significantly more injuries among cutters.[12]

CONCLUSION

Musculoskeletal disorders were the commonest morbidity among sawmill workers. Respiratory morbidities and other allergic effects of wood dust were other common morbidities among sawmill workers.

Cardiovascular morbidities, hearing impairment and hernia were chronic morbidities and they have shown increasing trend with the duration of work.

Cutters were more prone to injuries than the sawmill workers working in the other section. Controlling the dust in occupational environment, safety education, periodic medical examination and occupational training could solve majority of these problems.

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