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Original Article

Prevalence of respiratory symptoms among female workers in the fish processing industry in Odisha

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ABSTRACT:

Introduction: In recent years, there has been a significant expansion in the fish processing industry. The current study was made to evaluate the pulmonary and respiratory issues that the female workers of the fish processing industry faced.

Methods: A total of 60 female workers out of which 40 were in pre-processing unit and 20 were in post processing unit of fish processing work were selected randomly for the study held in a fish processing factory of Patia, Odisha, India. The study was carried out for nine months from January 2023 to September 2023 A descriptive study design was used for the present study and it involved the assessment of physical parameters, application of a questionnaire based on respiratory and pulmonary issues, spirometry for monitoring lung function and Peak expiratory flow rate (PEFR). The study also included an assessment of worksite by OSHA – recommended ergonomics checklist.

Results: The fish processing workers were found to complain about respiratory symptoms. 40% of the post-processing workers whereas 36% of the preprocessing workers experienced chest cold. More than 50% of the workers experienced headaches. The study also indicated reduced lung volumes predominantly Forced Vital Capacity ($p<0.05$) among workers indicating pulmonary problems, due to prolonged exposure to the low ambient temperature, cold air loaded allergens, and direct contact with chlorinated cold water.

Conclusion: The fish processing workers were found to complain about respiratory discomfort in the workplace. Respiratory disorders, both acute and chronic, can arise from prolonged exposure to the cold fish processing environment.

Keywords: Female fish processing workers, Low ambient temperature, Pre-processing unit, Post processing unit, Respiratory symptoms

Introduction

Fisheries and aquaculture in Odisha is comprised of long tradition of processing fishes majorly prawns, shrimps.[1] Fish processing facilities vary in terms of technology; smaller workplaces handle fish manually, while bigger companies use sophisticated, highly automated procedures. Increase in the demand for sea food across the globe has led to increased harvesting and production.[1] Workers in the fish processing industry are exposed to a variety of hazardous environmental conditions, including cold and humidity, allergies, fish flour, histamine aerosol, and other pollutants. These agents may result to various adverse reactions. The occupational exposure of seafood processing industry is found to be very complex on account of different aerosol that are produced at various seafood processing steps.[2,3] The intestinal flora and protein of fishes contribute to aerosols leading to various respiratory symptoms in fish processing industry.

Workplace factors comprising the air temperature and rate of exposure to chemical and biological agent that are suspended in the air has a correlation with prevalence of respiratory symptoms.[4] Individual factors involving history

of smoking, atopy, and existing respiratory morbidity also contribute to respiratory effects respectively. The workplace of fish processing industry is characterized by moderate low temperatures. The workers in the cold store are found to work at below -19 degrees Celsius.

Inhaling of cool indoor air has resulted in eliciting physiological responses in the airway surfaces majorly involving alleviated nasal secretion, narrowing of nasal airway and swelling of the nasal mucosa respectively. The tracheobronchial walls are exposed to inspired air that is insufficiently warm and conditioned leading to lower airway symptoms.[5,6] There have been few studies on respiratory reactions among workers of fish processing agents that are exposed to harmful agents. chronic bronchitis, Asthma, conjunctivitis, angioedema, Rhinitis and rash are the most common respiratory symptoms among fish processing workers.[7,8] The current study set out to evaluate the pulmonary and respiratory issues among the female workers of the fish processing industry.

