

Original Research Article

Assessment of the prevalence of anemia and its association with nutritional anthropometric variables and dietary intakes among fishermen at coastal area, India

S. K. Nazibar Rahaman¹, Sovan Samanta¹, Rubai Ahmed¹, Sandeep Kumar Dash¹, Kazi Anika Nawar², Srijata Mitra³, Amitava Pal^{4*}, Kazi Monjur Ali^{2*}, Mafuza Yasmin⁵

¹Department of Physiology, University of Gour Banga, Malda, West Bengal, India

²Department of Nutrition, MUC Women's College, Purba Bardhaman, West Bengal, India

³School of Allied Health Sciences and Translation Research, Sister Nivedita University, New Town, Kolkata, West Bengal, India

⁴Department of Physiology, City College, 102/1, Raja Rammohan Sarani, Kolkata, West Bengal, India

⁵Department of Sociology, Surendranath Law College, 24/2 Mahatma Gandhi Road, Kolkata, West Bengal, India

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*Correspondence:

Dr. Kazi Monjur Ali,

E-mail: kazimonjur1984@gmail.com

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ABSTRACT

Background: Anemia is associated with poor physical performance due to promotes exhaustion and a lack of muscular oxygen, resulting in reduced muscular strength, quality, and performance. Various characteristics including ethnicity, sex, age, sociodemographic profile, eating pattern, physical and mental health, environment and genetics are correlated with anemia. Aim of our study is to explore the prevalence of anemia with difference BMI categories along with comparison of nutrients intake between anemic and non-anemic subjects in our study group in the area of coastline of Purba Medinipur district, India.

Methods: A cross-sectional study was carried out from September 2023 to December 2023 in the coastline of Purba (East) Medinipur district, West Bengal. In the study, 410 fishermen and 205 non-fishermen were included. Following standard procedure haemoglobin (Hb) estimation and anthropometric variables were measured. Diet survey was conducted by standard 24 hours recall method. Collected data was analyzed statistically using Student's t-test, Chi-square test and bivariate logistic regression analysis.

Results: Prevalence of anemia were more likely to non-fishermen compared to fishermen. It is also noted that obesity indicators are significantly higher in non-anemic participants. Participants who have been classified as overweight or obese take more nutrients and have a lower risk of anemia.

Conclusions: The present study illustrates the prevalence of anemia among fishermen and fishermen with higher BMI are less likely to have anemia. This study exposes an inverse relationship between anemia and overweight/obesity to the fishermen in the maritime of Purba (East) Medinipur district. Poor nutritional status and unhealthy dietary practices are significant causes of anemia.

Keywords: Anemia, Fishermen, Nutritional status, Physical measures

INTRODUCTION

Fishing is fast growing industries globally and boost the overall economic development for any nation.^{1,2}

Approximately 10% of people worldwide rendered their living from fishing.² Achieving societal sustainability has been greatly impacted by the significance of human health. Regarding the importance of seafood for nutrition

and food security, there is a direct connection between fishing and human health for fishing communities and as well as fisherman and their health are the main component of fishing industries.³

Deficits in micronutrients and protein-energy lead to the world's foremost nutritional issue and it causes nutritional deficiency anemia which is attributed by a diet low in iron, vitamin B₁₂ (cyanocobalamin), vitamin C and, folic acid.⁴ Additionally, worm infection, multiple gestations, menstrual bleeding, postpartum hemorrhage, ulcer bleeding, bleeding disorders, aspirin/non-steroidal anti-inflammatory drug use, and a strict vegan or vegetarian daily living are specific causes of nutritional anemia.⁵ Iron deficiency anemia (IDA), accounting for 50% of nutritional anemia worldwide, and megaloblastic anemia are triggered by deficient ingestion of foods that contain iron, poor vitamin B and C intake, and improper sanitation and hygiene practices.^{4,6} In India, anemia affects 67.1% of children under five, 57.2% of women, and 25% of men, according to a report from the National Family Health Survey-5 (NFHS-5).⁷ Anemia accounts for 9% of the global challenges stress, resulting in lowered efficiency at work, comprehension abilities, and substantial decline in cognitive ability, with implications for health, financial, and social development. Low socioeconomic class, a lack of education, and being underweight during pregnancy are all linked to an increased risk of anemia. These variables typically lead to food and nutritional inadequacy which encompasses issues such as access, availability, use, and stability of basic food supplies as well as commodities and services.⁸

