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Relationship between duration of Sport Service, Body Mass Index and some Cardiovascular and Respiratory indices among professional sportsmen in Calabar, Cross River State, Nigeria.

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ABSTRACT

Poor cardiopulmonary fitness levels and sedentary lifestyle have been documented as causes of morbidity and mortality.This study investigated the relationship between duration of sports service, body mass index(BMI), blood pressure(BP) and some respiratory indices amongst 370 sportsmen in Calabar, Cross River State, Nigeria. Body weight, height, body mass index, peak expiratory flow rate(PEFR), rate of respiration(RR), systolic blood pressure(SBP), diastolic blood pressure(DBP), pulse pressure (PP) and mean arterial pressure (MAP) were assessed using standard methods. Three hundred and fifty(350) sportsmen met the inclusion criteria. The PEFR(580.50 ±6.15 and 587.02 ±11.06) and MAP(88.82 ±0.83 and 90.18 ±0.88) of individuals in the sports group duration of 5 – 8 and >8 years showed higher values which were not significant compared to those from individuals in the 1 – 4 years group(579.45 ±5.25; 86.51 ±0.62). BMI had a strong significant positive correlation with age($p<0.01$) and PEFR($p<0.05$) but weak correlation with exercise duration($p>0.05$), MAP($p<0.01$) and PR($p<0.01$). It correlated negatively with respiratory rate($p<0.01$). Exercise duration also had a significant($p<0.01$) weak positive correlation with MAP. This study has shown that even though there was a correlational relationship between BMI and PEFR, cardiovascular and respiratory indices of sportsmen in Calabar were not significantly affected by duration of sport service.

Keywords: Body mass index, blood pressure, peak expiratory flow rate, body weight

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INTRODUCTION

Individuals that engage in exercises which overburden the cardiopulmonary system, resulting from increase in activity above that obtained normally at rest are said to be involved in aerobic exercise. The American College of Sports Medicine (ACSM) defines aerobic exercise as "any activity that uses large muscle groups, can be maintained continuously, and is rhythmic in nature." Examples include jogging, running, skipping, playing soccer, swimming, cycling, etc. [1]. Body mass index (BMI), calculated as weight (kg) divided by the square of height (m^2) is an important index which can be used as a measure of percentage fat in an individual [2,3]. Physical activity by sportsmen has been shown to increase muscular strength, reduce body fat and increase lean body mass, thus keeping BMI within physiological limits [4]

Ventilatory function tests like PEFR, give a clue as to the functional state of the lungs and their significance as it relates to diagnosis [5]. The PEFR has been defined by the European Respiratory Society as the maximal flow which is achieved during expiration that is delivered with maximal force starting from the level of maximal lung inflation. This lung function test is an important index used to monitor the severity of diseases like asthma [6]. The normal range of PEFR is related to factors such as age, height, weight, gender, race and environmental conditions [7,8,9]. Few parameters of lung function so far have been reported for Nigerians (10,11,12). A positive correlation has been found to exist between peak expiratory flow rate (PEFR) and forced expiratory volume in the first second (FEV_1) [13,14].

Blood pressure is a vital cardiovascular variable which has been documented to have an abstract association with body mass; a relationship that is poorly understood [15]. Exercise has been documented to increase muscular strength, reduce body fat and increase lean body mass, potentially decreasing resting systolic and diastolic blood pressure [16].

The present study was undertaken to assess both the relationship that exists between and the effect of sport duration on body mass index, blood pressure, pulse rate and respiratory indices in sportsmen that reside in Calabar, Cross River State, Nigeria. Although extensive research has been done in previous studies to investigate the relationship between body mass index, blood pressure and respiratory indices in diverse population groups, there still exist paucity of scientific documentation on information relating to the above variables in sportsmen in Calabar, Nigeria. In addition, this study will provide baseline information considering that blood pressure has abstract association with the other indices. In one previous study, blood pressure indices were found to be elevated in football athletes in comparison to non-athletes despite their lean body mass [17]. This study was thus designed to determine if there was any significant correlation between BMI, blood pressure and respiratory indices and also to weigh the outcome of this study against similar studies that used other population groups.