Methods

Sixty female fish processing workers were selected by random sampling from a fish processing industry in Patia in Odisha where 40 workers were found to be engaged in pre-processing task and 20 were involved in post processing tasks. All the subjects selected for the study belonged to the age group of 20-35 years. The data was collected in the span of nine months from January 2023 to September 2023.They were having a minimum of 1 year of working experience in fish processing industry. Verbal consent of the workers was taken before the start of the study. Workers having any previous non-occupational history (accident) and non-occupational chronic diseases (asthma, skin allergies, chronic cough bronchitis, cardiovascular disease were excluded from the study. The height and weight of the fish processing workers were recorded using anthropometer and weighing machine respectively. BMI of the subjects were recorded from the collected data. A modified British Medical Research Council Questionnaire was used to assess the prevalence of respiratory symptoms.9 The structure of the questionnaire was composed of multiple-choice responses and objective types. The questions were categorised into following sections - Demographic information about the workers – age, working experience, work behavior, and work organization, stress assessment at work and question on prevalence of various pulmonary disorder – Phlegm, Chest illness, past illness, breathlessness. Evaluation of the worksite of fish processing industry was made using OSHA recommended ergonomics checklist for assessing the job types and their respective demands that are taken care by the workers.10 Pulmonary Function Test (PFT) of the selected subjects was done using the Spirovit Sp-10. Three recordings of Vital capacity (VC) and Forced Vital Capacity (FVC) were recorded of the female workers in the standing position and the three best ratings were taken for further study. Peak Expiratory Flow Rate (PEFR) was carried out using Peak expiratory flow meter. Before to the start of the reading and use of the instrument the process was demonstrated and explained repeatedly. The PEFR test was carried in a standing position with instrument being kept at horizontal position. The selected subjects were instructed to take a breath as deep as possible follow by a blow out in the instrument hardest to their capacity and as fast as possible. The three best readings were recorded. Assessment of the working environment was made of the fish processing industry. The Wet Bulb Globe Temperature (WBGT) and Relative humidity (RH) of the different working areas primarily pre-processing unit, post-processing unit and cold store was recoding by using a digital Anemometer. The best of three reading was recording in each working area. Wet Bulb Globe Temperature (WBGT) is defined to the weighted mean of Natural wet bulb temperature (NWB) , globe temperature (GT) and dry bulb temperature (DBT) respectively.

Student t- test was used for the statistical analysis of quantitative variables under normal data distribution. chi square test $\chi 2$ was performed to analyze association between the variables for the chosen significance level ($p<0.05$). All the statistical analysis was performed using the Statistical Package for the Social Science (SPSS) version 26. The ethical clearance for the study was taken from the Institutional Ethical Committee of Sri Sri University.

Results:

The physical characteristics of the study participants is represented in Table 1. It was found the age, height, weight and BMI of pre- processing workers was found to be 31.69 years, 165.08 cm, 62.74 kg and 24.14 kg/m2 respectively. The age, height, weight and BMI of the post processing workers was found to be 30.25 years, 155.78 cm, 58.96 kg and 23.05 kg/m2 respectively. It was found that the fish processing workers had to work for 10 hours a day with 1 hour of rest and the workers had 7 working days in a week (Table 1).

The working experience of the fish processing workers was segregated into >9 years, 5-9 years and 1-4 years respectively. It was found that 45% of the pre-processing workers and 51% of the post processing workers have working experience of 5-9 years. 35% of the pre-processing workers and 39% of the post processing workers have working experience of 1-4 years respectively as shown in the Figure 1.

Table 1: Demographics of fish processing workers.

Variables	Pre Processing workers M±SD (n=40)	Post Processing workers M±SD (n=20)
Age (years)	31.696 ± 3.51	30.254 ± 3.45
Height(cm)	165.08 ± 3.37	155.78 (±4.74)
Weight(kg)	62.783 ± 2.04	58.96 (±6.08)
BMI(kg/m2)	24.14±1.266	23.05(±2.38)
Hours worked per day at work	10 ±0.80	10 ±0.80
Hours of rest each day	1±1.00	1±1.00
No. of workdays in a week	7	7

