Prevalence of malnutrition and associated factors of pond fish farmers from Noakhali Coast, Bangladesh

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Abstract

Aim: Current investigation was conducted to elucidate the occurrence of malnutrition and related factors of pond fish farmers from Noakhali coast, Bangladesh.

Methodology: Eighty male pond fish farmers, aged 18-70 years, from Noakhali Sadar, Subarnachar, Kobirhat and Ramgati upazila of Noakhali coast, Bangladesh were selected randomly for the investigation. Data were collected through questionnaire interview and survey, focus group discussion, cross check interviews, Body Mass Index, Mid Upper Arm Circumference and blood Hb level. Pearson correlation was used to determine the association between anthropometric and socio-demographic characteristics and simple linear regression were fitted to identify factors associated with malnutrition among pond fish farmers.

Results: The overall prevalence of malnutrition, overweight, obesity of pond fish farmers were 18.8%, 21.2% and 17.5%, respectively, based on BMI while the prevalence of malnutrition was 23.7% as per MUAC. The prevalence of mild anaemia (57.5%) was high compared to the global anaemia prevalence. 10% had no education while 22.5%, 20%, 7.5% and 5% had primary, secondary, higher secondary and bachelor education level, respectively. The highest (38.8%) annual income of the pond fish farmers was 1,300-1,785 USD. Significant variations (tested by one-way ANOVA) in nutritional status and socio-demographic characteristics were observed. Pearson correlations of age with MUAC exhibited significant ($r = -0.271$; $p < 0.05$) negative association, BMI was found positively and significantly correlated with annual income ($r = 0.223$; $p < 0.05$) and MUAC ($r = 0.246$; $p < 0.05$). Linear regression analysis revealed that the age of pond fish farmers had negative significant influence on MUAC and positive impact of annual income on BMI.

Interpretation: The prevalence of malnutrition, mild anaemia with poor economic status were high among the pond fish farmers of Noakhali Coast. Therefore, community based health and nutritional education, effective public health and nutritional intervention programs, poverty alleviation program and economic growth may improve the overall health, nutritional knowledge and thus status of pond fish farmers.

Keywords: Body mass index, Economic growth, Fish farmers, Homestead ponds, Malnutrition

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Introduction

Malnutrition remains to be the foremost public health problems in Bangladesh. Infectious diseases like acute respiratory diseases and diarrheal diseases are responsible for most nutrition-related health problems in this country (Gross *et al.*, 2000). Due to malnutrition, anemia probably is another major public health issue in all developing countries (UNICEF, 2013). There are several reasons for prevalence of anaemia in a population, like deficiency of iron and other nutritional deficiencies of folate, Vitamin B₁₂ and Vitamin A parasitic infections, acute and chronic inflammation, and acquired disorders that affects the haemoglobin production or survival of red blood cell (WHO, 2011).

In our society, fishermen are underprivileged and considered as one of the poorest segments (Rahman *et al.*, 2012). Malnutrition depends on some factors like economic, ecological, social and others, therefore varies from country to country. There are some major reasons for high prevalence of malnutrition like poor sanitation and drinking water facilities, poverty, fluctuation in annual income. A close link exists between education of a pond fish farmer with their income and their well-being. As per Bangladesh Demographic and Health Survey (Biswas *et al.*, 2017) report, 29.1%, males were underweight, overweight and 3% obese. Recently in Bangladesh, to meet the nutritional demand of Sustainable Development Goals (SDG) there has been making an attempt in reducing malnutrition problems.

Nutritional status depends on food intake and health status. Food consumption, which mostly depends on production, access, distribution as well as financial ability, effects the health and nutritional status of population (UNICEF, 2013). The nutritional aspect of food security is attained when secure access to food can be ensured with a hygienic environment, satisfactory health service, income, and educated care to ensure a healthy life for all household members (Gross *et al.*, 2000). An anthropometric measurement such as Body Mass Index (BMI) and Mid Upper Arm Circumference (MUAC) are two useful indicators that record the nutritional status of pond fish farmers that lives under poor economic condition (WHO, 1995). Even though nutritional and health status of adult pond fish farmers can be assessed in many ways, BMI is most commonly used due to its inexpensiveness, non-invasion and suitability for large-scale surveys (Pirlich and Lochs, 2001; Lee and Nieman, 2007). Usually, BMI is considered as a good measurement index not only of the nutritional status but also the socio-economic status of pond fish farmers in developing countries (Kongsdier, 2002; Adak *et al.*, 2006). MUAC is other feasible tool for assessing the nutritional status because it is comparatively easy to use, requires minimum equipment as well as quick calculations, and inexpensive and simply transportable. It is particularly considered as efficacious tool for assessing the malnutrition in adult pond fish farmers.

