

A fitness assessment study among young fishermen of coastal areas of East Midnapore District of West Bengal, India

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Abstract

Being the fourth most populated state of India, West Bengal has a population of about 82 million, of which a major percentage is represented by coastal fishing communities who are habituated to do a physically demanding occupation which may have a positive influence on their the physical parameters. Thus the present investigation was designed in order to assess the influence of fishery, such a physically demanding occupation on physical fitness and to compare whether fishermen have more cardiovascular fitness and anaerobic power than sedentary workers or not. The study was conducted in 15 randomly selected male fishermen of the Midnapore District (East), West Bengal, India (mean age of 22.5 yrs), and the 15 college students (mean age of 21.9 yrs) served as a control group. A significant difference ($p < 0.05$) in blood pressure, PFI, energy expenditure, body fat% and anaerobic power was found in fishermen. But, in contrast, BSA, BMI, resting heart rate, VO_{2max} , mean upper arm circumference, thigh and calf circumferences were found to be non-significant. This study implies that fishermen have more physical fitness (cardiovascular fitness) and muscle mass, but a lower percentage of body fat than the sedentary population.

Keywords: Physical fitness, Anaerobic power, VO_{2max} , body fat, Fishermen, Harvard Step Test, West Bengal.

Introduction

West Bengal is the fourth most populated state situated in the Eastern Region of India, 82 million people stay in the State. It is 2.7% of India's area but about 7.8% of the country's population. This state ranks first in terms of density of 904 per sq. km as per the 2001 census. The boundaries of the state are Nepal, Bhutan and the Sikkim on the North, Goalpara district of Assam and Bangladesh on the East, Orissa and the Bay of Bengal on the South and Bihar on the West. The coastal area of West Bengal is the home of some of the poorest people, living in some of the least served and remote areas of the State; the 3 coastal districts i.e. South and North 24 Parganas and Purba (East) Midnapore.¹ Fishery is considered as one of the brightest and most prosperous industries in India.² Among the population of the 82 million peoples of West Bengal, (census, 2001) more than 2.4 million are fishers who live in West Bengal (whereas 33 million people are involved in fishing in India) (Table 1).^{3,4}

The occupation of fishing demands physical fitness, but the health status and physical fitness data of fishermen of India is scanty. A literature review of the fishing industry revealed

Practice points

- Fishing is the occupation of a major percentage of people residing in coastal West Bengal, India.
- Fishermen are habituated to do a physically demanding job which may have some influence on their physical parameters, but reports on this are quite scanty.
- The findings of the present investigation showed young fishermen have a greater PFI, lower BF%, greater anaerobic power and less energy expenditure.
- This study indicates that the physically demanding job of fishermen is positively related with their physical fitness.
- This study implies that the fishermen have more physical fitness and muscle mass, but a lower percentage of body fat than the sedentary population.

that there have been limited studies conducted among fishermen and the majority of studies focused on mortality

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Table 1: West Bengal and its fishing communities: At a glance

Location	Latitude 21° 38' N 27° 10' N Longitude 85° 38' E - 89° 50' E
Total area	88551.0 Sq. km
Total population*	82 million
Fishermen's villages	11200
Marine villages	652
Fishermen population	Inland- 22,12,019 Marine- 2,62,318 Total 24,74,337

*As per 2001 census

rates and accidents.⁵ Moreover, many of the studies examined the specific aspects of fishermen's health.^{6,7} It is also difficult to generalize the findings of the studies conducted in the UK⁸, Scotland⁶ and Australia⁷. Fishermen in other parts of the world are often involved in different types of fishing, and may experience different health and safety problems. Additionally, the majority of studies were conducted 20 years ago and several over 30-40 years ago,⁸⁻¹⁰ further reducing their relevance to the present day. Somewhat recent studies on seafarers and fishermen boarding ships showed severe obesity, leading to a decline in physical fitness which may interfere with the performance of daily duties and also constitute a safety issue in case of an emergency.¹¹ In addition, the increased risk of acute disease or acute complications to a chronic condition without access to professional medical assistance may become a problem. Previous research indicates that overweight is of major importance in some sectors of the maritime industry.^{11,12} It is known that physical fitness not only refers cardiorespiratory fitness and muscular strength, but also coordination and flexibility i.e. the full range of physical qualities which can be understood as an integrated measurement of all functions and structures involved in the performance.¹³ In adults, low physical fitness (principally cardiorespiratory fitness) seems to be a stronger predictor of both cardiovascular and all-cause mortality than any other well established risk factors.¹⁴ To a large extent, habitual physical activity levels among workers vary depending on the type of work performed. When the work is not of a sedentary nature, a large proportion of habitual physical activity is performed at the workplace.¹⁵ Such a type of job has been performed by the fishermen who need excellent muscular strength and better cardiovascular fitness in their occupation. Work in commercial fishing is physically demanding, but unlike merchant seamen, fishermen are not required to hold a certificate of medical fitness. Thus the aim of this study was to determine the influence of such occupational physical work volumes on fitness parameters, and to test the hypothesis that physically demanding jobs have a positive influence on the physical fitness of workers.