Fishing is the physical demanding occupation.⁹ So physical fitness and good nutritional status are important factors for high performance of work.⁹ Optimal hemoglobin concentration in the blood is the indicators of the performance capacity and several literatures indicates that low hemoglobin concentration is associated with loss of physical performance. It may be because anemia causes fatigue and a lack of muscular oxygen, leading to decreased muscular strength, quality, and physical performance.^{10,11} Different physical measures are available like body mass index (BMI), body weight and height to assess overall health condition. Presently BMI has been widely used to determine adult obesity and chronic energy deficiency (CED) in population and individual level.¹² Studies indicated that obese people seem to have a greater chance of rising iron deficit anemia (IDA) due to several risk factors, including persistently inadequate iron consumption, higher mass of adipose tissue which increased hepcidin expression and interferes with iron absorption from the intestine.¹³ In contrast, other studies revealed that individuals who are overweight or obese have higher hemoglobin levels.¹⁴

Present study aimed to investigate the incidence of anemia based on nutritional categories and its associated factors among fishermen in coastal areas of Purba Medinipur district in West Bengal, India. Particular

information regarding those factors that contribute to anemia will be provided by our investigation. Furthermore, the new dimension our study can provide was designed to help government officials and policymakers in determining the causes of anemia and developing effective programmes and policies to combat it among this demographic of people who work in physically demanding jobs.

METHODS

Selection of subjects and study sites

We executed a cross-sectional survey of 410 fishermen and 205 non-fishermen who lived along Purba (East) Medinipur district's coastline in West Bengal. The study was conducted specifically between September 2023 to December 2023. The study those in attendance were not compensated in any form for their participation in this study. Informal permission has been provided by the research participants. All participants were apprised of the intention of the research endeavour, and if they accepted the invitation, they were all incorporated.

Ethical clearance

The University of Gour Banga's Institutional Ethics Committee (Human) in Malda, West Bengal (India), approved the study and provided recommendations that were followed throughout the study (Reference No. UGB/IEC (Human)/0011-21, Date 25/11/2021).

Anthropometric measurements

Various anthropomorphic indices like body height, body weight, mid upper arm circumference (MUAC), waist circumference, hip circumference, and skinfold thickness such as thigh skinfold, chest skinfold, and abdominal skinfold were recorded by the help of standardized procedures. BMI, WHR, fat percentage, total fat, and lean body mass were evaluated using anthropometric variables.^{9,15-17}

Collection of blood samples

The hemoglobin (Hb) status was measured among 410 male fishermen and 205 non-fishermen subjects with a finger-prick capillary blood sample and analyzed immediately with the help of a hemoglobinometer. A capillary blood sample was collection by finger-prick from each participant. The initial diagnosis of anemia was performed by measuring hemoglobin (Hb) with a portable Hemo Cue photometer as per the standard method.¹⁸ The individuals' hemoglobin status was determined using international references to classify them as mild, moderate, and, severe anemic (WHO, 2011). For men, anemia was defined as Hb<13 gm/dl. Hemoglobin 10-12.9 gm/dl was considered mild anemia, while Hb of 7-9.9 gm/dl and <7 gm/dl were grouped as moderate and severe anemia, respectively.¹⁹

Diet survey

Diet survey was conducted based on 24 hours recall method for 7 days, avoiding occasion days. Subject were requested to remember all the consuming food the day before. Subjects were showed food models and household measurements to record the actual amount of food consumption. Nutrients were calculated by the help of the food composition reference.^{20,21}

Statistical analysis

Data were summarized using frequencies and percentages for categorical variables and mean and standard deviations for continuous variables. Differences were evaluated with the help of Student's t-test and Chi-square test for continuous and categorical variables, respectively. Bivariate logistic regression analysis assessed the risk of anemia of the subject of fishermen and controlled

participants with an increasing BMI. All analyses were accomplished with the help of the Statistical Package for Social Sciences (version 20). A p value <0.05 was applied statistically significant.

RESULTS

The different physical measures, obesity indicators, and hemoglobin concentrations of the fishermen (n=410) and non-fishermen (n=205). The average age of fishermen and non-fishermen was 39.2±10.4 years and 40.8±9.8 years, respectively, with no significant difference. There was no significant difference of height, weight, BMI hip circumference, WHR, abdominal skin fold, total weight of fat and fat percentage. MUAC, thigh skin fold, chest skin fold, and hemoglobin concentration are significantly higher in fishermen compared to non-fishermen. But Lean body mass is significantly higher in non-fishermen (Figure 1).

Table 1: Frequency and percentage of fishermen and non-fishermen having different categories of anemia.

