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An Assessment of Socio-economic Status and Occupational Health Hazards of Female Workers in Brick Industries at Western Maharashtra, India

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ABSTRACT

The objective of current research work is to assess the socio-economic scenario of the female brick workers and occupational health hazards of the brick industries located in the Pravara River basin from western Maharashtra, India. The entire study is based on primary data which has been collected from extensive field survey through standard questionnaire in the period of October 2022 to May 2023. Total 112 FBW of 14 sites and 8 female brick workers from each site have been selected along Pravara River based on random purposive sampling. The Kessler Psychological Distress Scale (K10) has been implemented to measure the current psychological level of FBW. The paired t-test and McNemer's analysis have been used for examine sleep duration and sleep quality on and off shift days. The 3 points Likert Scale has been used to examine the occupational health hazards and health problems of FBW. Descriptive statistics were used to summarize and tabulate the data. The socio-economic condition of the FBW indicated that 96% of FBW live in extremely poor condition, 86.61% FBW lives in kutcha house, 78.57% FBW earn about ₹1500/month which is very low income and 69.64% FBW are illiterate. No school and crèche provision for children has been provided by brick owner or local government. The leading causes of occupational hazards were fall from height, stuck by objects, slippage and snake and insect bite as well as after join brick occupation majority of FBW experienced respiratory, skin, eye and gastrointestinal problems. 92.86% of FBW spend long hours (> 12 h) to acquire higher wages. FBW reported longer sleep duration (6.5 ± 0.62 h vs 7.8 ± 0.74 h and p<0.001) and sleep

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quality (83.92% vs 18.75%) during off-shift day than on-shift day which were linked to moderate psychological distress (33.93%). The study concluded that sustainable approach should be taken to improve the socio-economic condition of FBW and to minimize occupational health hazard in the brick kilns.

Keywords: Socio-economic status, Occupational health hazards, Psychological distress, FBW

INTRODUCTION

Geographically India is second largest brick producing country in South Asian region after China. India produced more than 140 billion bricks annually and the brick kiln sector contributes to 11% of its Gross Domestic Product (GDP). India estimated to have more than 1, 50,000 registered and unregistered brick kilns (CPCB 2017). In India brick production units are widely scattered and located in general rural and semi-urban areas. These industries are the major users of natural resources, energy, labor and capital (Duddagi and Jadhav, 2020). It is a seasonal industry with a seasonal employment opportunity (Rupaketi et al., 2018). It is labor intensive industry (Bhat, 1994) which provides direct employment to more than 8 million workers. Female workers in the brick industry are almost equal in number to the male workers because industry required unskilled labors without education (Khan and More, 2015). Female workers carry the work of bearing and rearing children along with work in brick kilns. Female workers belongs economically poor background. The brick industry is the major source for brick laborers for the income and fulfills their daily necessities. Income from brick units helps to bring economic changes in the life of brick workers (Das, 2013) but it also bring drastic changes in social environment.

The occupational factors also play an important role in affecting health of employees (Das, 2017). Occupational health is the promotion and maintenance of the highest degree of physical, mental and social well-being of the workers at work place (WHO, 2015). Most of the kilns are developed on roadsides due to lack of proper allotment of space for the construction of brick kiln in India or along riverside which pose health risk to the brick kiln labors (David et al., 2020). There is a higher probability of several occupational and environmental hazards (Das, 2020) due to the labor intensity and traditional way of manual brick making process (Ijaz et al., 2020). There are around 340 million occupational accidents and 160 million victims of work-related illness annually have reported worldwide (ILO, 2019). Female workers in several manual brick manufacturing units are suffering from occupational problems (Kumari, 2018) in terms of respiratory, gastrointestinal, skin, eye and ear (Duddagi and Jadhav, 2020; Venugopal et al., 2016). The female brick workers mainly posed with physical, chemical, biological and psychosocial hazards (Rupaketi et al., 2018). Handling material and carrying weight adds burden to the already malnourished body structure of female workers (Ijaz et al., 2020). Furthermore, some studies had reported that these workers suffer from assorted health problems (Das, 2021) due to handling of heavy loads without taking adequate rest breaks (Sett and Sahu, 2014). Female workers had a higher prevalence rate of work related musculoskeletal disorder (MSDs) (Bijetri and Sen, 2014). Brick kiln work has taken place at extreme temperature, emitting masses of black smoke containing harmful gases, brick dust, silica, carbon monoxide (CO), sulfur dioxide (SO_2), fluoride compounds and nitrogen oxides (NO_2) which pollutes the environment and affect human health (Rupaketi et al., 2018; David et al.,

2020). Biological hazards have reported due to contact with soil, insects and animals surprisingly snake and scorpio bites at some of the unit (Duddagi and Jadhav, 2020).