Notes: BMI is Body Mass Index, M±SD, Mean and Standard Deviation

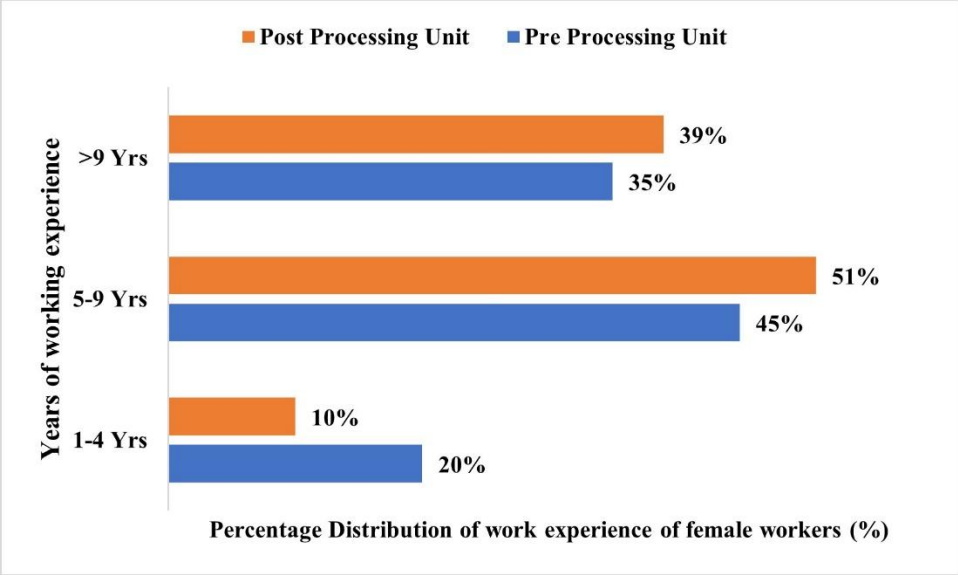


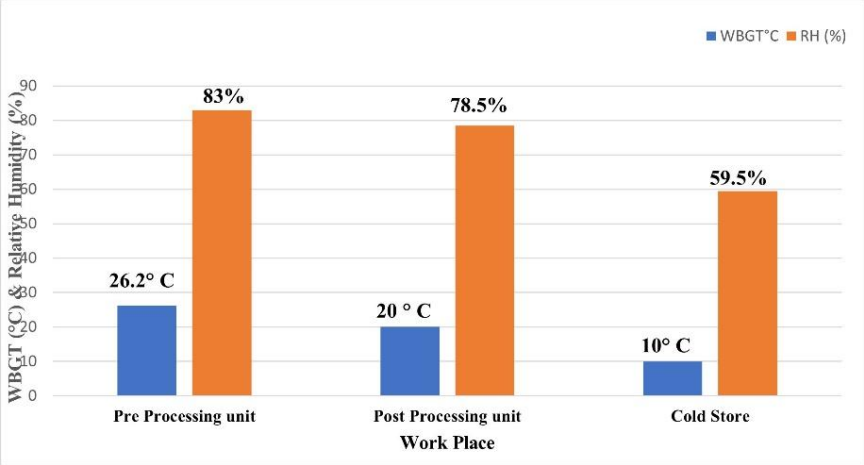
Figure 1: work experience of the fish processing workers

A chi-square association test was used to evaluate any effect of the fish processing activities on the fish processing workers. The effect was based on the responses made through the questionnaire i.e. whether having discomfort or not and it was found that there was a significant association between them as shown in Table 3.

The calculated WBGT index in the pre-processing unit, post-processing unit and in the cold store was found to be 26.2 °C, 23.5°C and -19°C respectively. The Relative humidity of the pre-processing unit, post processing unit and in the cold store was found to be 80%, 78.5% and 69.5% respectively as shown in Figure 2.