Anemia classifications	Fishermen (n=410)	Non-fishermen (n=205)	χ^2 (p)
Severe (Hb<7 gm/dl)	0	0	-
Moderate (Hb 7-9.9 gm/dl)	10 (2.4)	6 (2.9)	0.128 (NS)
Mild (Hb 10-12.9 gm/dl)	130 (31.7)	90 (43.9)	8.846 (p<0.01)
All category (Hb<13 gm/dl)	140 (34.1)	96 (46.8)	9.296 (p<0.01)

Table 2: Comparison of nutrient intake between non anemic and anemic subjects.

	Parameters	Fishermen		Non-fishermen	
		Non anemic (n=270)	Anemic (n=140)	Non anemic (n=16)	Anemic (n=35)
All	Energy (kcal)	2842.5±448.0	2707.3±384.7***	2491.2±232.0###	2305.3±184.8**###
	Carbohydrate (gm)	530.7±82.6	504.5±73.0***	478.6±49.1###	443.0±37.4**###
	Protein (gm)	100.7±23.5	95.36±2.6**	60.3±5.7###	54.6±6.3**###
	Fat (gm)	75.3±18.9	72.8±16.4	40.3±4.3###	38.6±4.5###
	Iron (mg)	12.6±7.0	12.3±7.3	13.3±2.6	12.8±3.5
	Vitamin-C (mg)	143.8±68.1	141.4±70.5	125.7±15.6###	122.3±35.1#
Animal foods	Energy (kcal)	316.8±104.7	297.9±88.2*	98.7±20.6###	83.1±24.8*###
	Carbohydrate (gm)	13.4±4.6	12.6±3.8*	3.5±0.6###	3.1±0.8*###
	Protein (gm)	56.3±18.4	52.9±15.6*	18.5±4.1###	15.4±4.9*###
	Fat (gm)	4.0±1.3	3.8±1.1*	1.1±0.2###	1.0±0.3*###
	Iron (mg)	1.4±0.5	1.4±0.4*	0.4±0.1###	0.3±0.1*###
	Vitamin-C (mg)	50.7±17.3	47.7±14.5*	13.3±2.5###	11.6±3.1*###
Cereals	Energy (kcal)	2033.9±296.5	1931.3±264.9***	1799.6±197.6###	1672.1±152.0*###
	Carbohydrate (gm)	464.3±67.7	440.9±60.5***	410.7±45.1###	381.6±34.7*###
	Protein (gm)	37.7±5.5	35.8±4.9***	33.8±3.8###	31.4±2.8*###
	Fat (gm)	2.3±0.3	2.2±0.3***	2.0±0.2###	1.8±0.2*###
	Iron (mg)	6.2±1.1	5.8±1.0***	7.1±1.1###	6.5±0.9*###
Vegetables	Energy (kcal)	163.0±87.2	158.8±90.1	250.3±24.9###	218.3±46.0**###
	Carbohydrate (gm)	35.1±18.0	34.2±18.5	54.6±5.2###	47.0±10.1***###
	Protein (gm)	4.4±2.7	4.3±2.76	6.3±0.8###	5.9±1.3###
	Fat (gm)	0.6±0.6	0.6±0.6	0.9±0.2###	0.9±0.3###
	Iron (mg)	4.8±7.0	5.0±7.3	5.5±1.7	5.7±3.4
	Vitamin-C (mg)	92.8±65.5	93.4±68.4	111.9±16.3###	110.1±34.9#

w.r.t. Non anemic *p<0.05; **p<0.01; ***p<0.001; w.r.t. fishermen #p<0.05, ###p<0.01, ###p<0.00, FM-fishermen; NFM- non-fishermen.

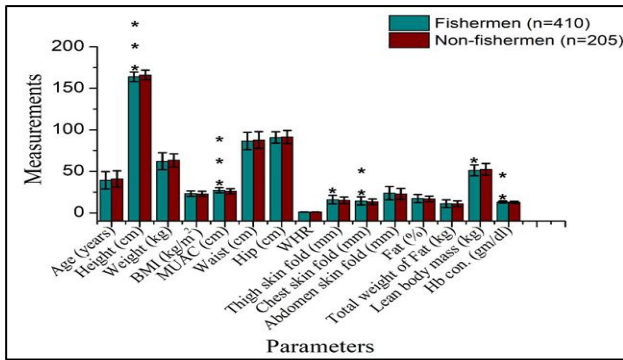


Figure 1: Different physical measures, Hb concentrations, and obesity indicators of the participants.

The values are expressed as mean±SD. *P<0.05, **p<0.01 and ***p<0.001.

