

Original Research Article

An occupational health survey of sewage treatment plant workers of Dakshina Kannada, Karnataka

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ABSTRACT

Background: Sanitation workers are at a risk of exposure to various health hazards which are preventable. The present study aimed at assessing the health status of sewage treatment plant (STP) workers, their respiratory morbidity and onsite assessment of their occupational safety.

Methods: A cross sectional study was conducted in a single STP during June-July months of 2017. A total of 32 employees were enrolled in the study. Data collection was done using a questionnaire, clinical examination and onsite assessment for occupational safety. The questionnaire included demographic details, clinical symptoms and use of personal protective equipment (PPE). Clinical examination with special focus on respiratory system and portable spirometry was conducted followed by health education on workplace safety. Descriptive statistics were reported as mean and standard deviation for continuous variables and frequency and proportion for categorical variable.

Results: None of the workers underwent pre-placement health check-up and routine health check-ups at regular interval. PPE were available in adequate number. Spirometry revealed 12 workers having forced expiratory volume in one second/forced vital capacity (FEV1/FVC) within normal limits and seven workers with mild restriction. Early small airway obstruction was found in six workers. Regarding the on-site safety, an absence of barricades at two places near anaerobic sludge reactor and clarifier tank was of concern.

Conclusions: The workers in STP are at risk of respiratory occupational hazards and should undergo pre-placement and routine health check-up for prevention of occupational hazards. Physical safety in terms of barricades at appropriate sites also needs attention.

Keywords: Sewage treatment plant, Occupational safety, Personal protective equipment, Personal protective measures, Restrictive lung disease

INTRODUCTION

There are 816 functioning sewage treatment plants (STPs) in India as on March 2015 and an average sewage generation is approximately 62,000 million litres per day (MLD).¹ Karnataka has 57 STPs with five in Mangalore district. More than 1.2 million sanitation workers are involved in maintaining the environmental sanitation.^{1,2} The waste water in STPs has many pathogenic organisms

and also emits harmful gases such as methane and hydrogen sulphide.^{3,4} The sanitation workers are at risk of developing health hazards which includes respiratory problems due to exposure to chemicals like hydrogen sulphide, methane and biological pollutants such as bacteria and fungi.^{4,5} These aerosols can lead to respiratory disorders and pulmonary function impairment.^{6,7} Productive cough, throat irritation, wheezing and chronic bronchitis are common in these

workers.⁸ Many of these are preventable by proper medical, legislative and engineering measures.^{9,10} The present study was done with the objective of assessing the health status of sewage treatment plant workers with special focus on the respiratory morbidities along with an onsite assessment of their occupational safety in STP of Mangalore, India.

METHODS

Study design and setting

A cross-sectional study was conducted in the STP of Mangalore city among sewage treatment plant workers. Mangalore is located about 352 km west to Bangalore, (Karnataka state capital) between Arabian Sea and Western Ghats, with a total population of 488,968 in 2011.

Study period

The study was conducted between June and July 2017.

Sample size and sampling

A total of 32 employees of the STP were enrolled in the study by complete enumeration (census) method.

Data collection

The data collection process involved four components;

- An interview schedule.
- Clinical examination with special focus on respiratory system.
- An onsite assessment for occupational hazards.
- Health education session for occupational safety.

Study tools

An interview schedule was employed to collect baseline demographic details and duration of employment in the plant. Information about self-reported morbidity was collected. This was followed by clinical examination designed on the basis of literature review and likely respiratory health hazards of occupational exposure. Clinical examination included measuring height, weight, pulse rate, blood pressure examination, respiratory rate, oxygen saturation by pulse-oximetry and respiratory system examination. Forced expiratory volume in one second/forced vital capacity (FEV1/FVC) was measured by portable spirometer (Recorders and Medicare systems Pvt. Ltd, India). An onsite assessment for occupational hazards, availability and use of personal protective equipment (PPE) and safety measures was conducted to collect the appropriate information. This was followed by health education for safety at the workplace along with distribution of printed health education material for future reference.

Inclusion and exclusion criteria

All the workers in the STP were included with exclusion criteria being presence of an acute respiratory infection as spirometry cannot be done on them.

