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OCCUPATIONAL HAZARDS IN SEAFOOD INDUSTRY: A CASE STUDY IN ERNAKULAM DISTRICT, KERALA.

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ABSTRACT

Indian seafood factories have grown to have world class facilities, with better quality control; meeting the stringent international norms. But, the socio-economic conditions of the workers in such factories are well below the international standards.A cross sectional survey was initiated to understand the frequency of occupational injury occurrence and the associated factors in the fish processing industries of. Ernakulam district, Kerala.For the purpose of the survey, 180 randomly selectedworkers from 10 companies were requested to participate in the suvey. All the subjects were interviewed with the help of an interviewer-administered questionnaire to collect information regarding their personal, occupational and work related morbidity details (including details of occupational injuries). A peculiar pattern of such industries in Cochin is that they almost exclusively employ women and most of these women (poor, less educated and having a large family to support) leave this job within 5 years of joining. Though older women usually remain under mental tension they gather experience of job with time. This study has not only highlighted the problem of occupational hazards in Cochin fish processing industries and the factors associated with such hazards but also has strengthened the findings of some recent studies about the harmful effect of disinfectants used in the industry,namely, chlorine.

***Key words**: Chlorine, Disinfectant, Occupational hazard, Seafood industry, Women.*

1.INTRODUCTION

Indian seafood industry is over 50 years old and during this course they have grown tohave world class facilities, with better quality control to meet the stringent internationalnorms [1]. But, the socio-economic conditions of the workers in such factories are well below the international standards. Women play a crucial role in fisheries; their main activities are processing and marketing of fish products [2].In many countries, labour in the fishing industry is divided along sex lines with men almost exclusively involved in harvesting the seafood at sea and women doing most of the processing ashore [3]. Fish processing involves the preparation of fish for direct consumption or for

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preservation. Traditional fish processing activities include receiving the fish, washing the fish, splitting, filleting the fish and smoking [4]. Increased levels of production and consumption of seafood have ledand continue to lead to more frequent reporting of work-related respiratory allergy and asthma [5].The agents in seafood industry with the potential to cause respiratory disease include various contaminants such as marine toxins (histamines) [6], bacterial toxins (endotoxin), chemical additives (sodium disulphite, formaldehyde) [7,8]and spices (paprika, flouradditives, garlic). Gases produced by anaerobic decomposition of fish (hydrogen sulphide) have also been reported to cause acute respiratory disease[9].

Work conditions [10], age [11, 12], safety training [13], experience [14] and weather [15] have all been designated as responsible factors for occupational hazards. Some authors have also shown that the type of employment of the worker (temporary or permanent) [16] is also an important factor in the causation of occupational accidents. In recent times, contribution of poor work environmental conditions [17, 18], poor perception of work conditions [17] and presence of disease of adverse health condition in workers [19, 15] on occupational injury occurrence has been highlighted.

In this study a cross sectional survey was initiated to understand the frequency of occupational injury occurrence and the associated factors in the fish processing industries of Cochin involving randomly selected subjects. All the subjects were interviewed with the help of an interviewer-administered questionnaire to collect information regarding their personal, occupational and work related details (including details of occupational injuries). Logistic regression method was used to analyze the data in order to obtain the contribution of individual factors on occupational injuries.

II.MATERIALS AND METHEODS

2.1. HADDON MATRIX

In this study, occupational risk factors was identified by reviewing 10 fish processing establishments and analyzing them in light of the Haddon matrix [20](Haddon,1972) as applied by Myers [21](1992, 2004). The Haddon matrix is a conceptual model that “combines public health concepts of host-agent-environment as targets of change with the concepts of primary, secondary, and tertiary prevention”[22] (Runyan, 1998).

Fig.1 Model of Haddon matrix

Factor	Pre-event	Event	Post-event
Human			
Technology			
Environment			

A Haddon matrix generally consists of a grid with four columns and three rows. In Haddon matrix, the columns represent different phases of an injury (pre-event, event, and post-event), while the rows represent different

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"influencing factors"[23]. In this study, interviews with supervisors, electricians and mechanics helped in the identification of risk factors and potential countermeasures.

2.2. SAMPLE SELECTION

We set our target as 20 persons per plant. At first ten industries were selected randomly from a list of all the industries of that area. Afterwards, random selection of subjects was done from the list of workers of those ten industries by using random numbers generated from Microsoft Excel software. Among the 200 workers, who were approached for study, 185 subjects participated.

