Occupational health problems and major risk factor profile of non-communicable diseases among workers in the Aquaculture industry in Visakhapatnam

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ABSTRACT

Background: Globally the rapid growth of the aquaculture sector has generated a huge work force posing significant risks to the workers due to the combined effect of the exposure to hazards at the workplace and unhealthy lifestyle. Aim and Objectives: To study the morbidity profile of workers in the aquaculture industry in terms of the occupational health problems and risk factors of non-communicable diseases. Methods: A community-based cross-sectional study was conducted among 133 workers in five aquaculture farms. Ethical Committee clearance was obtained. Data regarding the occupational health problems and major risk factors of non-communicable diseases (NCDs) was collected by using a pre-designed pretested questionnaire after obtaining informed consent from workers. The blood pressure and random blood sugar levels were measured at the time of the interview. Results: Most of the participants were in the age group 18-66 years and 94% were males. Major occupational health problems reported were musculoskeletal (56.3%), neurological (48.1%), stress related (46.7%), injuries (43%), skin infections (23%). Regarding risk factors for NCDs- 16.3% were current smokers, 51.1% were alcoholics, 50.4% had a sedentary lifestyle, <1% consumed fruits and vegetables. Among participants, 65.2% had central obesity, 28.2% were hypertensive, 9.6% were diabetic. The on-site evaluation showed that most of the aquaculture farms lack safety measures. Conclusion: The study identified potential occupational health problems and risk factors for non-communicable diseases among workers in aquaculture farms. The deficiencies in the safety measures at the workplace were also identified through on site evaluation. Hence there is a need to educate the workers regarding healthy lifestyle and safety at work place. There is a need to overcome organizational challenges at the workplace by adopting safety measures for a better working environment and to reduce the significant risk of exposure to hazards.

Keywords: Aquaculture, non-communicable, occupational, risk factors, Visakhapatnam

Introduction

The aquaculture sector is the fastest-growing food industry globally.¹ According to the 2019 data by National Fisheries Development Board, Government of India, India ranks 2nd in the world in aquaculture contributing to 20% of agricultural exports and engaging about 1.4 crore people in different activities. India has six major states (Andhra Pradesh, Haryana, Karnataka, Orissa, Uttar Pradesh and West Bengal) where aquaculture is practiced. Among them, Andhra Pradesh ranks first in coastal and freshwater aquaculture contributing nearly 40% of total marine exports of the country. Although aquaculture is being presented as a solution to the future global food gap, the workers worldwide are at increased risk of developing occupational diseases and the risks are often under-reported.²

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Occupational hazards in aquaculture can generally be categorized into **physical hazards** (noise, extreme temperatures, injuries); **chemical hazards** (seawater, detergents, irritants, fertilizers, pesticides) leading to contact dermatitis, asthma; **biological hazards** (bacterial, fish proteins, fungal); hazards due to **poor ergonomic practices** (prolonged standing, loading bags and cans), workplace design (unprotected machinery) and **psychosocial hazards** (work related stress). Commonly reported occupational health problems in the literature include musculoskeletal disorders, skin allergies, needle-stick injuries, and slips/trips/falls.[3-6]

Previous studies showed that there is an increase in the prevalence of risk factors for non-communicable diseases (NCDs) such as tobacco and alcohol consumption, physical inactivity, unhealthy diet among people working in the fishing industry due to the effect of culture, ethnicity, work socialization and heavy work schedule.[7-11] The combined effect of exposure to occupational hazards and lifestyle factors will affect the overall health of the economically important occupational group.

**Need of the present study:** Despite general information on occupational hazards present in the aquaculture industry globally, limited research is done in developing countries like India where 87% of the global aquaculture production takes place. The present study will help in a comprehensive understanding of the morbidity profile of the workers in the aquaculture industry. The findings of the research will help the family practitioners and community level health workers in planning and conducting the activities like health education campaigns, early diagnosis and treatment, training the workers in the adoption of the safety measures at work place, etc., In the present study, the aquaculture industries were also evaluated in terms of occupational health and safety so that various organizational challenges can be identified which might affect working conditions negatively.

**Aim:** To study the morbidity profile of the workers in the aquaculture industry.

**Primary objectives**

1. To determine the occupational health problems among the workers in the aquaculture industry.
2. To assess the major risk factor profile for NCDs among the workers in the aquaculture industry.