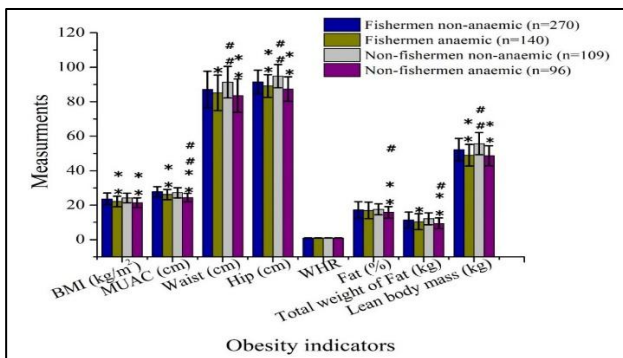


Figure 2: Obesity indicators of anemic and non-anemic subjects.

The values are expressed as mean±SD. *p<0.05, **p<0.01 with respect to non-anaemic and with respect to fishermen #p<0.05; ##p<0.01).

Prevalence of anemia among both group of participants and accounting 34% of fishermen and 47% of non-fishermen were anemic. The subjects were subdivided

into different anemic categories. The results found that about 2.4% of fishermen and 2.9% of non-fishermen were moderate category of anemia, whereas around 32% of fishermen and 44% of non-fishermen were mild anemia. There was no found of severe anemia in our study (Table 1).

Comparative study of nutrients consumption over anemic and non-anemic participants. Total calorie, carbohydrate, and protein consumption were significantly higher in non-anemic individuals when compared to anemic subjects of both fishermen and non-fishermen. It is also noted that most nutrient intake was considerably higher in fishermen (anemic and non-anemic) than non-fishermen (anemic and non-anemic). Nutrients from animal food and cereals were also significantly increased in fishermen. No significant difference was found in nutrient consumption from vegetables between non-anemic and anemic fishermen. Nutrient consumption from vegetables was high among non-fishermen, concerning fishermen (Table 2).

The different obesity indicators for anemic and non-anemic in both group of participants. It is noted that most of the obesity indicators are significantly higher in non-anemic subject in both group of participants (Figure 2).

Hemoglobin content concerning the BMI category was also analyzed. Underweight fishermen and non-fishermen contain hemoglobin of 12.2±1.7 gm/dl and 11.0±1.4 gm/dl, respectively. Normal BMI categories for fishermen and non-fishermen containing hemoglobin were 12.2±1.4 gm/dl and 12.4±1.3 gm/dl, respectively. And overweight or obese fishermen and non-fishermen contain more hemoglobin, which were 13.3±1.2 gm/dl and 13.4±1.1 gm/dl, respectively. Significant differences in hemoglobin content are found in the BMI categories of fishing community and non-fishing community [fishermen -F ratio 11.5 (p<0.001) and non-fishermen- F ratio 37.4 (p<0.001)] (Table 3).

Table 3: Hemoglobin content (gm/dl) of different BMI categories.

BMI categories	Fishermen	Non-fishermen
Underweight (BMI<18.5 kg/m ²) (FM:27; NFM:20)	12.2±1.7	11.0±1.4
Normal (BMI18.5 to 22.99 kg/m ²) (FM:179; NFM:92)	12.2±1.4	12.4±1.3
Overweight/Obese (BMI≥23 kg/m ²) FM:204; NFM:93)	13.3±1.2	13.4±1.1
F ratio	11.5 (p<0.001)	37.4 (p<0.001)

Table 4: Odd ratio and 95% CI of anemia prevalence according to the nutritional categories.

BMI categories	Fishermen	Non-fishermen	OR (95% CI)	
			Fishermen	Non-fishermen
Underweight (FM:27; NFM:20)	17 (63.0)	19 (95.0)	3.05* (1.32-7.07)	13.98* (1.79-108.92)
Normal (FM:179; NFM:92)	64 (35.7)	53 (57.6)	1	1
Overweight/Obese (FM:204; NFM:93)	59 (28.92)	24 (25.81)	0.73 (0.47-1.12)	0.26** (0.14-0.47)
χ ² (p)	12.6 (p<0.01)	39.4 (p<0.001)	-	-

*p<0.01; **p>0.001.

The prevalence of anemia in different BMI categories of both fishermen and non-fishermen was also studied, and the result reveals that anemia prevalence was significantly different ($p < 0.001$) in different BMI categories. The probability of anemia was tended to be 3.05 times (OR 3.05: 95% CI: 1.32-7.07) higher in underweight fishermen and 13.98 times (OR 13.98: 95% CI: 1.79-108.92) higher in underweight non-fishermen compared to the normal weight individuals. Overweight/obese individuals were less likely to be anemic (fishermen-OR 0.73: 95% CI: 0.47-1.12; non-fishermen-OR 0.26: 95% CI: 0.14-0.47) (Table 4).