The brick industry is an important cottage industry in Pravara River basin. In this point of view, brick kiln industry located in Pravara River basin has been selected for current research work. The growth of population has been reported time to time which resulted as more number of brick kiln industries in the study area. It is easy source of money earning specially for female workers of rural area hence most of the female workers have been engaged in brick kiln industries in the study area. The objective of current research work is to understand socio-economic condition of the female brick workers (FBW), occupational health hazards of industry and to suggest the remedial measures for the same. This research will helpful to highlight the standard of living, socio-economic scenario and problems of the FBW which will provide guidelines to policymakers.

STUDY AREA

Pravara River is a one of the major right hand tributary of the River Godavari which is an important drainage system of western Maharashtra. The northern part of the Ahmednagar district of Maharashtra is drained by Pravara River. The study area extends between 19^0 23' 25.71" N to 19^0 45’ 23.25" N latitudes and 73^0 37’ 14.02" E to 74^0 49’ 40.06" E longitudes with 366.13 km perimeter and the elevation of the basin range in between 470 to 1646 m MSL. The study area covers 2653.8 km^2 area and formed the dendritic drainage network. The river rises at Ratangarh on the elevation of 1280 m MSL on the eastern slope of Sahyadri ranges between Kulang and Ratangarh peaks. River Pravara flows about 208 km in eastward direction with 7^{th} order stream network. It flows through Akole, Sangamner, Rahata, Shrirampur and Newasa Tehsils of the Ahmednagar district (Fig 1).

The area is covered by basaltic lava flow related to Deccan volcanic activity of late cretaceous to Eocene period. The area is dominated by Black cotton (*Regur*) soil. Alluvium deposits are developed along main stream which is good for cultivation of sugarcane, pulses, fodder and fruits. The study area is characterized by semi-arid climatic condition and it falls under Western Maharashtra Water Scarcity Zone. The distribution of rainfall is mostly uneven, the western part of the study area receives highest rainfall (>1500 mm) but in eastern part it is more erratic (<500) because the basin is located immediately on the leeward side of the Sahyadri Ghat (Kharake et al., 2021). The average annual rainfall of the area is 501.8 mm. Natural vegetation in the study area represents the southern tropical dry deciduous forest cover.

Total population of study area is 1785291 which account 38.42% of district population (Census, 2011). Agriculture is major occupation in the study area and approximately 61% of population has engaged in agriculture activity. Significant changes in agricultural practices have been observed due to construction of dam in the upper part of the study area. Pravara River and its canals are major source of irrigation and have facilitated setting up of a number of sugar factories, brick industries, cotton ginning, engineering units, oil making and jaggery making activities in the area. The brick making industry is one of the wide spread industry in the study area. The growth of population leads to increased demand of bricks, ultimately results growth and development of brick industries (Kumbhar, 2007).