Table 2: Respiratory Discomfort of the fish processing workers

Subjects	Discomfort	No discomfort	$\chi 2$	P value
Pre processing unit (n=40)	19 (47.5%)	21(52.5%)	12.954	P=0.001
Post processing unit (n=20)	19(95%)	1(5%)		



*Notes: WBGT-Wet Bulb Globe Temperature, RH-Relative Humidity

Figure 2: Working environment in the industry

The fish processing workers were found to have respiratory symptoms. It was found that 61% of the post processing workers whereas 50% of the pre-processing workers complained about headaches. The pre-processing workers and post processing workers complained of chronic cough, chronic phlegm, Dyspnea, chest cold, throat irritation, dry throat, eye irritation, nasal secretion, nasal bleeding and their frequency distribution has been shown in Figure 3.

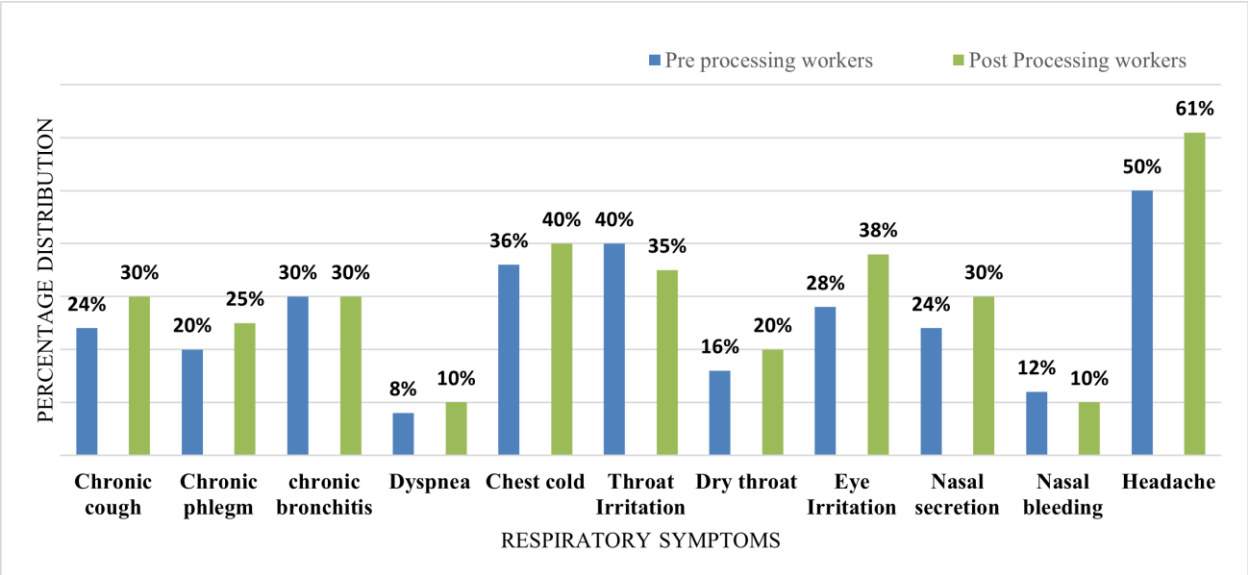


Figure 3: Respiratory symptoms of fish processing workers

The mean and SD of pulmonary functions majorly VC and FVC of the study participants were recorded. The VC of the preprocessing workers and post processing workers was found to be 3.01±0.35 and 2.73 ±0.22 respectively. The mean FVC of the preprocessing workers and post-processing workers was 3.36 ±0.73 and 2.94 ±0.38 as shown in the Table 3.

PEFR and various pulmonary functions majorly VC and FVC of the pre and post -processing

workers with respect to their working experience i.e 1-4 years, 5-9 years and >9 years was recorded and shown in Table 4.