Methods

Selection of subjects

Two groups of 15 non-smoker male subjects between 18-25 years of age are randomly selected to participate in the present study. Subjects of one group are young fishermen (22.5±2.97 years) selected randomly from fishermen slum of Midnapore (East) District, West Bengal, India; other group consists of college students (21.9±2.16 years) (control). Subjects were instructed to take their last meal at least two hours before conducting the test in order to avoid the specific dynamic action (SDA) of food. All the experiments were carried out and measurements were taken in temperature of 20°-25°C and relative humidity of about 45-50% in the winter season in India, both for control subjects and fishermen, to avoid a seasonal influence on fitness pattern. To minimize the experimenter bias, each measurement was taken three times and the mean was represented as the final result. Subjects with any type of disease, specially cardiac and respiratory ailments were not taken for experiments, only healthy subjects were considered for each experiment. Each subject was given sufficient rest before each experiment to get an accurate result.

Assessment body mass index (BMI)

The body mass index (or *Quetelet Index*) is the statistical measure which compares a person's weight and height by the following formula:^{16,17}

$$BMI = \text{Mass (kg)} / (\text{Height in m})^2$$

The WHO¹⁸ regards a BMI of less than 18.5 as underweight and may indicate malnutrition, an eating disorder, or other health problems, while a BMI greater than 25 is considered overweight and above 30 is considered obese.

Body fat % measurement (From BMI, age and gender)

Body fat can be estimated from BMI. There is a linear relationship between densitometrically-determined body fat percentage (BF%) and BMI, taking age and gender into account. Based on which following prediction formulas have been derived which showed a valid estimates of body fat at all ages, in males and females. But, in obese subjects, the prediction formulas are slightly overestimated. The prediction error is comparable with other methods of estimating body fat percentage, such as skinfold thickness measurements or bioelectrical impedance.¹⁹⁻²¹

The following formula¹⁹ was used to predict body fat percentage is based on current BMI, age, and gender:

$$\text{Adult Body Fat \%} = (1.20 \times \text{BMI}) + (0.23 \times \text{Age}) - (10.8 \times \text{gender}) - 5.4$$

Gender values for male = 1, female = 0

Body surface area (BSA)

Body surface area (BSA) represents the measured or calculated surface of a human body. Various calculations have been published to get BSA without direct measurement.

The Dubois and Dubois formula²² was used for estimating BSA.

$$BSA (m^2) = 0.007184 \times Weight (kg)^{0.425} \times Height (cm)^{0.725}$$

Resting heart rate

Baseline HR was obtained after five minutes rest in the sitting position. The resting heart beat was measured at carotid pulse. When two successive heart rate scores became equal then it was considered as resting heart rate.²³

Blood pressure

Arterial pressure is most commonly measured by a sphygmomanometer, which historically used the height of a column of mercury to reflect the circulating pressure.²⁴ BP values were obtained after five minutes rest in the sitting position.²⁵

Physical fitness index (PFI)

PFI was calculated by measuring heart rate after performing Harvard step test (HST) developed by Brouha et al. in the Harvard Fatigue Laboratories using long form PFI equation.²⁶ But, following modified HST under Indian conditions, a 51 cm high stool was used and the subjects stepped up and down at a rate of 30 cycles/min for 3 minutes or up to exhaustion. Exhaustion is defined as when the subject cannot maintain the stepping rate for 15 seconds.^{27,28} The recovery pulse was counted at 1 to 1.5, 2 to 2.5 and 3 to 3.5 minutes of recovery.

