www.ijpm.ir

A Small-scale Cross-sectional Study for the Assessment of Cardiorespiratory Fitness in Relation to Body Composition and Morphometric Characters in Fishermen of Araku Valley, Andhra Pradesh, India

Pallav Sengupta

Department of Physiology, Vidyasagar College for Women, University of Calcutta, Kolkata, West Bengal, India

Correspondence to:
Dr. Pallav Sengupta,
Department of Physiology, Vidyasagar College for Women, University of Calcutta, 39 Sankar Gosh Lane, Kolkata - 700 006, West Bengal, India.
E-mail: pallav_cu@yahoo.com

Date of Submission: Sep 04, 2012

Date of Acceptance: Sep 20, 2012

How to cite this article: Sengupta P. A small-scale cross-sectional study for the assessment of cardiorespiratory fitness in relation to body composition and morphometric characters in fishermen of Araku valley, Andhra Pradesh, India. Int J Prev Med 2014;5:557-62.

ABSTRACT

Background: The people residing in coastal areas of Visakhapatnam are mostly engaged in fishery, which is always been a physically demanding job, and numerous factors have direct or indirect impact on the health of fishermen; but, the data about their physical fitness or health status is quite scanty. Thus, the present study was conducted to assess their cardiorespiratory fitness pattern, as well as morphometric characters, which may be influenced by their occupation.

Methods: In this retrospective cohort study, 25 young fishermen (mean age of 22.8 ± 1.92 years) were randomly selected from Araku valley of Visakhapatnam District, Andhra Pradesh and compared with 25 subjects who were randomly selected from college students (mean age of 21.9 ± 2.25 years) of Kolkata, West Bengal. Some physical and physiological fitness variables including height, weight, body mass index, body surface area, physical fitness index, anaerobic power, and energy expenditure were measured along with their morphometric characters.

Results: Analysis of data indicated a significant difference in blood pressure, physical fitness index, energy expenditure, body fat percent and anaerobic power among fishermen compared to controls. However, there were no changes in morphometric characters between the two groups.

Conclusions: Findings of this small-scale population-based study indicated that health and physical fitness of young fishermen is under the influence of both occupational workload and nutritional status, as found by body composition and morphometric characters.

Keywords: Anaerobic power, body fat, Harvard Step Test, physical fitness, Visakhapatnam

Original Article

INTRODUCTION

The Jewel of the East Coast, Visakhapatnam is a coastal port city, situated in Andhra Pradesh, located on the eastern shore of India, nestled among the hills of the Eastern Ghats and facing the Bay of Bengal to the east. Peoples are mainly engaged in agriculture, fishery, animal husbandry and in industries. Fishery is an important economic activity of the of the district; fishermen population living in about 59 fishery villages and hamlets on coastline stretching to a length of 132 kilometers, covering 11 coastal mandals. About 13,000 fishermen families eke out their livelihood from marine, inland and brackish water fishing.[1] The peoples residing in coastal regions of Visakhapatnam, engaged in fishery, supposed to be affected by the workload of this energy-demanding occupation over their physical fitness, which not only refers cardiorespiratory fitness and muscular strength, but also in the full range of physical qualities which can be understood as an integrated measurement of all functions and structures involved in the performance.[2] Their occupation demands a better physical fitness, but the health status and physical fitness data of fishermen of India is quite scanty. In adults, low physical fitness (mainly cardiorespiratory fitness) seems to be a stronger predictor of both cardiorespiratory and all-cause mortality than any other well established risk factors.[3,4]

Thus, the aim of this investigation was to determine the physical efficiency of the local peoples engaged in fishery and also to determine the influence of occupational workload over certain fitness parameters of young adults among fishing communities residing in Araku valley of Visakhapatnam district, thus, to test the hypothesis that physically demanding occupations have an influence over the physical fitness pattern of workers.