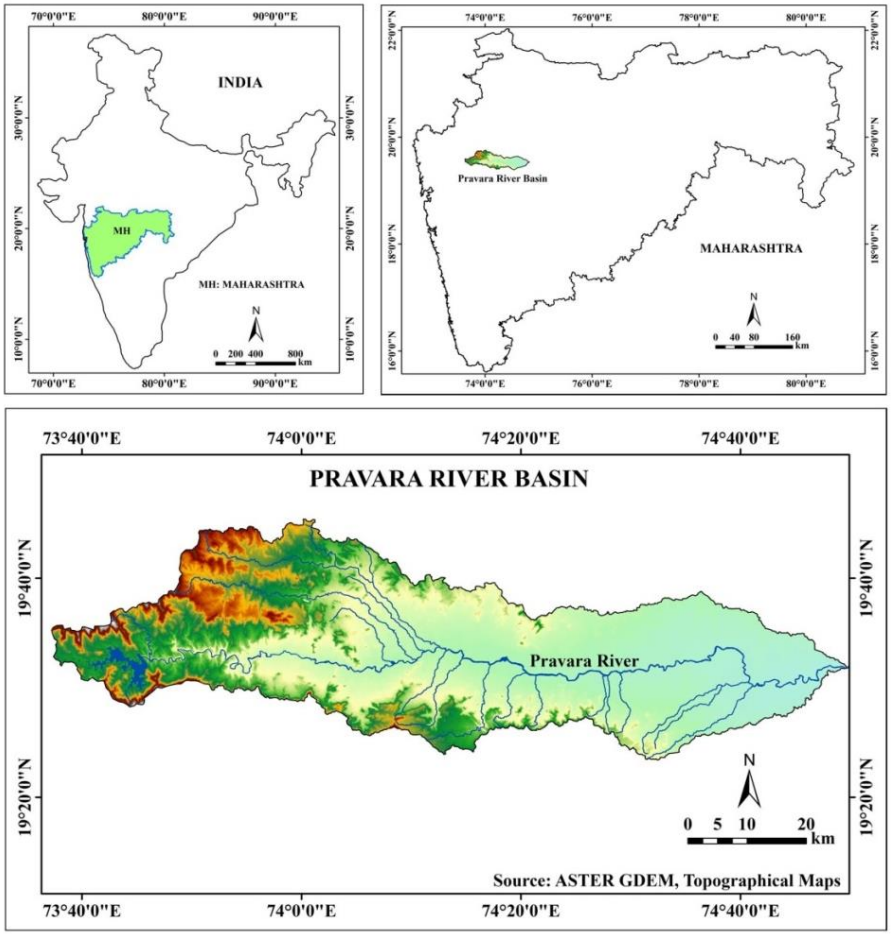

Fig 1: Location of the study Area

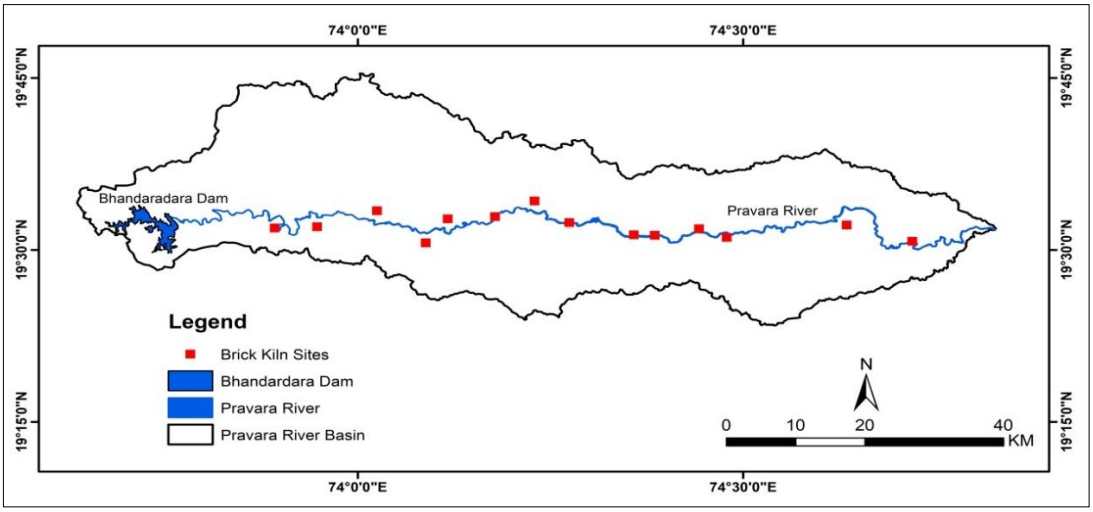

Fig 2: Selected brick kiln sites in the study area

DATA COLLECTION AND METHODOLOGY

The entire study is based on primary data which has been collected from extensive field survey through standard questionnaire in the period of October 2022 to May 2023. Total 112 FBW of 14 sites (Fig 2) and 8 female brick workers from each site have been selected along Pravara

River based on random purposive sampling. The selection criteria of the female workers considered as those were aged above 18 years and engaged in all operations at brickfields. The questionnaire has been designed based on socio-economic, educational and psychological factors which include age, marital status, family size, migration, off-season occupation and emotional situations of FBW. Additionally, to understand the intensity of the FBW problems the work-related measures which deal with the working hours, experience, designation, residence type, the basic facilities provided by brick industry owner etc. have been studied.

The Kessler Psychological Distress Scale (K10) has been implemented to measure the current psychological level of FBW. The test measures negative emotions i.e. nervous, depressed, restless or hopeless etc. stated by FBW about last 30 days. The K10 criteria indicates score under 20 are likely to be well, score 20-24 likely to have a mild mental disorder, score 25-29 moderate mental disorder and score above 30 likely to have a severe mental disorder. The cross-tabulation has been performed to get the frequency and percentage of the mentioned categories. The occupational hazards and health problems have been identified using statistical techniques such as mean and standard deviation. The paired t-test and McNemer's analysis have been used for examine sleep duration and sleep quality on and off shift days. If P value shows **<**0.001 result, it represents highly significant relation between two variables and if it is 0.05 then non-significant relation. Always (3), sometime (2) and never (1) these 3 points Likert Scale has been used to examine the occupational health hazards and health problems of FBW. It has been helped the individual to express the intensity of the problem with particular statement.