Table 3 Pulmonary function of the fish processing workers

Pulmonary Function	Preprocessing workers(n=40) M±SD	Postprocessing workers (n=20) M±SD	t value	P value
VC (litre)	3.01 ±0.35	2.73 ±0.22	4.915	P=0.05
FVC(litre)	3.36 ±0.73	2.94 ±0.38	2.408	P=0.01
PEFR(lit/min)	438.72±12.73	423.83±18.68	3.638	P=0.08

Notes: VC-Vital Capacity, FVC- Forced Vital Capacity, PEFR: Peak Expiratory Flow Rate

Table 4 Pulmonary function of the subjects according to their working experience M(SD)

Subjects	Experience (Years)	VC	FVC	PEFR	P value
Preprocessing unit	1-4 years	3.46 ±0.13	2.96±0.12	430 ±83.18	0.09
	5-9 years	3.42 ±0.21	2.86±0.14	428 ±103.03	0.65
	>9 years	3.25±0.30	2.86±0.10	425 ±73.95	0.56
Post processing unit	1-4 years	3.02 ±0.34	2.80 ±0.44	387.18±10.48	0.77
	5-9 years*	2.95 ±0.18	2.67 ±0.22	393.75±17.46	0.001*
	>9 years	2.70 ±1.02	2.09 ±0.95	374.68±13.59	0.76

Notes: *-significant at p<0.05,
VC- Vital Capacity, FVC- Forced Vital Capacity, PEFR- Peak Expiratory Flow Rate

Discussion:

The working environment of fish processing workers exposes them to a variety of occupational health and safety hazards which increases their risk of respiratory problems. There are various agents that lead to the development of respiratory symptoms majorly involving cold exposure, cuts and lacerations, fish proteins and skin. In the current study a chi square test of association was carried out for establishing effect of different work on the responses based on questionnaire. It was found from the Table 2 that there was significant association among experiencing respiratory discomfort. 52.5% of the pre-processing workers were having respiratory discomfort whereas 95% of the post processing workers experienced respiratory discomfort. These lead to an indication of dominance of respiratory discomfort among post processing workers than pre-processing workers in fish processing industry. These findings can be supported by Farbu et al. (2019) who has shown an association of feeling cold during work with development of musculoskeletal pain, skin and airway symptoms among seafood industry workers.[2] From the assessment of work environment, it was found that both the pre and post processing workers are exposed to low ambient air temperature and high humid conditions. The relative humidity of the preprocessing unit and post processing unit remained 83% and 78.5% with excessive use of water , valuing above 70% leads to the risk of development of respiratory infections and allergies. This can be supported by a study showing reduced infection rate on exposure to relative humidity ranging from 40%- 70%.[11]

The effect of cold on airway majorly involves bronchoconstriction, asthmatic attacks and secretions. Symptoms that are derived from nose along with cough are found to be more prevalent