**Secondary objectives**

1. To study the association between socio-demographic factors and major risk factors for NCDs among study participants.
2. To identify factors associated with occupational health problems among the workers in the aquaculture industry.
3. To evaluate the aquaculture industries in terms of occupational health and safety.

**Materials and Methods**

**Study design**
A descriptive cross sectional community based study.

**Study setting**
There are seven well established aquaculture farms along the 30 km long coastal belt of Visakhapatnam. Out of seven, five aquaculture industries gave permission for the conduction of the study. Hence the study was conducted among workers in five aquaculture industries.

**Study duration**
2 months - August to September 2019.

**Study population**
The total number of workers in the five aquaculture industries who had given permission for the conduction of the study after fulfilling eligibility criteria.

**Inclusion criteria**
Those who are regular workers and working in the current industry for more than 3 months were included in the study so that the effect of the occupational hazards in the working environment can be determined.

**Exclusion criteria**
Those who are not willing to participate in the study.

**Sampling method and sample size calculation**
As there were no previous studies done on workers in aquaculture industries in South India (Visakhapatnam, Andhra Pradesh), a pilot study was done among 30 workers (n = 30) to know the prevalence (p). The prevalence of musculoskeletal disorder was found to be 78%. Hence, taking prevalence (p) = 78,

\[
\begin{align*}
\text{Sample size} &= \frac{Z^2 \cdot 1 - \alpha \cdot p \cdot (1 - p)}{d^2} \\
&= 4 \times 78 \times 22 / 7.8 \times 7.8 \\
&= 112.8 \text{ (taken as 113)}
\end{align*}
\]

Where, **n** = sample size,

\[Z = Z \text{ statistic for a level of confidence},\]

\[P = \text{expected prevalence or proportion}\]

\[d = \text{allowable error (10% of p)}\]

To the actual sample size 113, adding a non-response rate of 20% the sample size was calculated as 135.
Ethical consideration
Institutional Ethical Committee clearance (GIMSR/Admn./Ethics/Approval/33/2019) was obtained prior to the initiation of the study. Permission was taken from the head of the institution and also from the management of the aquaculture industries for the conduction of the study. The purpose of the study was explained to the study participants and informed consent was obtained from them prior to the interview.

Method of sample collection
Among the study population fulfilling eligibility criteria, the sample size (N = 135) was selected randomly and interviewed using a pre-designed pre-tested interview schedule.

Study tools
A pre-designed pre-tested interview schedule, non-stretchable measuring tape, Digital weighing scale, Digital automatic blood pressure monitor (OMRON), ACCU-CHEK ACTIVE blood glucose meter for measuring Random blood sugar were used to collect data. The checklist was used to evaluate the workplace in terms of occupational health and safety.

Data entry and analysis
Data was entered in the MS Excel sheet version 2010. The data were analyzed by using SPSS version 24. The associations between variables were assessed by using the Chi-square test, Fisher’s Exact test. $P < 0.05$ was taken statistically significant at 95% confidence limits.

Results
The study was conducted among 135 workers from five Aquaculture industries included in the study. The participants were in the age group of 18 to 66 years with mean age of 32.32 ± 11.78 years. The majority of the participants (94.1%) were males. The age and gender wise distribution of the participants is mentioned in Table 1.

Regarding socio-demographic details of the participants, 92.6% were from an urban background and 83.7% were literates. In majority, 98.5% of the participants were Hindu by religion. About 57.8% were married and 58.5% of participants were below middle class based on Modified BG Prasad’s socioeconomic scale 2019.

The participants (N = 135) with work experience >3 months were included in the study. The work experience ranged from 4 months to 30 years with a mean of 7.710 ± 7.99 years. The working hours per day ranged from 4 hrs to 18 hrs with a mean of 9.93 ± 2.167 hrs. In majority, 94.8% of the participants work for >5 days a week. The occupational health problems reported by the workers are represented in Figure 1. Multiple responses were noted. Most of the study participants complained about musculoskeletal problems 76 (56.3%) followed by neurological problems 65 (48.1%), work related stress disorders 63 (46.7%), injuries 58 (43%), skin infections 32 (23.7%), eye-related problems 28 (20.7%), respiratory problems 22 (16.3%). The diseases related to noise-induced hearing loss, exposure to extremely cold temperatures (like hypothermia, frost bite, etc) were found to be less common (<5%) among the study participants.