2.3. SURVEY INSTRUMENT DEVELOPMENT

Survey instrument development was preceded by certain prerequisites. First, the focus of the study was carefully defined. Second, the study objectives were translated into measurable factors that contribute to that focus [24]. Third, the researcher had to gain knowledge in the topic.

2.4. SURVEY EXECUTION

The third phase of the survey process was the execution, or use, of the survey instrument. Salant and Dillman[24] emphasized the importance of maintaining the confidentiality of individual responses and reporting survey results only in the aggregate. Another ethical consideration was recognizing that survey participation as a voluntary event that requires the researcher to encourage participation without undue pressure or coercion of the participants.Once field testing of the survey instrument has been completed, the survey is conducted and the data are collected, coded, and processed.

All the subjects were interviewed with the help of the interviewer-administered questionnaire to collect information regarding their personal, occupational and work related details (including details of occupational injuries). Initially, a descriptive analysis was done to observe the personal and occupational characteristics of the study subjects as well as to understand the prevalence of different work related hazards.

2.5. DATA ANALYSIS AND REPORTING SURVEY RESULT

Data analysis was done with the help of SPSS 17.0 software to obtain the contribution of different factors on occupational injury occurrence. In univariate analysis the contribution of the variables like age group, job duration group, marital status, education level, nature of job, recurrent musculoskeletal pain, headache during work, recurrent sneezing/coughing (respiratory irritation) at work on injury occurrence was examined. In multivariate analysis, logistic regression method was used to obtain the contribution of individual factors on occupational injuries irrespective of the effect of the other factors. While analyzing, we used three logistic regression models. In the first, we accommodated only three variables (age, education level, marital status). In the second we added the hazard variables (blanching of hand, musculoskeletal pain, pain in upper limb) also. Finally in the third we added the variables related to work (department/nature of job and experience in the job) and analyzed all variables

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simultaneously in the model in order to estimate the effect of every individual variable adjusting for the effect of other variables.

III. RESULT AND DISCUSSION

Employees from ten seafood industry was surveyed for this study. Fig.1 shows marital status of workers in sea food industry in Ernakulam region. Majority of the seafood workers were single. Their level of education was very low. Fig.2 graphically shows the educational level of seafood workers. According to the survey report majority have education up to or below S.S.L.C (96.92%). The number of persons educated up to Plus two is only 3.08%.Fig.3 shows that number of family members in the workers household. More than 75% of the workers interviewed have four or five members in their family with only 1 or 2 earning members. Fig.4. shows that distribution of workers in seafood industry based on sex. Female workers (79%) are higher in seafood industry compared to males (21%). Loading and unloading tasks are mainly done by the male workers. Their contribution to the processing and cleaning jobs are limited.

On arrival of fish in the processing plant, grading is done initially to segregate them into different categories. Afterwards peeling is done where necessary. Some fishes are chopped into rings and some are sent for further processing. Finally packing is done. Peeling is done mostly manually (needed in case of small shrimps only) and ring cutting is a mechanized process in most of the units. Small hand tools like knife, needle are used in gradingand packing. The whole activity is done at a low room temperature and hardly any personal protective equipment is being used. The hands of workers come in frequent contact with ice and ice cold water.

Occupational hazards in the industry was analyzed using Haddon matrix. Among the listed hazards, the frequency of effect was more in chemical hazards followed by psychological hazards. There was no incidence of biological hazard (*Salmonella, Vibrio, E.coli and S.aureus*) among the workers interviewed. The hazards according to their frequency of occurrence is given in fig 5.

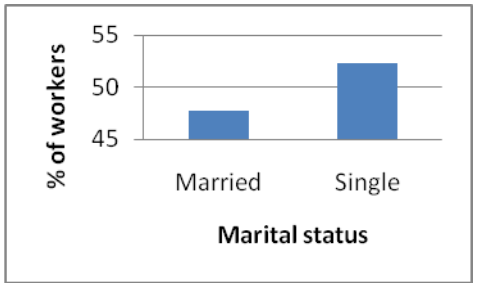

Fig.1 Marital status of workers in sea food industry.

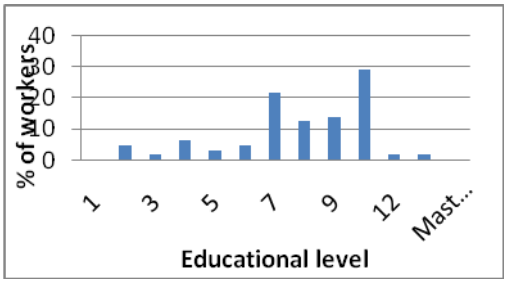

Fig. 2 Educational level of seafood workers.