RESULT AND DISCUSSION

Demographic Profile of FBW

The study of educational status, family size, marital status etc. is essential to assess the demographic profile of FBW which may enhance the social and personal status of the workers. Table 1 indicates that 70.54% FBW were belonged to the age group 25-44. Out of total targeted group 66.07% married women were engaged in the brick field and majority of them working with their husband. It has been observed that 69.64% FBW were illiterate followed by primary (19.64%) and secondary (10.72%) level in the study area. It may due to traditional nature of brick industry which can manage with the help of unskilled labors. The more illiteracy found due to poor living and migratory nature of workers. It has been observed that the family size of the FBW, 42.85% workers have more than 6 persons in the family which indicates poorness of FBW and remaining 52.68% have 4 to 6 persons whereas only 4.46% FBW have 1 or 2 persons in their families, which represents negative association between family size and economic condition (Namboodiri, 1970). Most of the FBW in the study area have been worked together with their whole family for better wages. The migratory status highlights that due to the easy availability of jobs in the brick field and better wages majority of local FBW (50.89%) belonging from nearby villages and 45.54% FBW were from the same district.

Socio-economic Profile of FBW

An analysis of socio-economic parameters comprises study of annual income, size of family, education, health and standard of living (Miles, 2018). Income from brick industry is the major source for FBW to fulfill their daily necessities which helps to bring economic changes in FBW but it also brings changes in social scenario. Table 2 and figure 3 have been represented that maximum participants (78.57%) were working for annual income 15000-20000 rupees; only

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2.68% of female workers earned annual income more than 20000 rupees. It has been found that many FBW have been worked together with their whole family to earn higher wages. Maximum female workers (61.61%) have 2 earning members in the family, it may resulted due to the most of female works with their husband and only 19.64% FBW were working alone for their family.

The brick industry remains working only about 8 months (from October to May) so the nature of brick industry is seasonal. Rainy season is an off-season for brick industry and construction industry therefore the employment of workers is also seasonal. During the off-season of brick industry FBW should search for another work for the source of income for livelihood. It also noticed that many villages have small land holders who cannot run the agricultural activities due to lack of water so they prefer brick work. Many of them leave their villages and settled at brick unit, so during off-season they returned at their own village and work on their agriculture field. It has been found that majority (63.39%) of FBW engaged in agriculture practices during off-season. Most of FBW have been answered during the discussion that brick unit owner has their own agricultural land, dairy or poultry units in which they practice during off-season.

Table 1: Distribution of demographics of Female Brick Workers (*N*=112)

Personal Characteristics	**Frequency**	**Percent**
Age in years		
<24	13	11.61
25-34	38	33.93
34-44	41	36.61
45<	20	17.86
Marital Status		
Single/Unmarried	6	5.36
Married	74	66.07
Widowed/ Separated/Divorcee	32	28.57
Number of Children		
None	6	5.36
1	2	1.79
2	24	21.43
3	33	29.46
4+	47	41.96
Educational Status		
Illiterate	78	69.64
Primary	22	19.64
Secondary	12	10.72
Number of Family Member		
1-3	5	4.46
4-6	59	52.68
6+	48	42.86
Migration		
Local	57	50.89
Same District	51	45.54
Other District	4	3.57

Table 2: Socio-economic profile of Female Brick Workers (*N*=112)

Annual Income (Rs)	**Frequency**	**Percent**
<15000	21	18.75
15000-20000	88	78.57
20000<	03	2.68
Number of earning members in the family		
1	22	19.64
2	69	61.61
3	15	13.39
4+	06	5.36
Off-season occupations		
Agriculture	71	63.39
Dairy	17	15.18
Poultry	13	11.61
Other	11	9.82