The participants who reported musculoskeletal problems mostly complained of backache (45%), joint pains (25%), generalized myalgia (10%), pain in the neck (12%), leg cramps (8%). Stress related disorders reported were anxiety (56%), generalized fatigue (35%), gastritis (38%), and insomnia (12%). The injuries most commonly encountered by the workers were cuts (33%), sprains (8%). Contact dermatitis (18%), scabies (5%) were the common skin diseases complained by the participants. Among the respiratory diseases, chronic bronchitis (15%), upper respiratory tract infections (5%) were found to be the most common.

The behavioral risk factors associated with NCDs were identified. The participants were enquired regarding tobacco consumption both for smoking and smokeless forms. About 16.3% of the participants were found to be current smokers with a mean duration of smoking 7.98 ± 10.75 years. The participants who consume smokeless forms of tobacco currently were 18.5% with a mean duration of 7.21 ± 7.44 years. About, 51.1% of the participants were current alcoholics with a mean duration of consumption of alcohol 8.04 ± 8.07 years. Among the participants who currently consume alcohol, seven (10.14%) were binge drinkers.

![Figure 1: The occupational health problems reported by study participants](image-url)

| Occupational health problems | Percentage |
|------------------------------|------------|
| Musculoskeletal              | 56.3%      |
| Neurological                 | 48.1%      |
| Stress related               | 43%        |
| Injuries                     | 23.7%      |
| Skin infections              | 16.3%      |
| Eye related                  | 20.7%      |
| Ear related (noise induced)  | 16.3%      |
| Respiratory diseases         | 10.0%      |
| Hypothermia                  | 5.2%       |

Table 1: Age and gender wise distribution of the participants

| Gender          | Male | Female | Total |
|-----------------|------|--------|-------|
|                 | n    | %      | n     | %    |
| Age             |      |        |       |      |
| 18-29           | 68   | 53.5%  | 2     | 25.0%|
| 30-44           | 37   | 29.1%  | 4     | 50.0%|
| 45-59           | 19   | 15.0%  | 2     | 25.0%|
| 60-69           | 3    | 2.4%   | 0     | 0.0% |
| Total           | 127  | 100.0% | 8     | 100.0%|
| Mean age        | 32.19±11.93 | 34.38±9.55 | 32.32±11.78 |
Regarding the consumption of fruits and vegetables in their diet, the participants who took ≥5 servings of fruits and vegetables per day as per WHO recommendations were 0% and 0.7% respectively. About 55.6% of the participants consume outside food at least once a week. The study participants were categorized into 3 categories based on physical activity as – vigorous activity 9 (6.7%), moderate activity 58 (43%), sedentary 68 (50.4%). The participants with physical activity for ≥5 days in a week were 31.9%.

The physical measurements like height, weight, waist circumference, hip circumference, blood pressure were taken. Among males (n = 127), 82 (64.6%) had waist–hip ratio ≥ 0.9. Among females (n = 8), 6 (75%) had waist–hip ratio ≥ 0.85. Among the total participants, 65.2% of workers had central obesity. Figure 2 shows the gender wise distribution of the study population based on the blood pressure (BP) levels. Among total participants (N = 135), 38 (28.14%) had BP ≥140/90 and 63 (46.6%) participants were in pre-hypertensive state. Among males, overall 27.55% and among females 37.5% had BP ≥140/90 mm Hg at the time of interview.

The random blood sugar (RBS) level of the participants was assessed at the time of the interview. Among the participants, 9 (6.7%) had RBS ≥200 mg/dl. About 11.9% were known hypertensive and 9.6% were known diabetics and reportedly on medication at the time of interview.

The present study showed no significant association between socio-demographic factors and risk factors for NCDs. There was a significant association between age group and musculoskeletal disorders among the reported occupational health problems as shown in Table 2.

Five aquaculture industries were included in the study. For the study purpose these were named as A, B, C, D, E. Each aquaculture farm was evaluated in terms of occupational health and safety as shown in Table 3.