METHODS

In this cohort study, 25 young fishermen (mean age of 22.8 ± 1.92 years) of Araku valley of Visakhapatnam District, Andhra Pradesh, were randomly selected to participate in the study as exposed group. Twenty-five subjects are also randomly selected from college students (mean age of 21.9 ± 2.25 years) of Kolkata, West Bengal as unexposed group. Subjects were instructed to take their last meal at least 2 h before conducting the test in order to avoid the specific dynamic action (SDA) of food. All the participants were non-smokers. The entire experimental protocol was explained to them to allay their apprehension. Consent from each participant was taken for conducting the study, and the experiments were carried out following Institutional ethical permission. 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 (2010-2011), to avoid seasonal influence on fitness pattern. To minimize the experimenter bias each measurement was taken for three times and the mean was represented as final result.

The body mass index (BMI) was measured by the following formula:[5,6] *BMI = mass (kg)/(Height in m)*^{2} Body fat percentage was also calculated by a predictive formula using BMI, age, and gender:[7] *Adult body fat % = (1.20 × BMI) + (0.23 × Age) - 10.8-5.4 (for male subjects)*. Dubois and Dubois formula was used for estimating body surface area (BSA).[8]

Resting heart rate was recorded after 5 min of rest at carotid pulse. When two successive heart rate scores become equal then it was considered as resting heart rate.[9] Arterial blood pressure was measured by using sphygmomanometer.[10]

Physical fitness index (PFI) was calculated by measuring heart rate after performing Harvard step test (HST) developed by Brouha *et al.*,[11] using long form PFI equation. However, 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 min or up to exhaustion. Exhaustion is defined as when the subject cannot maintain the stepping rate for 15 seconds. The recovery pulse was counted at 1 to 1.5, 2 to 2.5 and 3 to 3.5 minutes of recovery.

To calculate the anaerobic power, Margaria double step test was carried out.[12] The height of ascend, the body weight, and the duration (seconds) was noted by the stopwatch. At first the work done is calculated by the following formulae: *Work done = body weight × height of ascend × 0.002342*. From the calculated work done the anaerobic power is obtained by the following formula:

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

Nomogram of Astrand-Ryhming was used to determinate the maximum oxygen uptake capacity or $VO_{2\ max}$.[13] It was estimated (or predicted) by indirect method using the nomogram, from the peak heart rate (obtained during recording of PFI by HST) and body weight of the subject. The cross-sectional point from these two bars of peak heart rate and body weight indicated the predicted $VO_{2\,max}$ of the subject.

Energy expenditure (EE) has also been determined by another predictive formula using peak heart rate (HR) scores recorded during HST:[14] $EE\ (Kcal\ min^{-2}) = -1.42 + (0.045 \times peak\ H.R)$.

Curvilinear distances were taken around the midpoint of upper arm (MUAC), thigh (TC), calf muscle (CC), waist (WC) and buttock (BC). Waist and buttock circumferences are used to predict the body fat content.[15]

Data are expressed as mean ± SD. Comparison of parameters between control and young fishermen was done by two tailed unpaired *t*-test, using Microsoft Excel- 2007 and the result was considered as significant when the two-tailed $P < 0.05$.[16]

RESULTS

Results of both physical and physiological parameters are represented in Table 1. The height (cm) and body weight (kg) of 25 control subjects is 164.6 ± 7.21 and 59.3 ± 7.5 (mean ± SD), respectively and those of young fishermen of Araku valley are 162.3 ± 6.33 and 56.1 ± 9.3 (mean ± SD), respectively. All mean values of physical parameters (BMI, BSA and fat percentage) are represented in Table 1. Other than body fat percentage no significant differences were found in the physical parameters between the two groups.

Table 1 also represents comparative aspects of physical fitness variables (including PFI). PFI scores reveal that the young fishermen have excellent physical fitness level. Comparative aspect of physical efficiency measures i.e., anaerobic power, energy expenditure and predicted aerobic capacity ($VO_{2\,max}$) showed young fishermen of Araku has a greater anaerobic power and $VO_{2\,max}$ but less expenditure of energy for a specific work than control subjects.

Anthropometric measures reflect the nutritional status of both groups, which may affect the fitness pattern. However in these parameters, fishermen showed no significant difference with control subjects.