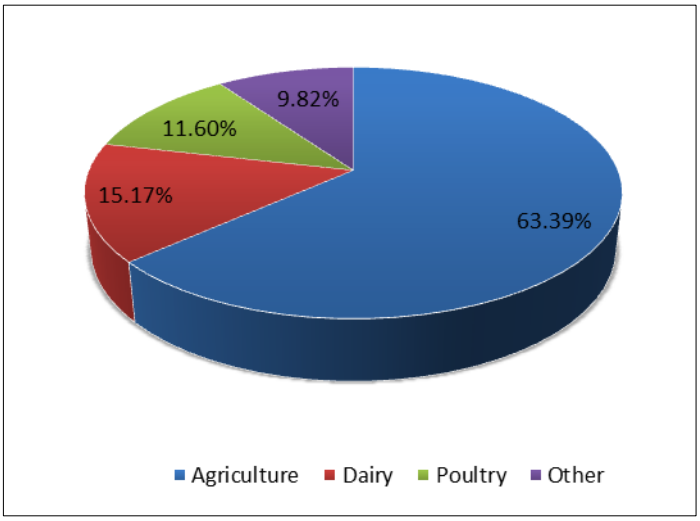


Fig 3: Off- season occupations of FBW

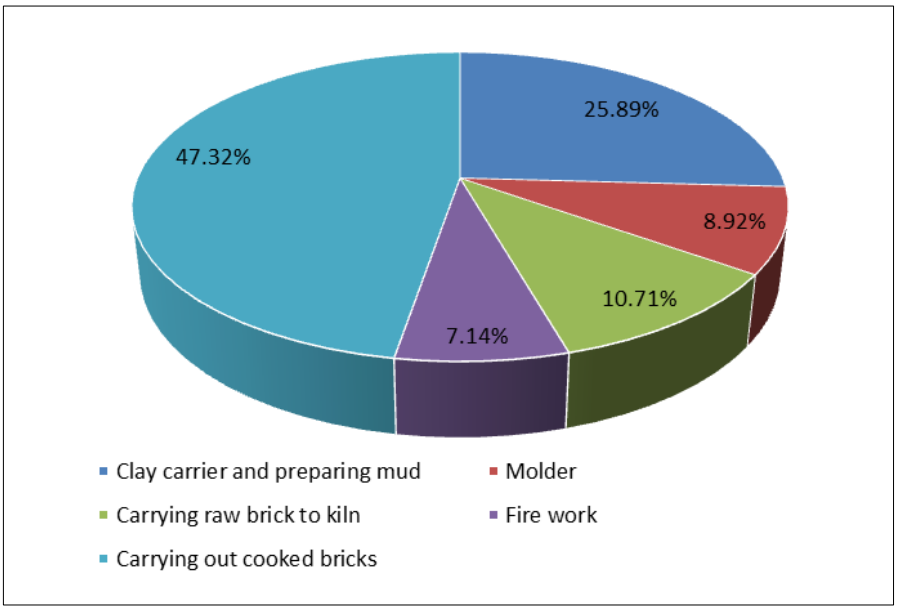
Work-related Measures of FBW

Female workers are compelled by brick kiln owners to spend long working hours it may extends 10+ hours (60 h/week) (Table 3). It may results ignorance towards personal health and dependent members of the family. It also noted that FBW are getting very less economic returns with the comparison of working hours which resulted into low standard of living. It has been observed that 47.32% of FBW working for 1-5 years and 33.93% for less than one year in the brick kiln industry. The nature of industry is seasonal and without any written contract with the workers so majority of FBW having less experience. In the field 90.17 % FBW having resident at brick field and only 9.82% female workers came daily for work those resides in the local residents. It was surveyed that 86.60% of the FBW living in the *kutcha* houses (tin-fence or clay) and 13.39% houses were *Pucca* (builded with bricks). It may states from the present study that most of FBW were living in poor housing with unhealthy environment. Brick making is multistage processes (Ijaz et al., 2020) which require more number of workers for different task. The present study shows that 47.33% FBW were engaged with carrying out cooked bricks

and only 7.14% FBW were work for fire work due to conjunction with high temperature and smoky environment (Fig 4).

Table 3: Occupational Profile of Female Brick Workers (*N*=112)

Working Hours	Frequency	Percent
<12 hours	08	7.14
12 hours	84	75.00
12 hours<	20	17.85
Experience of Work		
<1 year	38	33.93
1- 5 years	53	47.32
5+	21	18.75
Type of Residence		
Residence at brick kiln	101	90.18
Non-Residence	11	9.82
House type at brick kiln		
Kutcha house	97	86.61
Pucca house	15	13.39
Working Designation		
Clay carrier and preparing mud	29	25.89
Molder	10	8.93
Carrying raw brick to kiln	12	10.71
Fire work	08	7.14
Carrying out cooked bricks	53	47.33