Discussion

The present study was carried out among 135 workers in aquaculture farms along the coastal belt of Visakhapatnam. The socio-demographic profile of the workers showed that most of them were young to middle age and literate. This indicates that the young educated people are showing interest in working in fishing farms as discussed by Pandey et al.[12] in West Tripura. This might be due to an increase in opportunities in the field of aquaculture. The findings of the current study showed gender inequality with more men working in aquaculture. This was due to factors like ergonomic risks associated with the activities, shift duties, long duration of work, social environment at the workplace as explained in the study done by Tripathi et al.[13]

The current study identified potential occupational health problems and lifestyle risk factors among workers. The most common occupational health hazard identified in the present study was related to mechanical/ergonomic hazards leading to musculoskeletal disorders. These are caused by lifting heavy loads and improper ergonomic posture at work. These findings are consistent with studies done by Mandal et al. in Bangladesh[14] and Anderson et al.[15] followed by musculoskeletal disorders, in the present study the workers complained of neurological and psychosocial work related disorders. These are due to factors identified like - long duration of shift duties, lack of enough resting time, inadequate work experience among workers.[9]

The study done by Olajide[16] and review of literature done by Nggia[17] reported injuries at work place were common among workers. The workers in the present study also experienced injuries like cuts, sprains, fractures. These were due to factors like slipping on the wet surface, working with sharp objects and unguarded machines without using personal protective measures and lack of pre-placement training as identified in the current study during the onsite evaluation of the farms. Dermatological complaints like contact dermatitis and scabies were commonly complained by the workers due to working in wet conditions bare feet for long duration, lack of personal hygiene and allergens from fish farming. This is in line with the studies done on occupational hazard in fish farming.[18,19] In the present study, exposure to chemicals (disinfectants, fertilizers, pesticides) and lack of ventilation at the workplace led to the development of eye irritation (itching, redness of eye); respiratory infections (asthma, cough) similar to studies done in Canadian aquaculture[9] and in Ennore (India).[20]

There was a significant association between age group and risk of occupational hazards in the current study. Similar to the present study, the studies done by Ojediran et al.,[21] Breslin et al.[22] revealed that the majority of the respondents were below 40 yrs age and the studies showed a significant association between age group and risk of occupational hazards. This explains younger age group has a higher chance of experiencing occupational hazards and risks due to lack of work experience.

The present study also assessed risk factors for NCDs. These findings were compared with other studies,[9,11,23-26] and NFHS-4 data,[27] (Andhra Pradesh) and DLHS-4
In the present study, there was no significant association between socio-demographic factors and risk factors for NCDs. This indicates a general increase in the trend of risk factors among the population irrespective of socio-demographic factors. Literature review on cardiovascular risk factors in fishermen, and study done in Tamilnadu indicated an increasing trend and early age of onset of risk factors among fishermen community.

In the current study, five aquaculture farms were evaluated for occupational health and safety. Some organizational challenges were observed like lack of pre-placement training, periodic medical examination, supply of personal protective equipment. There was no maintenance of the health records of workers. Most of the aquaculture farms in the study didn’t appoint a medical officer/safety officer at the workplace. There was no safety policy and the majority of the workers didn't have health insurance. The absence of safety measures at the workplace will aggravate the condition making workers more prone to occupational health problems which were also reported by a study done in the Udipi district by Ansysa et al.

Most of the previous studies discussed were done among fishermen communities with different socio-demographic backgrounds, ethnicity, cultures. There was no specific data available regarding the risk factor profile among workers in the aquaculture industry in Andhra Pradesh in order to compare with the results of the present study. There might be recall bias in reporting some of the risk factors by the workers. This explains the variation between the prevalence of risk factors for NCDs and occupational health problems in the present study in comparison with others. Despite the above mentioned limitations, the strength of the study is that it is the first and foremost study done among aquaculture workers in Visakhapatnam, coastal Andhra Pradesh to assess the overall morbidity status.

**Conclusion and Recommendations**

The present study identified potential occupational health problems and risk factors for further development of NCDs among workers in aquaculture farms. The deficiencies in the safety measures at the workplace were also identified through on-site evaluation. There is a need for further multi-centric research studies to be done in India to quantify the disease burden and evaluate risks in the aquaculture industry. This would necessitate the development of appropriate industrial monitoring techniques, medical surveillance