Several studies have been conducted on anthropometric characteristics, nutritional status and prevalence of anaemia in adult males (Monteiro *et al.*, 2004; Sultana *et al.*, 2015; Banik, 2008; Tonder *et al.*, 2018; Shahabuddin *et al.*, 2000; Ahmed, 2000; Shill *et al.*, 2014; Hyder *et al.*, 2004; Hyder *et al.*, 2001; Heck *et al.*, 2008). However, information on the nutritional status of males in Bangladesh is meagre (Sultana *et al.*, 2015). Besides, these studies were based on the conventional indicators of nutritional status. Hence, direct measure of height or weight could not be measured to underestimate the prevalence of malnutrition in adult male that could have impacted the precision of the findings. Moreover, the limitations of previous studies were unavailability of blood markers like HemoCue or other device that could be used for acquiring more accurate results on the concentration of haemoglobin. To date, no study on nutritional health status of pond fish farmers has been assessed in the Noakhali coastal area. Therefore, considering the knowledge gap and above mentioned importance the present study was conducted to assess the prevalence of malnutrition and associated factors in pond fish farmers of Noakhali coast, Bangladesh.

Materials and Methods

Study site: The present study was executed in eight unions from four upazilas of Noakhali Coast based on collection of data from 80 pond fish farmers during the period 6th November, 2018 to 7th January, 2019 (Fig. 1).

Data collection: A draft questionnaire was developed and pre-tested with few pond fish farmers before collecting primary data. The final questionnaire was then pre-tested, improved and modified. The questionnaire included anthropometric characteristics (Height, weight, MUAC), anaemia prevalence (Hb level) and socio-demographic (sex, age, religion, education, annual income) characteristics of pond fish farmers. Secondary data on nutritional health were gathered from books, from various published and unpublished relevant documents of various sources, journal articles, government and non government organizations like District Fisheries Office, Central Library of Noakhali Science and Technology University.

Height and weight was measured using ideal height and weight measuring scale (H07, Zhongshan Dingheng Yipin Home Product Co. Ltd., China). While measuring the weight, individuals were requested to be bare footed and put off heavy clothes, and weight was logged in to the nearest 0.5 kg, for measuring, height individuals were positioned to stand on plain land, bare foot looking straight. Height was recorded to the nearest 0.1 cm. Nutritional health condition was calculated by estimating the Body Mass Index (BMI) by the following formula and classified according to "Asian criteria" (WHO, 2000; Llado and Mirasol, 2011).

Fig. 1 : Map showing the study sites. (S₁, S₂ indicates Noakhali Sadar, S₃, S₄ indicates Subarnachar, S₅, S₆ indicates Kobirhat and S₇, S₈ indicates Ramgati).

$$\text{BMI} = \frac{\text{Weight in kilograms}}{(\text{Height in meters})^2}$$

MUAC value was calculated to the nearest 0.1 cm with a tape, and measurement was taken at the mid-point of the upper left arm. After locating the mid-point, the subjects were asked to keep their arm extended with palm facing inward. The tape was wrapped smoothly and gently around the mid-point of arm, and MUAC was classified according to James *et al.* (1994), Tang *et al.* (2013) and Ulijaszek and Kerr (1999).

During the study, the blood samples were collected to assess the prevalence of anaemia by a nurse who was trained for two days. Anemia prevalence was assessed by determining the haemoglobin level (gdl⁻¹) as per WHO (1992; WHO, 2001) using Hemoglobin analyzer (HemoCue Hb 201⁺, HemoCue AB, Sweden).