Supplementary Fig 1: Working designation of FBW

Basic and Other Facilities Provided by Brick Owner

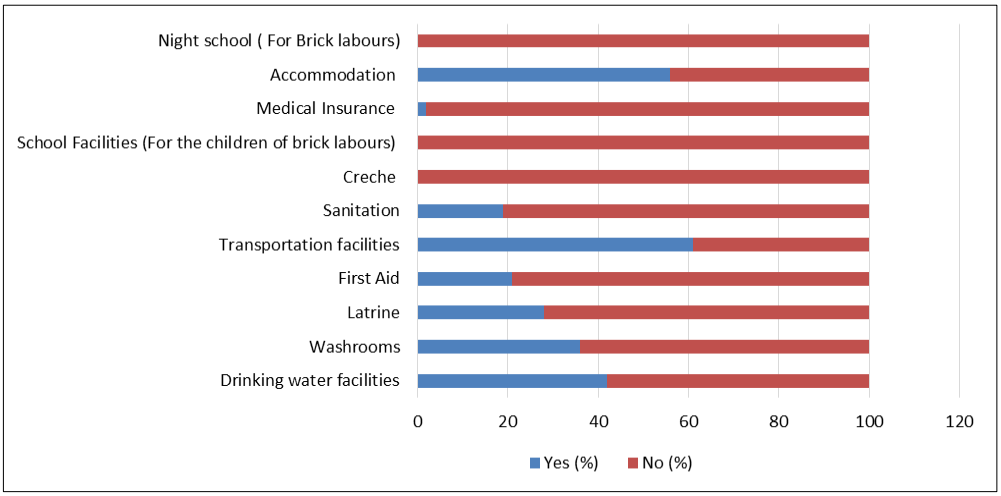
FBW works at brick unit about 8 to 10 hours daily, at the time of working hours they totally depends on basic facilities which provided by brick owner. It has been observed that 58% FBW couldn't get drinking water at brick units therefore; nearby river or well became the major

source of drinking water (Table 4). Many brick owner couldn't provide washrooms and latrine so workers have defecated at along the river, which contaminates the river side environment. It has been found that 79% brick owner couldn't keep first aid at brick kiln sites; hence workers do not get even basic medical facilities in case of major or minor injuries. The local brick workers come from nearby area so after completion of their daily working hours workers returned at their native place. 61% brick owners provide transport facilities to the workers for daily transportation whereas, 39% brick owners did not provide local transport facilities hence the associated workers struggle for their daily transport (Fig 5).

At the time of field visit, it has been observed that there were local and migrated FBW working together who were carrying their children with them at working site inspite that the children of FBW did not get crèche as well as school facilities by owner or local government at any site of the brick unit. Hence their children were played in unhealthy environment which mainly highlight the backwardness of socio-economic and health situation of the FBW along with unhygienic lifestyle. It has been noticed that brick owner did not provide any night school and medical insurance facilities to the FBW for future sustainability.

Supplementary Tab 1: Basic and other facilities provided by brick owner

Basic facilities at brick kiln	**Yes (%)**	**No (%)**
Drinking water facilities	42	58
Washrooms	36	64
Latrine	28	72
First Aid	21	79
Transportation facilities	61	39
Sanitation	19	81
Other facilities provided by brick kiln owner		
Creche	----------	100 %
School Facilities (for the children of brick labours)	----------	100 %
Medical Insurance	2 %	98 %
Accommodation	56 %	44 %
Night school (for brick labours)	--------	100 %



Supplementary Fig 2: Facilities for FBW at Brick Kiln

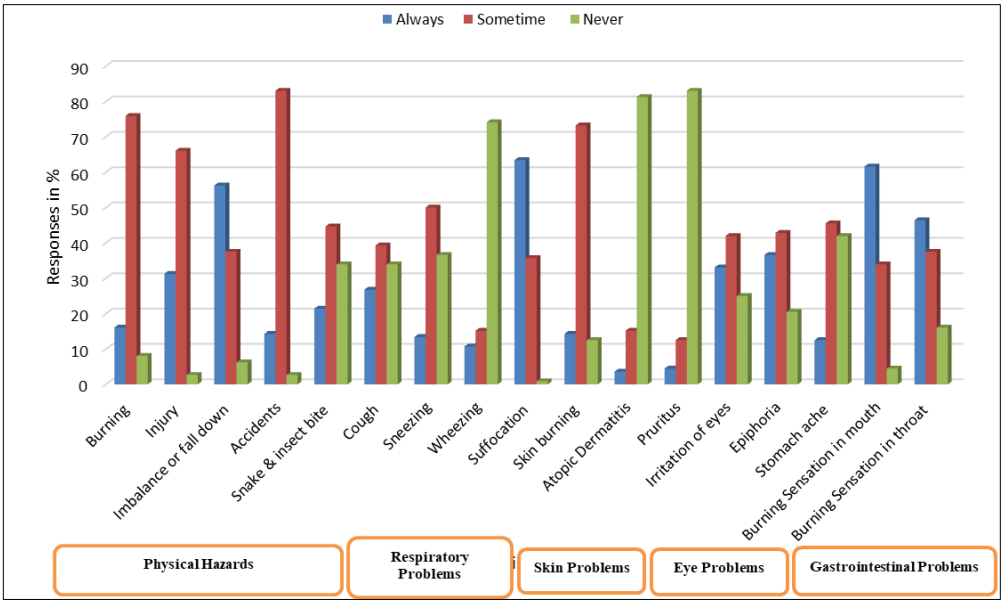
Occupational Health Problems and Hazards Faced by FBW