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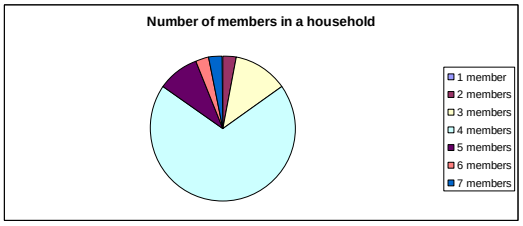

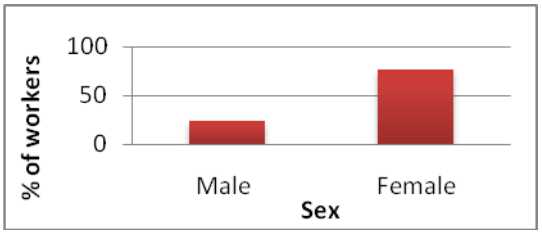

Fig.3 NumberZ of members in household. **Fig.4. Distribution of workers in seafood industry**

There is good correlation between the sex and frequency of chemical contact among workers(r=0.909). Female workers spend more time cleaning and thereby come in close contact with disinfecting agents. Processing and peeling units have more female workers which is another major reason for increased female contact of chemicals. Analysis of the data also revealed positive correlation (r=0.341) between disease occurrence and chemical contact at p = 0.01 . Negative correlation was observed between education and chemical contact (r= - 0.339). Educated workers will be knowledgable about the harmful effects of the chemicals they commonly use in the industry. This awareness can help them to avoid cleaning jobs and stick to less harmful tasks like sorting and packing Since, chemical contact showed good correlation with incidence of diseases, the chemicals used in seafood industry andtheir contact time was further analysed. The details are given in Table 3. Chlorine had the maximum contact time with the workers and the contact was direct. Sodium chloride was the next chemical which came in contact withworkers. The use of chlorine was studied in detail and the concentrations used during each task was recorded (table 5).

Table 2. Occupational hazards in seafood industry

Type of hazards	Hazards	Effects
Physical hazards	Cold, heat, viberation-cooker, electricity	Numbness of fingers and toes, blanching of fingers, shock.
Chemical hazards	Chlorine, NaCl, paprika, sodium metabisulfite	Local action, inhalation,Bronchitis, Rashes, Swelling of eye.
Biological hazards	Bacteria, virus	Bacterial and viral diseases
Mechanical hazards	Sharp Machinery- Cooker, Steam Jet Water pumps	Bruises, Injury by jet pumps
Pscychosocial hazards	Work-related stress, included excessive working time and over work.Bullying, which may include emotional and verbal abuse	Insecurity, Inferiority complex

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Liquid chlorine in contact with any part of the body will result in a freeze burn of varying severity depending on the length of exposure. Immediate first aid is needed to reduce the severity of the burn. Chlorine gas is a respiratory irritant. Chlorine concentrations above five parts per million (ppm) are irritating to the nose, throat, and eyes. In concentrations around the 1-3 ppm, chlorine causes mild eye and respiratory-tract irritation after several hours. Inhaling the gas at almost any noticeable concentration causes coughing, tears, a "running nose," and breathing difficulties. These symptoms result from chlorine combining with moisture in the eyes, nose, throat, and lungs forming a weak acid[25]. Fukayama *et al.*, [26] had reported many reactions of aqueous chlorine with model food compounds.

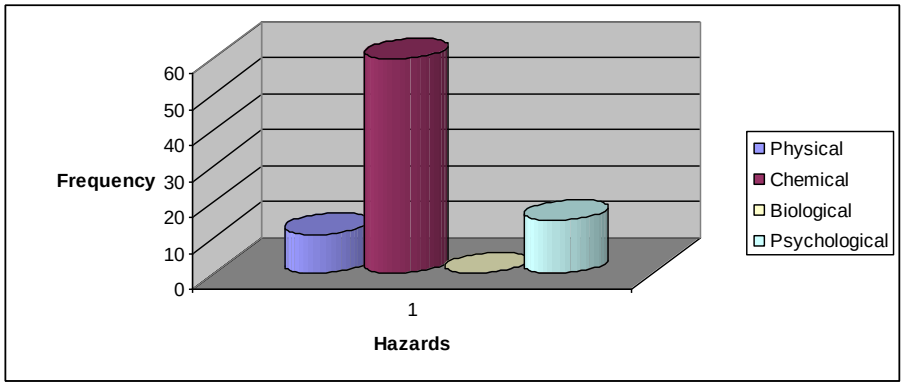

Fig.5. Frequency of varioushazards.