Data processing and analysis: One-way analysis of variance (ANOVA) was conducted to test the difference in the mean anthropometric characteristics. Simple linear regression and Pearson correlation coefficients (*r*) were used to elucidate the

interrelationship between anthropometric and socio-demographic characteristics. Age and annual income were used as continuous independent variables in these analyses. Data were evaluated by software SPSS (Statistical Package for Social Science) version 25.

Results and Discussion

The perusal of data of body mass index revealed that 18.8% of pond fish farmers living in the investigated area were underweight and 21.2% overweight, while 17.5% were pre-obese and obese (Table 1). Only 5% pond fish farmers suffered from obesity at Kobirhat upazila (Fig. 2). However, the underweight (25%) were more prevalent at Noakhali Sadar upazila than those of other upazilas (Fig. 2). The highest (30%) and lowest (15%) overweight were found at Kobirhat and Ramgati upazila, respectively. The present study demonstrated that the incidence of overweight (21.2%), pre-obesity and obesity (17.5%) were high compared to the National Demographic and Health Survey (BDHS) in Bangladesh (Biswas *et al.*, 2017) because the previous study wasn't conducted specially with pond fish farmers of Noakhali Coastal region. The present findings revealed that the

Table 1 : Prevalence of nutritional status according to Body mass index (BMI), Mid upper arm circumference (MUAC) and haemoglobin level among the pond fish farmers

BMI Range (kg m ⁻²)	Nutritional status	n (%)
< 18.5	underweight	15 (18.8)
18.5-22.99	Normal	34 (42.5)
23.0-24.99	Overweight	17 (21.2)
≥25.0		
Pre-obese and obese	14 (17.5)	
Total		80 (100)
MUAC (cm)	Nutritional status	n (%)
≥23.0	Normal	61 (76.3)
<23.0	Malnutrition	19 (23.7)
Total		80 (100)
Haemoglobin level (gdl ⁻¹)	Anaemia status	n (%)
10-12.99	Mild anaemia	46 (57.5%)
≥13	Non anaemia	34 (42.5)
Total		80 (100)

pond fish farmers were worse off. Von Tonder *et al.* (2018) elucidated Body Mass Index as a viable tool for identifying malnutrition in the Eastern Cape of South Africa and reported 16.9% population as overweight and 18.4 obese.

Nutritional status assessment based on cut off points of MUAC also indicated that 23.7% farmers suffered from malnutrition (Table 1). The highest (40%) and lowest (10%) number of farmers with malnutrition were reported from Noakhali Sadar and Ramgati upazila (Fig. 3). From the present study, it was found that the prevalence of malnutrition (23.7%) was comparatively higher than that reported by Von Tonder *et al.* (2019) in South Africa. The present findings varied with reports of Banik (2008) in Jharkhand, India as the study area was different.

The prevalence of malnutrition of pond fish farmers with poor economic status compared with Health Survey at national levels (Biswas *et al.*, 2017) as well as other countries (Von Tonder *et al.*, 2018). This difference might be due to using conventional methods which underestimated the nutritional status. Direct measures of weight or height could not be measured as the participants weren't ambulant, and some of them were unable to recollect their usual body weight. In such conditions, BMI was assessed and this could have affected the precision of the findings.

The perusal of data revealed that 57.5% farmers were found mild anaemic having haemoglobin level 10-12.99 gdl⁻¹ (Table 1), while the highest Hb level (75%) was reported from Noakhali Sadar and lowest (45%) from Ramgati upazila (Fig. 4). Hyder *et al.* (1998) found 51% mild anaemic male having haemoglobin level 10-12.99 gdl⁻¹ in a rural community of

Bangladesh. Heck *et al.* (2008) reported 5.7% men anemic having less than 12 g dl⁻¹ hemoglobin in Bangladesh. Kassebaum *et al.* (2014) conducted a study on global anemia burden from 1990 to 2010 and found that global anemia occurrence in 2010 was 32.9%, and the occurrence lowered in both sexes from 1990 to 2010. De Benoist *et al.* (2008) studied the occurrence of anaemia 1993–2005 worldwide and found that global anaemia occurrence in men was 12.7%. Compared to national and regional studies (Hyder *et al.*, 1998; De Benoist *et al.*, 2008), the occurrence of mild anaemia (57.5%) was reported to be higher in this study.