DISCUSSION

This study is based on a small-scale random sample of fishermen who were actively engaged

Table 1: Comparison of the various characteristics in fishermen as case group (*n*=25) and students as control group (*n*=25) using *t* test

Characteristics	Control		Fishermen		*P* value
	Mean	SD	Mean	SD	
Physical parameters					
Body mass index (Kg/m^2)	21.9	2.49	20.7	2.43	0.114
Body fat %	20.5	1.73	17.7*	3.54	0.033
Body surface area (m^2)	1.77	0.21	1.76	0.15	0.582
Physical fitness variables					
Resting heart rate (Beats/min)	76.2	8.10	75.3	5.70	0.082
Systolic blood pressure (mmHg)	123.0	4.62	126.6†	5.52	0.009
Diastolic blood pressure (mmHg)	84.1	6.81	86.9†	4.53	0.046
Physical fitness index	69.9	4.80	81.6†	1.56	0.004
Physical efficiency measures					
Anaerobic power ($kg.m^{-1}.sec^{-1}$)	12.3	2.46	15.0#	2.91	0.048
VO_{2max} ($liters.min^{-1}$)	3.12	0.33	3.20#	0.57	0.021
Energy expenditure ($K.Cal.min^{-2}$)	5.67	0.57	4.71#	0.39	0.003
Anthropometric measures					
Mid upper arm circumference (cm)	27.0	4.11	28.5	3.39	0.093
Thigh circumference (cm)	47.1	5.55	45.6	4.62	0.066
Calf circumference (cm)	32.1	3.78	33.0	3.93	0.123
Waist circumference (cm)	75.9	4.53	74.0	4.23	0.087
Buttock circumference (cm)	81.3	6.03	79.2	5.70	0.076
Waist-to-hip ratio	0.92	0.02	0.92	0.09	0.483

in fishing for more than 2 years. The data can be assumed to be representative for young people employed in fishing occupation of Araku Valley of Visakhapatnam district. The fishermen always face tough working conditions and continuous been exposed to challenging environments. Thus, the study was carried out to characterize the cardiorespiratory fitness along with their physical parameters. The findings of the present study revealed that physical parameters (height, weight, BMI, and BSA) of young adults among fishing communities of Visakhapatnam did not significantly differ from that of the control group. However, young fishermen was found to have significantly less body fat percentage than the reference control group, which may be due to their young age; hence have a propensity for being leaner rather than obese.[17] It has also been reported that in Andhra Pradesh more than 24.8% of men were reported to be underweight,[18] which rank 15 among the 28 states of India.

On the other hand, resting heart rate and aerobic capacity or maximum oxygen uptake capacity ($VO_{2\,max}$) has widely been considered to be a reliable and valid measure of cardiorespiratory fitness[19] and endurance. In the present study, a lower resting heart rate was observed in young fishermen than the control subjects that indicate the better physical condition (endurance) of the fishermen. Such physical differences may be due to their lifestyle and occupational need, which requires extra energy expenditure for their daily activities resulting in some adaptive changes.[20]

Activities that demand strength increases ventricular muscle mass,[21] which results in increased force of contraction and hence, cardiac output which may be the cause significant increase of resting blood pressure. However, Guyton emphasized that, during heavy workload stretching of muscle causes vasoconstriction, which resulted in restriction of blood flow and in turn increased systolic pressure.[22] He further reported that pooling of blood in many parts of the body causes vasoconstriction in muscles and thus increased the diastolic pressure. Astrand also found a significant increase of systolic and diastolic pressure during heavy work.[13] Results of the present study show the changes in systolic and diastolic blood pressure, as recorded, was similar to the findings of Astrand. Both, the systolic and diastolic pressure showed significant difference in respondents. Though, increased blood pressure in young fishermen is an indicator of effect of their workload on physiological parameters, but it is of great concern that if they retain high blood pressure for long time, it may have harmful effects on their health. Because, increased blood pressure is a widespread condition, which affects a large portion of the population in developed countries, including fishing communities. Several international studies from Spain, the Netherlands, Poland, Croatia, and Finland indicate high blood pressure among fishermen. It is an important risk factor for cardiovascular and cerebrovascular disease, as well as a significant preventable cause of mortality. According to the World Health Organization (WHO), hypertension is a risk factor for cardiovascular disease, which accounts for an estimated 17 million deaths each year.