Long from Equation - Fitness Index

$$= \frac{100 \times \text{Test Duration in Second}}{200 \times \text{Recovery heart rates (1 to 1.5 mins + 2 to 2.5 mins + 3 to 3.5 mins)}}$$

Anaerobic power test by Margaria double step method

It is a short-term anaerobic test or power test in which the subject is taking two steps at a time, the height of the stairs are measured by measuring tape. To calculate the anaerobic power; the height of ascend, the body weight, and the duration (sec) is noted by the stopwatch.²⁹ At first the work done is calculated by the following formulae:

$$\text{Work done} = \text{body weight} \times \text{height of ascend} \times 0.002342$$

From the calculated work done the anaerobic power (kg/meter/sec) is obtained by the following formulae:

$$\text{Anaerobic power} = \frac{\text{Work Done (Kg/mitre)}}{\text{Duration (Sec)}}$$

Determination of aerobic capacity (VO_{2max})

It is the maximum amount of oxygen consumed during rhythmic dynamic progressively increasing exercise done by any kind of ergometer (treadmill, stationary bicycle ergometer, hand cranking etc.) at sea level under thermally neutral condition when more muscle mass recruited then capacity of O₂ is increased. Nomogram of Astrand was used to determinate the VO_{2max}.³⁰

Energy expenditure (EE)

Energy expenditure for any kind of job is normally measured by different calorimetric methods. It has also been determined by predictive formula.³¹

$$EE (\text{Kcal min}^{-2}) = -1.42 + (0.045 \times \text{peak H.R})$$

Nutritional anthropometric measures

Curvilinear distances (circumferences) taken around the midpoint of mean upper arm (MUAC), mid-thigh (TC), calf muscle of leg (CC), waist (WC) and buttock (BC). WC and BC are used to predict the body fat content. UAC is an index of body Energy store and protein mass. Sometime it is combined with skin fold thickness to calculate the areas of arm muscle and adipose tissue. TC indicates muscle atrophy due to disease or atrophy and CC provides an estimate of cross-sectional and adipose tissue areas of calf.³²

Statistical analysis

Data was expressed as mean±SD. Comparison of parameters between control and fishermen was done by two tailed unpaired t-test, using Microsoft Excel 2007 and the result was considered as significant when the two-tailed p < 0.05.³³

Results

The height (cm) and body weight (kg) of 15 control subjects were 164.4±7.20 and 59.1±7.2 (mean±SD) respectively and those of young fishermen were 156.6±4.41 and 51.6±8.4 (mean±SD) respectively. Results are represented in Table 2 to Table 5.

Table 2 shows other than BF% no significant differences were found in the physical parameters between two groups. The physical fitness index (PFI) score reveals that young fishermen have excellent physical fitness level (Table 3).

Table 2: Physical parameters of control subjects and young fishermen

	Control (n=15)	Fishermen (n=15)	p values
BMI (Kg/m ²)	21.7±1.93	19.2±2.40	0.101
Body Fat %	20.5±1.73	17.7±3.06	0.007*
BSA (m ²)	1.68±0.08	1.62±0.06	0.609

Values are mean±SD; *Values are significant p<0.05.

Table 3: Physical fitness variables of control and fishermen

	Control (n=15)	Fishermen (n=15)	p values
Resting Heart Rate (beats/min)	76.2±8.10	73.5±4.051	0.453
Systolic Blood Pressure (mm Hg)	114±4.6	24.2±7.92	0.003*
Diastolic Blood Pressure (mm Hg)	74.1±6.8	78.0±5.25	0.102
PFI	75.9±10.8	88.5±6.30	0.001*

Values denote mean±SD; *Values are significant $p < 0.05$.

Table 4 mainly represents the comparative aspect of anaerobic power, energy expenditure and VO_{2max} . Fishermen showed greater anaerobic power, but less energy expenditure than the control subjects. They showed no significant difference in VO_{2max} .

Table 4: Comparison of anaerobic power, VO_{2max} and energy expenditure between control and fishermen

	Control (n=15)	Fishermen (n=15)	p values
Anaerobic power ($kg.m^{-1}.sec^{-1}$)	12.3±2.46	15.0±2.55	0.027*
VO_{2max} (liters.min ⁻¹)	3.12±0.33	3.27±0.57	0.093
Energy expenditure (K.Cal. min ⁻²)	5.67±0.57	4.35±0.66	0.002*

Values denote mean±SD; *Values are significant $p < 0.05$.

Table 5 represents the anthropometric measures of both groups which may affect fitness pattern. But these parameters showed no significant difference ($p > 0.05$) with control subjects.

Table 5: Comparison of anthropometric measures between control and fishermen

Group	Control (n=15)	Fishermen (n=15)
Mean Upper Arm Circumference (cm)	27.3±4.17	28.5±2.64
Thigh Circumference (cm)	47.4±5.52	46.2±4.56
Calf Circumference (cm)	32.4±3.81	34.5±2.10
Waist Circumference (cm)	75.6±4.50	72.3±5.55
Buttock Circumference (cm)	81.0±6.06	76.5±4.14
Waist-to-Hip ratio	0.94±0.02	0.92±0.01

Values denote mean± SD.

