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Evaluation of Health Status of the Fishers: Prediction of Cardiovascular Fitness and Anaerobic Power

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ABSTRACT [ENGLISH/ANGLAIS]

It is assumed that physically demanding jobs may have a positive influence on the physical parameters of workers. Thus the present study was designed to evaluate the influence of fishery, such an physically demanding occupation on physical fitness and to compare whether fishermen have more cardiovascular fitness, anaerobic power than sedentary population or not. The study was carried out among randomly selected fishermen of coastal West Bengal (mean age 22.4). 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, $V{\cdot}O_2$ max, upper arm circumference and thigh and calf circumferences were found to be non-significant. This study infers fishermen have more physical fitness (cardiovascular fitness) and muscle mass, but less fat percentage than sedentary population. But with physical strength and cardiovascular fitness more endurance is required for better health of young fishermen.

Keywords: Physical Fitness, anaerobic power, V.O2max, Body Fat, fishermen, Harvard Step Test

RÉSUMÉ [FRANÇAIS/FRENCH]

Il est connu que les emplois exigeant physiquement avoir une influence positive sur les paramètres physiques des travailleurs. Ainsi, la présente enquête a été conçue pour évaluer l'influence de la pêche, une telle occupation exigeant physiquement sur le conditionnement physique et de comparer si les pêcheurs ont plus de remise en forme cardio-vasculaire, la puissance anaérobie que les travailleurs sédentaires ou non. L'étude a été menée dans 15 hommes choisis au hasard pêcheurs de Midnapur District (Est), au Bengale occidental, en Inde (âge moyen 22,4) et les 15 étudiants de niveau collégial (âge moyen: 21,6) ont servi de témoins. Une différence significative ($p < 0,05$) de la pression artérielle, PFI, les dépenses d'énergie,% de graisse corporelle et la puissance anaérobie a été trouvé dans des pêcheurs. Mais, en revanche, BSA, IMC, fréquence cardiaque au repos, max V.O2, circonférence du bras et les cuisses et les circonférences de veau ont été jugés non significatifs. Cette étude implique pêcheurs ont meilleure forme physique (fitness cardio-vasculaires) et la masse musculaire, mais de pourcentage de moins de gras que la population sédentaire. Mais plus d'endurance est recommandé pour une meilleure santé et conditionnement physique.

Mots-clés: La condition physique, la puissance anaérobie, V.O2max, le corps gras, les pêcheurs, l'étape d'essai Harvard

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INTRODUCTION

Fishery is considered as one of the bright and prosperous industry in India [1]. More than 3 lacs of families are involved in fishing which includes more than 2.1 million fishers in India; and among them more than 83 thousand fishers live in West Bengal [2]. Their occupation demands a better physical fitness, but the health status and physical fitness data of fishermen of India is scanty. It is known that physical fitness not only refers to cardiorespiratory fitness and muscular strength, but also to 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 [3]. Low physical fitness (mainly cardiorespiratory fitness) seems to be a stronger predictor of both cardiovascular and all-cause mortality than any other well established risk factors [4]. Habitual physical activity levels among workers differ significantly 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 [5]. Such a type of job has been performed by the

fishermen who need excellent muscular strength and better cardiovascular fitness in their occupation. The objective of this investigation was to determine the influence of such occupational physical work volumes on fitness parameters, and to test the hypothesis that physically demanding occupations have a positive influence over the physical fitness of workers.

MATERIALS AND METHODS

Selection of Subjects and Study Conditions

This study was carried out during the period of 2009-2010. Two different groups of 15 male non-smoker subjects between 18-25 years of age were randomly selected to participate in the present investigation. Subjects of one group are young fishermen (age of 22.4 ± 2.94) selected randomly from different regions of Purba Midnapur District, West Bengal, India; other group consists of college students (age of 21.6±2.13) served as 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 20^0-25^0C and relative humidity of about 45-50% in winter season in India, both in control subjects and fishermen, to avoid seasonal influence on fitness pattern. To minimize the observer bias each measurement was taken for three times and the mean was represented as final result. Subjects with any type of disease, specially cardiac and respiratory ailments were not taken for experiments. Each subject was given sufficient rest before each experiment to get accurate result.

Measurement of 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 [6, 7]:

$$\textbf{BMI = mass (kg) / (Height in m)}^2$$

The WHO [8] regard 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 the Body mass index (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 BF%, such as skinfold thickness measurements or bioelectrical impedance. [9, 10, 11]

The following formula [9] was used to predict body fat percentage is based on current BMI, age, and gender:

Adult Body Fat % =

(1.20 x BMI) + (0.23 x Age) - (10.8 x gender) - 5.4

Gender values for male = 1, female = 0

Body Surface Area (BSA)

In Physiology, the body surface area (BSA) is the measured or calculated surface of a human body. Various calculations have been published to arrive at the BSA without direct measurement. Dubois & Dubois formula was used for estimating body surface area (BSA) [12].

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

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 become equal then it was considered as resting heart rate [13].

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 [14]. BP values were obtained after five minutes rest in the sitting position [15].

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 [16]. But, following modified HST under Indian condition, using stool of 51 cm high stepping up and down with 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 [17, 18].

The recovery pulse was counted at 1 to 1.5, 2 to 2.5 and 3 to 3.5 minutes of recovery.

$$\text{Long Form Equation} - \text{Fitness Index} = \frac{100 \times \text{Test duration in seconds}}{2 \times \text{Recovery heart rates (1 to1.5 mins + 2 to 2.5 mins + 3 to 3.5 mins)}}$$

Anaerobic Power Test by Margaria Double Step Method

The Margaria double step method is performed by the subjects for the calculation of anaerobic power. It is a short-term anaerobic test or power test in which the subject 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 [19]. At first the work done is calculated by the following formulae:

Work done = body weight × height of ascend × 0.002342

After the calculation of work done the anaerobic power is calculated by the following formulae:

$$\text{Anaerobic power} = \frac{Work\,Done(Kg/mitre)}{duration(sec)}$$

The unit of anaerobic power is expressed as kg/meter/sec.