DISCUSSION

Recently, fishing community struggle with various malnutrition like micronutrients deficiencies, undernutrition along with overweight or obesity, and associated chronic diseases.^{6,22} Micronutrients deficiencies disease like anemia worldwide public health concerns that extremely affects community health, affects both developing and wealthy nations and social and economic development.²³ The core goal of our study is to observe the incidence of anemia among the people in the fishing community. We record various physical parameters, Hb concentration, and obesity measures of the study participants. In the present study, hemoglobin concentration was significantly higher in fishermen compared to non-fishermen. Fishermen are less likely to have anemia. It may also be caused by eating animal-based foods. Because fish and shellfish are high in heme iron, the kind of iron that our bodies can absorb the most effectively. Fishermen take more protein and calories. The primary chemical component of hemoglobin production is protein. To minimize inflammation along with enhance iron absorption, a diet rich in energy and protein must be consumed.²⁴

Researchers found that, due to their eating habits, physical inactivity and mechanical changes made to fishing over the period may lead to a high frequency of weight gain and obesity in the fishing community.²⁵ MUAC, BMI and the total weight of fat (kg) were significantly higher in fishermen than non-fishermen in our study. More protein intake also causes a rise in significant weight gain. Various studies have reported an increased prevalence of anemia among overweight and obese people. Due to an increase in BMI, hemoglobin levels are decreased, and there is an increase in inflammatory activity, which produces a high hepcidin hormone. This high hepcidin hormone blocks intestinal iron absorption.^{13,23} In contrast, Sayed and Nagarajan, 2022 reported that hemoglobin concentration showed a rising trend with increase in the BMI.²⁶ However, in our study, overweight or obese people had high hemoglobin concentration and thereby lower chances of being anemic. A survey conducted by Hiremath et al also supports the present study findings, and they revealed that subjects with high BMI, visceral fat content, and body fat percentage have higher hemoglobin content.²⁷ Singh and

Mangang (2012) also found that underweight subjects had higher prevalence of anemia.²³

According to our findings, those obesity indicators are also higher in non-anemic subjects in both fishermen and non-fishermen. Hamed et al has also supported our finding.²⁸ Khan et al recorded the significant correlation between nutritional status and anemia with underweights being more prone to anemia than overweight/obese.²⁹ Our study also included low hemoglobin in underweight subjects. Overweight fishermen have a higher hemoglobin concentration than underweight and normal-weight fishermen.³⁰ According to this study, when comparing the prevalence of anemia with average weight, overweight fishermen have a significantly lower chance of anemia than underweight fishermen. Studies indicate that those who have higher Hb levels have better physical performance.³¹

We have studied the nutrient intake of subjects along with comparison between anemic and non-anemic subjects in both groups. Deficits of certain nutrients, such as iron, vitamin B₁₂, and folic acid (vitamin B₉), which are crucial for erythropoiesis, leads to nutritional anemia.⁴ It may be usually found in malnourished elderly individuals. Our study presents a low iron intake compared with ICMR-RDA in fishermen and non-fishermen.³² A regular diet has around 6 mg of iron/1000 kcal, giving 13-20 mg daily iron requirements.⁴ A complete blood count of the patient detects anemia and physical examination and medical history also play an crucial role in the recognition of anemia.³³ Iron deficiency anemia adversely affects physical performance due to a lack of oxygen availability to the tissues, disturbs cardiac output and the heart and may hinder physical work capacity (PWC).³⁴

There are some limitations associated with the current study that must be stated. The cross-sectional design of the study does not allow for the identification of temporal and causative relationships between the variables since the findings were obtained at one particular point in time. Moreover, the dietary consumption was estimated using self-reporting data, which might involve recall bias and inaccuracies in measuring the portions or servings of food consumed. Finally, anemia was only evaluated by means of hemoglobin concentration without assessing the iron status.

CONCLUSION

The present study illustrates the prevalence of anemia among fishermen and fishermen with higher BMI are less likely to have anemia. This study exposes an inverse relationship between anemia and overweight/obesity to the fishermen in the maritime of district Purba Medinipur. Our study also showed that poor nutritional status and an improper diet are significant causes of anemia. The study extends to the depth of knowledge that is available on the intricate relationship between anemia and obesity.

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