Based on the age, farmers were categorized into three groups: 20-35 years-old as young, 36-50 year as middle aged and 51-70 year as old (Table 2). It was found that middle aged group was maximum (38.8%) and old was minimum (31.1%) considering all farmers. This findings are somewhat in line with the findings of Ali *et al.* (2009) who conducted a study in Mymensingh and stated that most fish farmers (50%) belonged to age group of 31 to 40 years which is in agreement with the present findings. In the study area, the major population of fish farmers (81.3%) were Muslims. Khatun *et al.* (2013) also reported that Muslims and Hindus comprised 82% and 18% of the pond fish farmers, respectively.

Education is important for human existence as both education and society are interrelated and interdependent. Improvement and progress of an area largely depends on the quality of education. The study revealed that 10% population was illiterate, 35% could only sign, 22.5% had primary education, 20% secondary education, and the remaining were under graduates. This finding was compared with some other studies conducted in Bangladesh

Fig. 2 : Prevalence of malnutrition of the study areas based on MUAC (cm).

Fig. 3 : Prevalence of malnutrition of the study areas based on Body mass index.

Fig. 4 : Prevalence of anemia in the study areas based on haemoglobin level (g dl⁻¹).

(Fagun et al., 2020; Hossen et al., 2020; Khatun et al., 2013) where literacy rate was found higher in fish farmers than the national adult literacy rate (65%) which strongly supported the present outcome.

Based on the annual income, pond fish farmers were classified into five categories (Table 2). The 1st category included the pond fish farmers having annual income up to 365-845 USD. The 2nd, 3rd, 4th and 5th categories had annual income of 845-1,300 USD; 1,300-1,785 USD; 1,785-2,260 USD and 2,260-2,500 USD, respectively (1 USD is equivalent to 84 BDT). The highest percentage (38.8%) pond fish farmers earned USD 1,300-1,785 per year. Among the four upazila, maximum (60%) pond fish farmers from Ramgati upazila earned about 1300-1785 USD per year whereas only 25% of pond fish farmers from Noakhali Sadar upazila could earn that. It revealed that annual income of pond fish farmers was lower in Noakhali Sadar upazila than those of other. Therefore, the need of investment to provide facilities for improving education, knowledge about fish farming, health care facilities, proper sanitation etc. in Noakhali Sadar is crucial. However, it was observed that a total 38.8% of pond fish farmers from this studied area earned about 1300-1785 USD per year which was better from the findings of Khatun et al. (2013).

Analysis of Variance (ANOVA) was carried out to assess significant variation in the mean value of variables among the four selected upazila ($p < 0.05$) (Table 3). ANOVA result showed that the mean religion, annual income of pond fish farmers varied among the four selected upazila ($p < 0.05$). However, no significant variation in the mean age, education, BMI, MUAC and Hb level ($p < 0.05$) was noted.

In order to investigate the association of nutritional status and socio-demographic variables Pearson correlation was conducted (Table 4). It showed no statistically significant correlation between the nutritional status and socio-demographic variables, except for MUAC, BMI, age and annual income ($P < 0.05$). Age showed intermediate negative relationship with MUAC ($r = -0.271$; $p < 0.05$), BMI displayed positive significant association with MUAC ($r = 0.246$; $p < 0.05$) and annual income ($r = 0.223$; $p < 0.05$).

Simple linear regression was calculated explored to elucidate the effect of age on MUAC and annual income on BMI (Table 5) with increase in age of farmers each year, the farmer lost 5.6 cm of MUAC cut-off points. The results showed that a significant section of pond fish farmers were suffering from malnutrition, overweight and obesity. It is obvious that as they grew older, the pond fish farmers became nutritionally worm off. The annual income showed positive and significant correlation with BMI ($r = 0.223$; $p < 0.05$). It appeared as higher the annual income of pond fish farmers, greater was BMI with increase in one USD of annual income of each farmer, the farmer gained 0.0001991 BMI. It indicates that the pond fish farmers continued with poor economic condition which impacts nutritional status. The prevalence of malnutrition, mild anaemia with poor economic status was high among the pond fish farmers of Noakhali Coast.