Brouha *et al.* suggested that for a specific workload, better the physical condition of the individual, more rapid will be the return of heart rate to its resting level and consequently lower recovery cardiac cost.[11,23] Similar results were found in fishermen where the return of the heart rate to its resting level was more rapid than that of control subjects. Moreover, the peak heart rate is lesser in comparison to control subjects indicating their better physical condition. Their pulse rate recovered quickly, which an indicator of better fitness which is reflected in significantly higher PFI and lower energy expenditure and they also have better anaerobic power than sedentary workers [Table 1]. These data suggest young fishermen have a good cardiorespiratory fitness.

MUAC is the best (i.e., in terms of age independence, precision, accuracy, sensitivity and specificity) case-detection method for nutritional status. As young fishermen perform work related to strength more than control subjects, according to their life-style, so they should have more upper arm circumference [Table 1], which is also an estimate of energy storage and protein mass of the body which is an indirect estimate of strength,[24] but no significant difference was observed in upper arm circumference between the two groups. Waist-to-hip ratio (WHR)[23-35] is found to be insignificant in respondents than control subjects, which are another indicator of less fat percentage in young fishermen than control subjects, which may be caused due to their poor nutritional status.

CONCLUSIONS

Present study indicates that the health of young fishermen residing at coastal regions of Visakhapatnam district, India is better than the control subjects and their occupational workload has positive influence over their physical parameters.

ACKNOWLEDGMENT

We are sincerely thankful to Principal of Vidyasagar College for Women and Head and other faculties and staffs of Departments of Physiology, Vidyasagar College for Women, University of Calcutta and obviously to the fisher populations of Visakhapatnam District, Andhra Pradesh who responded in this study.