Discussion

Our nation's young people are, in large measure, unfit and increasingly overweight. In long run this physical inactivity may enhance risk of cardiovascular diseases and deaths. The percentage of young people who are overweight has doubled since last two decades. Whereas some reports describes poor nutritional status of young individuals in India that resulted in their less body weight. In West Bengal more than 22% of people are reported to be underweight,³⁴ but, the result of present study reveals that physical parameters (BMI, BSA) of fishermen did not significantly differ from control group, which may be due to their young age; hence tend to be lean rather than obese. But, young fishermen were found to have less body fat percentage than sedentary population (Table 2). Earlier findings of authors have also showed similar results in case of fishermen of coastal Orissa.³⁵ Some other reports, such as a study on fishermen of Pondicherry, similarly showed almost 50.5% of fishermen have BMI within normal range while undernourished fishermen are 36.5% and obese are only 1.9%.³⁶ The higher BMI in control subjects in the present study may be attributable to their greater weight and is consistent with findings from other studies.³⁷⁻³⁹ The BMI is an index of weight adjusted for stature. It is one of the most useful tools for diagnosing obesity or malnutrition. However, such a diagnosis should take into account a person's age, sex, fitness and ethnicity. The result of the present study implies no such difference in physical characteristics among two young populations.

Cardiorespiratory fitness is a measure of how well a physiological system is able to transport oxygen to your muscles during prolonged exercise. Resting heart rate and aerobic capacity or maximum oxygen uptake capacity (VO_{2max}) have been widely considered to be reliable and valid measure of cardiorespiratory or aerobic fitness^{35,40} along with endurance.⁴¹ As fishermen normally perform work related to muscular strength, no significant change was found in these parameters. This result may have some correlation with the findings of Bailey *et al.*⁴² who have found that lower VO_{2max} levels in men were associated with an increased probability of being overweight or obese. Therefore it can be presumed that normal body weight of fishermen in present study thus may have not influenced over this parameter. Strength exercise increases ventricular muscle mass⁴³ which results in increased force of contraction and hence cardiac output which may be the cause significant increase of blood pressure.⁴⁴ Conversely, studies on fishermen of Pondicherry showed they are less prone for higher systolic pressure whereas they were more prone for high diastolic blood pressure. In their study, they showed proportion of fishermen with optimal and normal systolic blood pressure was 76.3% and 67.2% respectively.³⁶ Some studies also revealed impact of BMI on blood pressure; they have showed with the increase of BMI a drastic increase in systolic and diastolic blood pressure, unlike the findings of present study.⁴⁵

PFI scores are useful measure of fitness for strenuous exercises. Physical fitness has three main aspects: static fitness (absence of disease), dynamic fitness (ability to perform strenuous work) and motor skills fitness. Of these three, dynamic fitness is very important and can be measured by the Harvard Step Test. As fishermen are habituated to do this strenuous job, i.e. they perform heavy muscular work regularly, their pulse rate recovered quickly which is an indicator of better fitness and is reflected in a significantly higher PFI (Table 3) and lower energy expenditure and they also have better anaerobic power than sedentary workers (Table 4). These results are very much similar to the earlier findings in fishermen of coastal Orissa.³⁵

As young fishermen perform heavy work, so they should have more mean upper arm circumference than control subjects which is an estimate of energy store and protein mass of the body which is an indirect estimate of strength, but no significant difference was observed in mean upper arm circumference (MUAC) between two groups. Waist-to-hip ratio⁴⁶ is found to be insignificant in fishermen than control subjects which are another indicator of less fat percentage in fishermen than control subjects, which is caused by their poor nutritional status, which again attributable to their economic condition.⁴⁷ BMI along with waist circumference have been used to evaluate health risks associated with obesity, because fats redistributes centrally with increases in waist circumference and results in altered waist-to-hip ratio. However, no significant difference was also found in thigh and calf circumference between two groups (Table 5).

Conclusion

Hence it may be concluded from the present study that physical anthropometric parameters (height, weight, BSA, BMI, waist-to-hip ratio) along with were found to be within expected range of normal in both group of subjects. But fitness variables (PFI, energy expenditure and anaerobic power) showed better result in young fishermen. Thus, this study indicates that the physically demanding job of fishermen is positively related with their physical fitness. But, for better health, not only fitness but physical endurance is also recommended.

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Disclosure

The authors report no conflicts of interest in this work.

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