in pre and post processing workers. A dose response relationship exist between muscle temperature and power of the muscles and there is a decrement of contraction velocity of the muscles with decreased temperature. Additionally there is an increment of antagonist muscle activity resulting in diminished motor control.[12,13] Low temperature leads to enhanced fatigue of the respiratory muscles while carrying out repetitive task in post processing unit and cold store respectively.[14] A study by Mahdavi et al. (2020) has showed similar results of exposure to cold leads to increased strain on musculoskeletal system.[15] The results of the present study have shown that more than 25% of the fish processing workers have complained about the chronic cough. However, the post processing workers (30%) had greater occurrence of chronic cough than pre-processing workers (Figure 3). This might be due to increased exposure to extreme cold working environment. The overall result do show that both the workers are working in cold environment, which is not suitable to work, leading to developing of acute and chronic cough among the workers. The prevalence of chronic phlegm, chronic bronchitis, dyspnea and chest cold was found to be more in post processing workers by 25%, 30% ,10% and 40% respectively. The result also has shown that Throat irritation and nasal bleeding to be more prevalent among pre- processing workers by 40% and 12 %. This might be due to working in low ambient air temperature for a prolong period of time. It was found that eye irritation, headache and nasal secretion was more prevalent in post processing workers by 38%, 61% and 30% compared to pre-processing workers. The prevailing temperature in the post processing unit was 20°C whereas in cold store was found to be -10°C. A study has shown prevailing of ambient temperature below 10°C in the working place is considered as cold working environment.[2] This might be due to prolong working in the cold surface, low temperature and contact with water resulting in thermal imbalance and risk of developing respiratory symptoms - acute and chronic A study by Pearsons, (2014) has mentioned cold surfaces, water contact, humidity, radiation, air velocity, clothing and production of heat by workers as the significant factors that affect the thermal balance of the workers.[16,17] The findings of spirometry and the level of statistical differences among the pre-processing and post processing workers have been mentioned in Table 3. The post processing workers were exposed to progressive low ambient air temperature due to constant shuffling between post processing unit and cold store. The workers are exposed to the -4°C during freezing the processed fish trays and also had to go for final storage in cold store (-20°C) after packaging. The lung volume of the pre-processing workers was high in comparison to the frequent exposed group(post processing group). This leads to an indication that continuous exposure to fish processing industry leads to significant change in lung volumes. By assessing the lung volume of the pre-processing worker and post processing workers, vital capacity of the post processing worker was at 2.73 lit (±0.22) and was significantly lower than the pre-processing worker which was 3.01 lit (±0.35), $t=3.026$ at $p<0.05$. Lung functions and PEFR of the pre-processing and post processing workers was recorded based on their work experience shown in Table 4. The workers were segregated into 3 based on their duration of employment in the industry – 1-4 years, 5-9 years and over 9 years. A significant reduction in vital capacity and FVC as well as Peak expiratory flow rate was found among the post processing workers with increased working experience. However the Post processing workers having an experience of over 10 years didn't show significant change in lung volumes and PEFR. There was no significant alteration in PEFR and Pulmonary functions with respect to duration of work. A study by Gro et al. (2018) showed normal range of pulmonary function test and with an indication of restrictive pattern among the salmon processing workers.[18] However a study by Morell et al. (2013) highlighted the criteria for testing hypersensitive pneumonitis and the salmon processing workers were found to show influenza like symptoms and reduced FVC and DLCO indicating compatibility with the criteria of prevalence of hypersensitive pneumonitis. Significant changes are observed in lung functioning with decreased forced expiratory flow leading to obstructive changes in the small airways which result in respiratory changes. Inspiring cold air loaded seafood allergens and direct contact with chlorinated cold water contribute to the development of respiratory symptoms in lower and upper respiratory tracts.[19,20]

Limitation

The study had potential limitations. The research strategy used for the research work was found to behave as a limitation as it restricted to the idea of studying the representatives in a closed manner and did not support the idea of generalization. Time constraint was found to be another limiting factor for the data collection relating to the

effectiveness of the research work.

Conclusion

It may be concluded that the fish processing workers have the greater tendency of developing respiratory changes. The post processing workers complained of increased respiratory symptoms compared to the preprocessing workers. They were exposed to poor work environment with low ambient temperature and high relative humidity, wet floor, bio aerosols comprising sea food allergens. The fish processing workers also complained about the non-respiratory occupational health problems predominantly headache and eye irritation. Continuous exposure to fish processing environment in a consecutive manner leads to development of acute and chronic pulmonary abnormalities. The prevalence of lung function impairment was significantly higher among the post processing workers who were exposed to poor work environment. Similar study by Amaravathi et al. (2016) showed higher prevalence of chronic respiratory symptoms in fish processing workers in compared to controls ($p<0.05$).[21] Workers in the fish processing industry have reduced lung volumes with longer exposure time.[22] This leads to the possibility of pulmonary and respiratory symptoms in the post processing workers from the exposure to the low ambient temperature, high relative humidity, seafood allergens and toxins, direct contact with chlorinated cold water prevailing in working environment. Appropriate usage of Personal Protective Equipment -gloves, masks and gumboot by the preprocessing and post processing workers of fish processing industry is recommended. Periodic Lung function test should be carried out from the beginning of the employment and should be continued regularly to have a check on the respiratory health of the workers which will result in reduced risk of development of respiratory symptoms.

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