Brick making is a multistage process which requires lot of physical strength. There are many responsible factors of health hazard (Thygerson et al., 2016) risks are found in the brick kiln due to long working hours, extremely hot and unsanitary environment (Das et al., 2017). It has been reported that about 60,000 people die at every year while working at construction and brick kiln site (ILO, 2019). Brick making process is a rigorous hand-intensive job (Das, 2014) in which occupational injuries have been considered as one of the most crippling factors contributing major cause of disability (Vaidya et al., 2015) and death. The result shows that each worker affects at different levels of injuries from beginning to end of brick making process. It has been observed that in the study area all selected brick kilns were operated manually; therefore, it needs physical involvement for brick making process which may resulting of high-risk work-related injuries (Asare et.al, 2023). In the study area it has been found that majority of work-related injuries caused by falling from height due to imbalance, stuck to the object, burning, snake & insect bite etc. It has also noticed that within all injury's maximum responders (56.25%) have been reported that they were injured due to fall from height due to imbalance from kiln and slippage of spade while mud collection (Table 5). The FBW not only continuously exposed to the sun but also exposed an extra amount of heat from brick kiln (Sett and Sahu, 2014, Rupakheti et al., 2018). It has been observed that in the study area 75.89% FBW were exposed to burn by mud dust mixed with coal and carrying cooked bricks on their head. Female workers also suffered from biological hazards like snake and insect bite due to continuous contact with soil, these injuries are major causes of deaths at the brick kiln site. The respiratory problems include cough, sneezing, wheezing and suffocation by FBW at different level (CPCB, 2010). It has been reported that 63.39% of respondents experiencing suffocation during working time. FBW has faced lot of skin problems such as, skin burning Atopic dermatitis and Pruritus within that 73.21% responders reported skin burning while mixing mud dust with coal and carrying cooked bricks. FBW also faced different eye problems like irritation of eyes and epiphoria, as per reported data, 36.61% of workers facing epiphoria due to smoky and dusty environment (Fig 6). The gastrointestinal problems faced by FBW during work includes stomach ache, burning sensation in mouth and throat, it may due to open fire and high concentration of hazardous dust.

Supplementary Tab 2: Occupational health problems and hazards faced by FBW (*N*=112)

Health problems & Hazard	Always (3) (%)	Sometime (2) (%)	Never (1) (%)
Physical Hazards			
Burning	18 (16.07)	85 (75.89)	09 (8.04)
Injury	35 (31.25)	74 (66.07)	03 (2.68)
Imbalance or fall down	63 (56.25)	42 (37.5)	07 (6.25)
Accidents	16 (14.29)	93 (83.04)	03 (2.68)
Snake and insect bite	24 (21.42)	50 (44.64)	38 (33.92)
Respiratory Problems			
Cough	30 (26.79)	44 (39.28)	38 (33.93)
Sneezing	15 (13.39)	56 (50)	41(36.61)
Wheezing	12 (10.71)	17 (15.18)	83 (74.11)
Suffocation	71 (63.39)	40 (35.72)	01 (0.89)
Skin Problems			
Skin burning	16 (14.28)	82 (73.21)	14(12.51)

Atopic Dermatitis	04 (3.57)	17 (15.18)	91 (81.25)
Pruritus	05 (4.46)	14 (12.50)	93 (83.04)
Eye Problems			
Irritation of eyes	37 (33.04)	47 (41.96)	28 (25.00)
Epiphoria	41 (36.60)	48 (42.86)	23 (20.54)
Gastrointestinal Problems			
Stomach ache	14 (12.50)	51 (45.54)	47 (41.96)
Burning Sensation in mouth	69 (61.61)	38 (33.93)	05 (4.46)
Burning Sensation in throat	52 (46.43)	42 (37.50)	18 (16.07)
Mean (± St. Deviation)	**31.125 (±22.49)**	**49.375 (±23.94)**	**31.5 (±31.92)**



Supplementary Fig 3: Occupational health problems and hazards faced by FBW

Health Status of FBW

Brick making is multistage process which requires exertion of different body parts of FBW resulting different health problems (Ijaz et al., 2020).