REFERENCES

1. Department of Fisheries, Govt. of Andhra Pradesh. Outcome Budget 2009-2010:1-29.
2. Sengupta P, Sahoo S. Evaluation of Health Status of the Fishers: Prediction of Cardiovascular Fitness and Anaerobic Power. World J Life Sci Med Res 2011;1:25-30.
3. Myers J, Prakash M, Froelicher V, Do D, Partington S, Atwood JE. Exercise capacity and mortality among men referred for exercise testing. N Engl J Med 2002;346:793-801.
4. Sengupta P. Health Impacts of Yoga and Pranayama: An Art-of-the-state Review. Int J Prev Med 2012;3:444-58.
5. Keys A, Fidanza F, Karvonen MJ, Kimura N, Taylor HL. Indices of relative weight and obesity. J Chronic Dis 1972;25:329-43.
6. Eknoyan G. Adolphe Quetelet (1796-1874): The average man and indices of obesity. Nephrol Dial Transplant 2008;23:47-51.
7. Deurenberg P, Westrate JA, Seidell JC. Body mass index as a measure of body fatness: Age- and sex-specific prediction formulas. Br J Nutr 1991;65:105-14.
8. DuBois D, DuBois EF. A formula to estimate the approximate surface area if height and weight be known. Arch Intern Med 1916;17:863.
9. Sengupta P, Chaudhuri P, Biswas S, Haldar RP. An evaluation of the effect of emerging trend of gym-going over physical and physiological fitness. International Conference on Molecules to Systems Physiology; 2011 September 21-September 23; India.
10. Booth J. A short history of blood pressure measurement. Proc Royal Soc Med 1977;70:793-9.
11. Brouha I, Health CW, Gray B. A step test simple method of measuring physical fitness for hard muscular work in adult men. Rev Canadian Biol 1943;2:86.
12. Margaria R, Aghemo P, Rovelli E. Measurement of muscular power (anaerobic) in man. J Appl Physiol 1966;21:1662-4.
13. Astrand PO, Rodahl K, Dahl H, Stromme S. Text book of work Physiology. 4th ed. United States: Human Kinetics Publishers; 2003.
14. Datta SR, Ramanathan NL. Energy Expenditure in work predicted from Heart rate and pulmonary ventilation. J App Physiol 1969;26:279-302.
15. Roy JS. Body composition in biological anthropology. Cambridge Studies in Biological and Evolutionary Anthropology Series. Toronto: Cambridge University Press; 1991.
16. Das D, Das A. Statistics in Biology and Psychology. 4th ed. Calcutta: Academic publishers; 2005.
17. Sengupta P, Sahoo S. A Fitness Assessment Study among Young Fishermen of Coastal Areas of West Bengal, India. South East Asia J Public Health 2011;1:6.
18. NFHS Report. Indian states ranking by underweight people. NFHS website; 2012 [Last cited on 28th July, 2012]; Available from: http://www.nfhsindia.org.
19. Sengupta P. Assessment of physical fitness status of young Sikkimese residing in high-hill temperate regions of Eastern Sikkim. Asian J Med Sci 2011;2:169-74.
20. Sengupta P, Bhattacharya K. High Altitude and Nutritional Status and its impact over the Physical Fitness of Young Nepalese Residing in Pokhara, Kaski District of Western Nepal. South East Asia J Public Health 2012;1:15-20.
21. Kanstrup L, Marving J, Høilund-Carlsen PF, Saltin B. Left ventricular response upon exercise with trained and detrained leg muscles. Scand J Med Sci Sports 1991;1:112-8.
22. Sengupta P, Sahoo S. A Cross Sectional Study to Evaluate the Fitness Pattern among the Young Fishermen of Coastal Orissa. Indian J Pub Health Res Dev 2013;4:171-5.
23. Sengupta P, Sahoo S. An Ergonomic Assessment and Fitness Evaluation of Young Male Tea Factory Workers in Dooars, West Bengal. Prog Health Sci 2012;2:51-7.
24. Chaudhuri P, Sengupta P, Ganguly S, Haldar RP. Emerging Trend of Gym Practice and Its Consequence over Physical and Physiological Fitness. Biol Exer 2012;8:49-58.
25. Sengupta P. Potential Health Impacts of Hard Water. Int J Prev Med 2013;4:866-75.
26. Sengupta P. Environmental and occupational exposure of metals and their role in male reproductive functions. Drug Chem Toxicol 2012;36:353-68.
27. Sengupta P. The Laboratory Rat: Relating its age with humans. Int J Prev Med 2013;4:624-30.
28. Dutta S, Joshi KR, Sengupta P, Bhattacharya K.

Unilateral and bilateral cryptorchidism and its effect on the testicular morphology, histology, accessory sex organs and sperm count in Laboratory Mice. J Hum Repro Sci 2013;6:106-10.
29. Sengupta P, Chaudhuri P, Bhattacharya K. Male Reproductive Health and Yoga. Int J Yoga 2013;6:87-95.
30. Sengupta P, Banerjee R. Environmental toxins: Alarming impacts of pesticides on male fertility. Hum Exp Toxicol 2013. [Epub ahead of print].
31. Sengupta P. Current trends of male reproductive health disorders and the changing semen quality. Int J Prev Med 2014;5:1-5.
32. Bhattarai T, Chaudhuri P, Bhattacharya K, Sengupta P. Effect of progesterone supplementation on post-coital unilaterally ovariectomized superovulated mice in relation to implantation and pregnancy. Asian J Pharm Clin Res. 2014;7:29-31.
33. Bhattrai T, Bhattacharya K, Chaudhuri P, Sengupta P. Correlation of common biochemical markers for bone turnover, serum calcium and alkaline phosphatase, in post-menopausal women. Malays J Med Sci 2014;21:58-61.
34. Krajewska-Kulak E, Sengupta P. Thyroid function in male infertility. Front Endocrinol 2013;4:1-2.
35. Chaudhuri P, Bhattacharya K, Sengupta P. Misty role of amygdala in female reproductive behavior. Int J Pharm Pharm Sci 2014. [Epub ahead of print].

Source of Support: Authors declare that they do not have any conflict of interest about the publication of this article, **Conflict of Interest:** None declared.