Table 2 : Socio-demographic characteristics of pond fish farmers in the study area

Variables	Frequency	Percentage (%)
Age (Year)		
20-35	16	20
36-50	31	48.8
51-70	33	41.2
Religion		
Muslim	65	81.2
Hindu	15	18.8
Education		
Illiterate	8	10
Only sign	28	35
Primary	18	22.5
Secondary	16	20
Higher secondary	6	7.5
Bachelor	4	5
Annual income (USD)		
365-845	7	8.8
845-1,300	27	33.8
1,300-1,785	31	38.8
1,785-2,260	12	15
2,260-2,500	3	3.8

Table 3 : Analysis of Variance (ANOVA) for comparing mean value of variable among pond fish farmers (Mean $\pm$ SD)

Variables	Mean $\pm$ SD				F	P Value
	Noakhali Sadar	Subarnachar	Kobirhat	Ramgati		
BMI (kg/m ²)	20.65 $\pm$ 3.11	2.53 $\pm$ 2.89	23.35 $\pm$ 4.13	22.32 $\pm$ 3.07	2.369	0.077
MUAC (cm)	22.92 $\pm$ 2.78	23.90 $\pm$ 2.02	24.45 $\pm$ 2.48	24.59 $\pm$ 1.92	2.128	0.104
Hb level (gdl ⁻¹)	12.44 $\pm$ 0.90	12.95 $\pm$ 1.04	12.72 $\pm$ 0.64	12.81 $\pm$ 0.89	1.215	0.310
Age (year)	51.95 $\pm$ 11.94	44.35 $\pm$ 11.45	49.25 $\pm$ 9.93	44.30 $\pm$ 11.54	2.270	0.087
Religion	1.25 $\pm$ 0.44	1.35 $\pm$ 0.48	1.15 $\pm$ 0.36	1.15 $\pm$ 0.36	3.123	0.031
Education	3.55 $\pm$ 3.98	5.35 $\pm$ 4.57	7.05 $\pm$ 5.06	7.05 $\pm$ 5.06	2.262	0.088
Annual income (USD)	1183.095 $\pm$ 354.26	1528.15 $\pm$ 444.95	1408.33 $\pm$ 310.39	1408.33 $\pm$ 310.39	4.399	.007

Table 4 : Association between nutritional status and socio-demographic characteristics

Variables	Correlations with	r	Significance (P<)
Age	BMI	0.025	0.826
	MUAC	-0.271	0.015
BMI	MUAC	0.246	0.028
Annual Income	BMI	0.223	0.047

Table 5 : Simple linear regression of anthropometric characteristics with age among pond fish farmers

	Unstandardized coefficients		Standardized coefficients	t	Sig	R	R ²	Adjusted R ²
	B	Std. Error	Beta					
Age	-0.056	0.023	-0.271	-2.486	0.015	0.271	0.73	0.62
Annual income	0.0001991	0.000	0.223	2.021	0.047	0.223	0.050	0.038

Dependent variable: MUAC (cm), BMI (kg m⁻²); B= Regression coefficient (Parameter estimate), Std. Error = Standard Error, Beta = Beta coefficient of estimated regression.

The nutritional status mostly relies on the availability of nutritious food in the household. Due to low income and poor education they are deprived of nutritious food. In developing countries like Bangladesh, low income level does not permit the type and amount of nutritious food available for consumption. It is unfortunate that maximum pond fish farmers are not aware of anaemia. Proper health education to develop knowledge on anaemia and injurious effect of clinical outcomes, benefits of taking Vitamin B₁₂, iron, folate rich food and avoiding unhealthy food like junk/ fast food, will be helpful to them. It may be noted that nutritional status of a nation has a complex chain with dietary pattern as well as environment and ecology. This study principally demarcated the annual income of pond fish farmers as a vital predictor uniformly in poor society. The Government of Bangladesh should take proper steps to determine the prevalence of anaemia among the pond fish farmers. Therefore, community based health and nutrition education, immediate nutritional intervention programs, poverty alleviation program and economic growth may improve the overall health, nutritional knowledge and status of pond fish farmers enabling them to make a wiser selection of nutritious foods.

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Ethical approval was obtained from Noakhali Science and Technology University Ethics Committee before the commencement of study. Informed consent was also attained from local community leaders and participants.

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