Table 4. Chemicals used in seafood industry

Chemicals	Contact time
Chlorine	Hand dip (1 minute) Raw material (throught out work) tap water (washing) Cleaning (1-2 hours)
Paprika	10 minutes (only inhalation. No direct contact)
Sodium metabisuplhite	10 minutes (only inhalation. No direct contact)
Sodium chloride	10 minutes

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Table 5.Chlorine usage and contact time

Contact occurrence	Concentration of chlorine
Hand dip	20ppm
Raw material	2ppm
Tap water	2ppm
Utensil cleaning	50-100ppm
Foot dip	200ppm
Floor cleaning	200-300ppm

Studies on fish processing workers have highlighted skin rashes, asthma and allergies as common work related symptoms [27]. Musculoskeletal problems have also been talked about [28,29]. Study conducted in Sweden on such workers showed that women workers are more susceptible to work related morbidities in comparison to their male counterparts despite superficially similar work [30]. So far as workplace injuries are concerned reports are there to show that injuries are higher in fish processing workers than non-exposed workers and women workers are more vulnerable than male workers

Though the studies conducted in fish processing industries have already highlighted that work related injury is a major problem area, hardly any study has explored the determinants. This present study has made an effort to identify the probable factors responsible for such work hazards so that this knowledge can ultimately help in prevention. Age group, sex, marital status, education level, disease occurrence and chemical contact were statistically analyzed. Educational level and sex showed significant contribution in the occurrence of disease. Negative correlation was reported by educational level and chemical contact. Marital status showed significance correlation with age group.

A peculiar pattern of such industries in Cochin is that they almost exclusively employ women and most of these women (poor, less educated and having a large family to support) leave this job within 5 years of joining this job. Though older women usually remain under mental tension (which may make them vulnerable to occupational injuries) they gather experience of job also with time. Naturally their on-job experience may contribute in protecting them from injuries also. Moreover, higher education level showed significant protective effect in univariate analysis. This study has not only highlighted the problem of occupational hazards in Cochin fish processing industries and the factors associated with such hazards but also has strengthened the findings of some recent studies about the harmful effect of disinfectants used in the industry(chlorine and chlorine dioxide.) Occupational asthma is the most frequent work-related respiratory disease reported in the seafood industry, withthe prevalence varying from 2 to 36%.[31]. A higher prevalence of occupational asthma is associated with exposure to aerosols arising from arthropods (crab and

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shrimp) than to molluscs and bony fish. Symptoms of asthma may develop after only a few weeks or months or after several years [32]. Symptoms are worse at work, improving on weekends or holidays and often awaken affected patients at night. There have also been isolated case reports of workers (fishmonger handling shrimp and lobster, fish smoking factory worker handling trout, anchovy, salmon and sardines) with work-related asthma symptoms who subsequently developed ingestion-related allergic symptoms [32]. However, prospective studies are needed to explore this in detail so as to quantify the risk of pre-existing seafood allergy predisposing to respiratory allergy.

IV. CONCLUSION

Educational level of majority of seafood workers was upto or below matriculation. 52.5% of the workers were single. More than 75% of the workers interviewed have four or five members in their family with only 1 or 2 earning members. Female worker percentage was higher than that of male in these industries. Loading and unloading tasks are mainly done by the male workers. Their contribution to the processing and cleaning jobs are limited. The physical, chemical, biological and psychological hazards in the seafood processing sector were identified. The physical hazards were mainly cold and heat. Among the listed hazards the frequency was more in chemical hazards followed by psychological. The chemicals used in seafood industry and their contact time was further analysed. Chlorine had the maximum contact time with the workers and the contact was direct. Studies on fish processing workers have highlighted skin rashes, asthma and allergies as common work related symptoms. Negative correlation was reported by educational level and chemical contact. This study has also strengthened the findings of some recent studies about the harmful effect of disinfectants used in the industry(chlorine). Hence, the dosage of chlorine used in the industry should be studied in detail. The residual chlorine in the seafood products and its effect on consumers is another area which requires a detailed survey. Apart from nature of job of fish processing workers occupational hazards prevailing in the work environment contribute significantly to the occurrence of work related diseases and prevention of such occupational hazards may help in protecting workers from occupational diseases also.

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