Determination of Aerobic Capacity (VO_2 Max)

It can be defined as the maximum amount of O_2 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 O_2 is increased.

Here the Nomogram of Astrand was used to determinate the VO_2 max. [20].

Energy Expenditure (EE)

Energy expenditure for any kind of job is normally measured by different calorimetric methods. It is also determined by many predictive equations. The following formula has been used for this study [21].

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

Upper Arm Circumference

It is the curvilinear distance taken around the midpoint of upper arm. It is an index of body Energy store and protein mass, although it can be used as an independent measure. Sometime it is combined with skin fold thickness to calculate the areas of arm muscle and adipose tissue. The measurement is taken of a subject standing erect and wearing sleeveless clothing [22].

Thigh Circumference

It is the curvilinear distance taken around the mid-thigh circumference. It is an indicator of adiposity and lean body mass. It also indicates muscle atrophy due to disease or atrophy. The measurement is taken of a subject standing erect and wearing bathing suit [22].

Calf Circumference

It is the maximum curvilinear distance taken around calf muscle of leg. It provides an estimate of cross-sectional and adipose tissue areas of calf. The measurement is taken of a subject standing erect or sitting on the table [22].

Statistical Analysis

Data are 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 value <0.05 [23].

RESULTS

The height (cm) and body weight (kg) of 15 control subjects are 164.6 ± 7.21 (mean± SD) respectively and 59.3 ± 7.5 and 15; and those of fishermen are 156.4 ± 4.44 and 51.0± 8.1 (mean± SD) respectively. All results are represented in Table 1 to Table 4.

TABLE 1

Table 1 shows the comparison of physical parameters between control and fishermen

	Control	Fishermen	*p*
BMI (Kg/m^2)	21.7±1.93	19.5±2.42	0.101
Body Fat %	20.5±1.73	17.4±3.03*	0.067
BSA (m^2)	1.68±0.08	1.56±0.09	0.609

Values are mean ± SD, sample size (n_1=n_2= 15). Superscript (*) indicates significant difference by two tail unpaired t-test (for equal variances) at P<0.05.

TABLE 2

Table 2 shows the Physical Fitness variables of control and fishermen

	Control	Fishermen	*p*
Resting Heart Rate (Beats/min)	76.2±8.10	73.8±4.02	0.426
Systolic Blood Pressure (mm Hg)	114±4.66	123±7.94†	0.0004
Diastolic Blood Pressure (mm Hg)	74.1±6.81	78.3±5.22	0.002
PFI	75.9±10.8	88.2±6.33†	0.001

Values are mean ± SD, sample size (n_1=n_2= 15). Superscript (*) indicates significant difference by two tail unpaired t-test (for equal variances) at P<0.05.

TABLE 3

Table 3 shows comparison of anaerobic power, VO2 max and Energy expenditure control and fishermen

	Control	Fishermen	*p*
Anaerobic power (kg.m^{-1}.sec^{-1})	12.3±2.46	15.1±2.52 $^{\#}$	0.101
V·O$_2$ max (liters.min^{-1})	3.12±0.33	3.24±0.60	0.093
Energy expenditure (K.Cal. min^{-2})	5.67±0.57	4.32±0.69 $^{\#}$	0.002

Values are mean ± SD, sample size (n_1=n_2= 15). Superscript (*) indicates significant difference by two tail unpaired t-test (for equal variances) at P<0.05.

DISCUSSION

This investigation reports that physical parameters other than body fat percentage (BMI, BSA) did not significantly differ (p>0.05) between two groups which may be due to their young age (Table 1). Resting heart rate and Aerobic capacity or maximum oxygen uptake capacity (V·O2max) are reliable and useful measure of cardio-respiratory fitness [24] and along with diastolic blood pressure these are the excellent indicators of endurance. Since fishermen routinely perform work related to muscular strength, no significant change was found in these parameters (Resting HR, V·O2max). Some reports suggest strength exercises increases ventricular muscle mass [25] which results in increased force of contraction and hence cardiac output which may be the cause significant increase (p<0.05) of systolic blood pressure. Since they often perform this job, their pulse rate recovered quickly which is an indicator of better cardiovascular fitness that reflected in significantly higher PFI (Table 2) and lower Energy Expenditure and they also have better anaerobic power than sedentary workers (Table 3).

TABLE 4

Table 4 shows the comparison of UAC, TC and CC between control and Fishermen

	Control	Fishermen	*p*
Upper Arm Circumference (cm)	27.0±4.11	28.2±2.61	> 0.05
Thigh Circumference (cm)	47.1±5.55	46.0±4.53	> 0.05
Calf Circumference (cm)	32.1±3.78	34.2±2.16	> 0.05

Values are mean ± SD, sample size (n_1=n_2= 15). Superscript (*) indicates significant difference by two tail unpaired t-test (for equal variances) at P<0.05.

Fishermen perform heavy work, therefore they be supposed to have more upper arm circumference (UAC) 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 upper arm circumference between two groups. This may be due to the less fat percentage in fishermen than control subjects, which is caused by their poor nutritional status, which is again attributable to their economic condition [26]. However, no significant difference was also found in thigh and calf circumference between two groups (Table 4).

Results suggest that the physically challenging job of fishers have positive influence over their PFI, energy expenditure and anaerobic power.

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CONFLICT OF INTEREST

No conflict of interest was declared by authors.