Data analysis

Data analysis was done by statistical package for social science (SPSS22). Descriptive statistics was reported as mean and standard deviation for continuous variables and frequency and proportion for categorical variable

Ethics and approvals

Permission from Mangalore city commissioner to conduct the study was taken. Institutional ethics committee approval was taken before the initiation of the study process. Written informed consent was obtained from all the study participants after sharing participant information sheet elaborating the study objectives, privacy, confidentiality and voluntariness.

RESULTS

A total of 32 STP workers were enrolled in the study. Selected socio-demographic characteristics of the study participants are described in Table 1. The mean age of study participants was 32.5 years (SD \pm 10.4). Majority of them were males (87.5%). Most of these workers belonged to urban area (68%). Mean duration of working in the plant was 3.2 years (SD \pm 2.8).

Clinical symptoms in the past one month among study participants are described in Table 2. While none of them reported of any pre-employment check-up, they also could not recall any routine health check-up that they underwent in last one year. For any routine illness, 68.8% of study participants accessed private health care for consultation and treatment. With regard to PPE, the usage of protective gloves was poor (31.3%). But majority of study participants followed personal protective measures like usage of face mask (81.3%) and rubber boots (81.3%). Running water for hand-washing was available and used by most (93.8%), soap for hand washing was also used before and after work and food (90.6%) and a designated place to have food was used by most participants (90.6%) (Table 3).

All participants underwent clinical examination. None of the STP workers had any abnormality on auscultation. Two workers had clinical features of anaemia. Seven persons were diagnosed to have hypertension. On spirometry, 50% of workers examined had varying degree of airway abnormality. The type of airway abnormality seen were mild restriction (29.16%), severe restriction and mixed type of blockage (4.16%), small airway obstruction (25%) (Table 4).

Table 1: Socio demographic profile and work function of the study participants (n=32).

Characteristics	N	%
Age group (in years)		
18-24	9	28
25-34	8	25
35-44	11	34
>45	4	12
Education		
Illiterate	4	12.5
Primary	3	9.4
High school	9	28.1
Secondary	10	31.3
College	2	6.3
Graduation and above	4	12.5
Type of work		
Chemist	2	6.3
Electrician	2	6.3
Gardner	4	12.5
Helper	17	53.1
Manual worker separating waste	1	3.1
Operator	1	3.1
Security	2	6.3
Supervisor	2	6.3
Technicians	1	3.1
Total	32	100

Table 2: Clinical symptoms in the past one month (n=32).

Symptoms	Yes N (%)	No N (%)
Irritation in the eyes	9 (28.1)	23 (71.9)
Redness of the eyes	8 (25)	24 (75)
Recurrent headache	9 (28.1)	23 (71.9)
Loss of consciousness	4 (12.5)	28 (87.5)
Breathlessness	2 (6.2)	30 (93.8)
Cough with sputum	2 (6.3)	30 (93.7)
Generalised body ache and pain	6 (18.8)	26 (81.2)
Unusual tiredness	5 (15.6)	27 (84.4)

Table 3: Personal protective equipment's and measures (n=32).

Personal protective measures	Yes N (%)	No N (%)
Protective gloves	10 (31.3)	22 (68.7)
Face mask	26 (81.2)	6 (18.8)
Rubber boots	26 (81.2)	6 (18.8)
Running water for hand washing	30 (93.7)	2 (6.3)
Soap for hand washing	29 (90.6)	3 (9.4)
Designated place to have food	29 (90.6)	3 (9.4)

Table 4: Clinical examination and spirometry findings.

Parameter	Mean	SD
Weight	62.28	9.1
Height	163	6.07
Pulse rate	77.1	9.98
Respiratory rate	17.43	0.91
SpO₂	97.31	2.22
Blood pressure	n=32	%
Normotensive	25	78.1
Hypertensive (systolic >140 mmHg or diastolic >90 mmHg)	7	21.9
Spirometry findings	n=24*	%
FEV1/FVC [†] - normal limit [(FEV1/FVC)% Pred >95 and FVC% Pred >80]	12	50
Mild restriction [(FEV1/FVC)% Pred >95 and FVC% Pred <80]	7	29.16
Severe restriction [(FEV1/FVC)% Pred >95 and FVC% Pred <44]	1	4.16
Mixed type of blockage [(FEV1/FVC)% Pred <95 and FVC% Pred <80]	1	4.16
Early small airway obstruction [FEF [‡] 25-75% Pred or PEF [§] Pred <70]	6	25

*multiple responses; [†]FEV1- Forced expiratory volume during first second; FVC: Forced vital capacity; [‡]FEF: Forced expiratory flow; [§]PEFR: Peak expiratory flow rate.