### Table 2: Association between occupational health problems and age group

| Age in years | Musculo‑skeletal | Skin diseases | Respiratory diseases | Stress related | Neurological diseases |
|--------------|-----------------|---------------|----------------------|----------------|----------------------|
|              | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| 18‑44 (n=111) | 57  | 54 | 26  | 85 | 17  | 94 | 49  | 62 | 52  | 59 |
| 45‑69 (n=24)  | 19  | 5  | 6   | 18 | 5   | 19 | 14  | 10 | 13  | 11 |
| Total (135)   | 76  | 59 | 32  | 103| 22  | 113| 63  | 72 | 65  | 70 |

$\chi^2$ indicates statistically significant association

| Evaluation Criteria                                                                 | Aquaculture farms in the study |
|-------------------------------------------------------------------------------------|--------------------------------|
| Occupational health safety policy                                                   | A B C D E                       |
| Medical officer/qualified health physician at workplace                              |                               |
| First aid center at workplace                                                       |                               |
| Pre-placement medical examination of employees                                      |                               |
| Periodic medical examination of employees                                           |                               |
| Maintenance of health records                                                       |                               |
| Pre-placement training of employees                                                 |                               |
| Personal protective equipment                                                       |                               |
| Facility for safe drinking water & sanitation                                        |                               |

*Red color—absence of facility, Yellow—present but non functional, Green—present and functional

In the study, the prevalence of diabetes was assessed by measuring the RBS levels of the participants at the time of the interview. The prevalence of self-reported diabetes in the present study was 9.6%. On examination, 6.7% had RBS >200 mg/dl at the time of the study. This might be due to some of the participants who reported diabetes being already on medication. About 11.9% of the participants reported that they had hypertension. But on examination, 28.2% had BP >140/90 mmHg. This showed that most workers were not aware of their blood pressure levels. In concordance with the present study, the study done by Rao CR et al. showed an increase in the prevalence of type 2 diabetes among workers.

Most of the participants had an unhealthy dietary pattern, as they were not aware of the consequences of an unhealthy diet and the benefits of the intake of fruits and vegetables in the diet. More than half of the participants had a sedentary lifestyle. These findings were similar to studies done in Tamilnadu. These increased the risk of development of central obesity in most of the workers.

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### Table 3: Evaluation of aquaculture farms in terms of occupational health and safety

| Evaluation Criteria                                                                 | A | B | C | D | E                                    |
|-------------------------------------------------------------------------------------|---|---|---|---|--------------------------------------|
| Occupational health safety policy                                                   |   |   |   |   |                                      |
| Medical officer/qualified health physician at workplace                              |   |   |   |   |                                      |
| First aid center at workplace                                                       |   |   |   |   |                                      |
| Pre-placement medical examination of employees                                      |   |   |   |   |                                      |
| Periodic medical examination of employees                                           |   |   |   |   |                                      |
| Maintenance of health records                                                       |   |   |   |   |                                      |
| Pre-placement training of employees                                                 |   |   |   |   |                                      |
| Personal protective equipment                                                       |   |   |   |   |                                      |
| Facility for safe drinking water & sanitation                                        |   |   |   |   |                                      |

*Red color—absence of facility, Yellow—present but non functional, Green—present and functional

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|              | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| 18‑44 (n=111) | 57  | 54 | 26  | 85 | 17  | 94 | 49  | 62 | 52  | 59 |
| 45‑69 (n=24)  | 19  | 5  | 6   | 18 | 5   | 19 | 14  | 10 | 13  | 11 |
| Total (135)   | 76  | 59 | 32  | 103| 22  | 113| 63  | 72 | 65  | 70 |

$\chi^2$ indicates statistically significant association

| Evaluation Criteria                                                                 | A | B | C | D | E |
|-------------------------------------------------------------------------------------|---|---|---|---|---|
| Occupational health safety policy                                                   |   |   |   |   |   |
| Medical officer/qualified health physician at workplace                              |   |   |   |   |   |
| First aid center at workplace                                                       |   |   |   |   |   |
| Pre-placement medical examination of employees                                      |   |   |   |   |   |
| Periodic medical examination of employees                                           |   |   |   |   |   |
| Maintenance of health records                                                       |   |   |   |   |   |
| Pre-placement training of employees                                                 |   |   |   |   |   |
| Personal protective equipment                                                       |   |   |   |   |   |
| Facility for safe drinking water & sanitation                                        |   |   |   |   |   |
protocols, adoption of legislations at work place and planning of health services for workers in the aquaculture industry.

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Conflicts of interest
There are no conflicts of interest.

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