- **Sleep duration and quality:** A good night sleep is an important factor in trying to achieve maximum efficiency for working in tedious environment (Sett and Sahu, 2014). During on-shift days FBW reported shorter sleep duration (6.5 ± 0.62 h) (Table No. 6) compared to off-shift days (7.8 ± 0.74 h) ($p < 0.001$). It has been reported that 91.96% participants can fulfill 7+ hours sleeping duration for off-shift days whereas, 91.07% participants have been reported poorer sleep quality during on-shift days.
- **Mode of addiction**: The stressful condition and restless work resulted into having habit of tobacco or chewing of baked ash of tobacco (Khan and More, 2015). In the study area, 78.58% participants reported to chewing of baked ash of tobacco (*Mishri*) and 23.22% FBW have chewing habit of tobacco. It may due to the over burden of tedious work at workplace and home.
- **Physical health and psychological distress:** 87.5% of participants have been classified into good health status and only 12.5% FBW have been reported poor health. It has been also found that female workers also work on risk factor of health hazard because they managed their daily brick work as well as household work. Male workers

at many fields go back to take rest after work but the female workers have to manage their children and household work and related issues. 33.93% respondents have been included in moderate psychological distress (Table 6).

Supplementary Tab 3: Health status of FBW (*N*=112)

Health and Related Behaviors	On-shift days m±sd/n %	Off-Shift days m±sd/n %	*P*-Value
Sleep duration	6.5 ± 0.62 h	7.8 ± 0.74 h	**<0.001***
<7 h	102 (91.07)	09 (8.04)	
7+	10 (8.93)	103 (91.96)	
Sleep quality			**<0.001****
Fairly good/ very good	21(18.75)	94 (83.93)	
Fairly bad/ very bad	91 (81.25)	18 (16.07)	
Mode of addiction			
Chewing baked ash of tobacco	88 (78.58)		
Chewing tobacco	26 (23.22)		
Physical health status			
Poor	14 (12.5)		
Good	98 (87.5)		
Psychological distress			
Low risk	24 (21.43)		
Moderate risk	38 (33.93)		
High risk	35 (31.25)		
Very high risk	15 (13.39)		

**P*-value from paired t test **Mc Nemar significant probability

CONCLUSION

The current study reveals that, in the brick industries jobs are easily available and no requirement of special skills therefore most of the female workers has been joined the brick industries. Though there is easy availability of job, FBW has consequently facing number of problems such as, majority of FBW lived in the muddy houses in scanty places and unhealthy environment without supply of drinking water, which indicates economically and socially backwardness of FBW. FBW's illiteracy has been noticed 69.64% which reflects unawareness about the education as well as available facilities at the working place. It has been recorded that, the monthly income is too low to fulfill daily essentials of family needs which reflects in poor living of standard. FBW's wages mostly spend on their daily needs even majority of female workers not aware about the saving for future betterment. Female workers in the brick industry working equally as male workers but they are not benefited with adequate wages as compare to male workers. It has been noticed that, the female workers facing specific stress-related disorder due to uneven treatment at job place as well as over burden at the workplace and home. FBW do not have proper lunch time, long working hours without rest and stressful condition creates psychological distress among them which resulted as the addiction of chewing tobacco and ash of baked tobacco in the FBW which builds health issues. Many FBW could not send their children to the school; it has been found that no crèche and school provision for children has been provided by brick owner or local government. It has also notified that brick owner has not aware about provision of night school facility for FBW. The present study revealed that many of FBW suffered by work-related injuries in the manual brick making process. Brick making process is a rigorous hand-intensive job in which occupational

injuries have been considered as one of the most crippling factors contributing major cause of disability and death. It has been seen that unsanitary, extremely hot environment and air pollution are common factors of health problems in the FBW. The present research work suggests that, the awareness about equality at brick units should create among brick owners, brick workers and local people that will be helpful to enhance the standard of living of the female brick workers in the study area and it also minimize such discrimination in future. Research also suggests that proper training and awareness among brick owners and workers should organize so it could be minimized ergonomic injuries and other occupational problems related to FBW.

Practitioner Summary: The study explored the socio-economic assessment and Physical, occupational and psychological risk factors of female brick workers at workplace. It aims to inform occupational health researchers and ergonomists about inequity at workplace and sustainable approach should be taken to improve the socio-economic condition and to minimize occupational health hazards.

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The authors declare no competing interests.

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Data Availability:
Data has been collected on field through the questionnaires. The required data is available with the authors and can be provide on the request.

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