On site assessment indicated adequate number of personal protective equipments. Absence of barricades at two places near anaerobic sludge reactor and clarifier tank was of concern.

DISCUSSION

The present study surveyed the sewage treatment plant workers in a single sewage treatment plant. This was followed by an on-site assessment for occupational safety. It was found that headache, eye complaints, body ache and respiratory symptoms were common. According to a study conducted by Batanony in Berket Al-Sabih among waste water treatment plant workers, it was found that they suffered from symptoms like body ache, abdominal pain, wheeze, asthma and dyspnoea more than the non-exposed employees working at departments of faculty of commerce (<0.05).¹¹ According to a study conducted by Jahangiri et al in Iran, it was found that prevalence of respiratory symptoms was significantly high in exposed when compared to unexposed waste water treatment plant workers.⁷ According to study conducted by Zuskin et al in Croatia, respiratory symptoms and ventilator capacity was studied in a group of 74 sewage workers it was found that prevalence of chronic respiratory symptoms such as chronic cough, chronic phlegm, chest tightness was high in closed channel and drainage workers than in controls.¹² According to Rahman et al it was found that 23.5% of the

study group workers at As-salam city sewage treatment plant had fatigue, whereas only 4.7% of the control group complained about the same. The difference between the two groups was statistically significant with regard to cough and expectoration ($p < 0.05$).¹³ Majority of the study participants followed personal protective measures such as usage of face mask, rubber boots, usage of running water and soap for hand washing, used designated place to have food except for protective gloves which was used only by 31% of study participants. Workers who handle human waste or sewage have to be provided with proper personal protective equipment and have to be trained to use goggles, protective face mask or splash proof shield, liquid repellent coveralls, water proof gloves, rubber boots.^{2,14} Workers should be educated about personal protective measures such as avoid direct contact with sewage, wash hands and face with soap and water before eating, drinking or smoking, use personal protective equipment.¹⁵

Spirometric changes among the workers show that half of the workers had varying degree of airway abnormality. Mild restriction was seen in 29% of study participants, 4.16% of study participants had severe restriction and mixed type of blockage, 25% of them had early small airway obstruction. Richardson studied effect of exposure of hydrogen sulphide on 68 sewer workers; non-smoking sewer workers achieved 89% of predicted FEV₁/FVC values while non-smoking water treatment plant workers achieved 98% of predicted FEV₁/FVC value.¹⁶ According to study conducted by Batanony and Shafi it was found that obstructive type of pulmonary function impairment was significantly more common in waste water treatment plant workers when compared to comparison group of non-exposed employees working at departments of faculty of commerce.¹¹ Zuskin et al found out that baseline ventilatory capacity was reduced significantly when compared to predictive value in sewage workers, Forced expiratory flow 50 and forced expiratory flow 25 (FEF50 and FEF25) were reduced which suggest that there is obstructive changes in smaller airway.¹² According to study conducted by Jahangiri et al it was found that obstructive ventilatory disorders were seen in waste water treatment workers.⁷ According to a systematic review conducted by Chandra et al about occupational lung diseases in sewage workers, it was found that obstructive type of pulmonary function test was seen among sewage workers.¹⁷ Whereas in a study conducted Rahman et al pulmonary function test showed insignificant difference between study group and control group.¹³

Strength of the study was that the spirometry was conducted among all study participants and done by trained pulmonologist. But the limitation was that the sample size was small and self-reported morbidity method was used to collect information on health status which can lead to recall bias. Preliminary investigation suggests that further investigation like diffusion lung capacity for carbon monoxide (DLCO) and chest

radiography (chest X-ray and CT thorax) can better predict pulmonary damage in these workers.

CONCLUSION

Workers in STP are at high risk of occupational hazards especially respiratory hazards which require further evaluation in the form of pre-placement and routine health check-up. They should be educated regarding the regular use of personal protective measures. Physical safety in terms of barricades at appropriate sites is another aspect that needs attention.

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