MATERIALS AND METHODS

Subject Selection

This research was undertaken using 370 male subjects randomly selected from the Calabar Sports Council, Calabar, Nigeria. Subjects with history of cardiovascular and respiratory disorders were excluded from the study. After applying the exclusion criteria including chest x-rays, only 354 subjects were qualified. The following equipment were employed for this study: a weighing scale, peak expiratory flow meter, a height scale (metre rule), sphygmomanometer and stop watch.

Measurement of Body Weight and Height

Subjects body weight was measured using a weighing scale (Hanson, CHINA). The subjects were made to stand upright on the scale wearing only light shorts after taking off their shoes, clothes and socks. Standing height of each subject was taken with the subject standing erect against a height measurement metre rule placed against a wall. The subject's occiput, shoulders, buttocks and back of the heel were made to touch the wall with the subject looking forward.

Measurement of Blood Pressure

Blood pressure was measured using an Omron MX3 plus digital blood pressure monitor (Model HFM 742F, Omron Health Care UK Ltd). Each subjects reading was obtained thrice after which the average was used as the subject's blood pressure.

Determination of Body Mass Index (BMI)

BMI of each subject was obtained mathematically using the formula:

$$BMI = \frac{\text{Weight (Kg)}}{\text{Height } (m^2)}$$

Determination of Peak Expiratory Flow Rate(PEFR) ,Respiratory Rate(RR) and Pulse Rate(PR)

Peak expiratory flow rate was measured using the mini-Wright peak flow metre (Clement Clark International Ltd. Edinburgh way Harlow, Essex, CM20 2TT, England). The subject was asked to inhale deeply and then exhale maximally throught the mouth piece of the device. The reading was taken thrice, after which the highest of the three readings was recorded as the PEFR. For determination of respiratory rate, the subject were asked to remove their shirts and lie supine on the couch after which the respiratory movement of the chest wall was observed for a few minutes as the chest increased and decreased its circumference. After noting a steady inspiratory and expiratory movement, the normal resting RR was counted (without the knowledge of the subject) for 1 minute, using a stop watch. The value was recorded as RR in cycles/minute. Similarly, the pulse rate was taken by palpating the radial artery at the wrist for one minute using the stop watch.

Statistical Analysis

Results were presented as mean ± SEM. Data analysis was done using SPSS version 17.0 and Microsoft Excel analyser (version 2010). One way analysis of variance (ANOVA) was employed in this study. Statistical significance was set at $p<0.05$.

RESULTS

A total of 354 sportsmen engaged in diverse category of sports were recruited for the study. The types of sports ranged from football, basketball, judo, karate and boxing. The full category of sportsmen employed and the frequency of each category is found in Table 1**.**

Table 2 shows the effect of duration of sports on anthropometric, respiratory and cardiovascular parameters. Sportsmen with duration of one to four years, five to eight years and greater than eight years of service were compared to see if there was any significant difference in the values of the above parameters. Although there was no significant difference in the BMI of the three groups (22.75 ±0.17, 22.69 ±0.17and 22.89 ±0.29 Kg/m^2 respectively), the PEFR (580.50 ±6.15 and 587.02 ±11.06 L/min) and MAP (88.82 ±0.83 and 90.18 ±0.88 mmHg) of individuals in the sports group of duration, 5 – 8 and >8 years showed higher values which were not significant when compared to that obtained from individuals in the 1 – 4 years group (579.45 ±5.25; 86.51 ±0.62) as shown in table 2. The values of all the other anthropometric, respiratory and cardiovascular parameters did not differ much despite the duration of the sports.

Results from table 3 show correlation between anthropometric, respiratory and cardiovascular parameters. Body mass index showed a strong significant ($p<0.01$,$p<0.05$) positive correlation with age and peak expiratory flow rate. Also, table 3 reports that BMI shows a weak positive correlation with exercise duration, mean arterial pressure (MAP) and pulse rate (PR in beats/min) which was not significant($p>0.05$) for exercise duration but was significant($p<0.01$) for both MAP and PR. Furthermore, table 3 shows correlation between exercise duration with MAP on the one hand and PR on the other hand which reports a significant ($p<0.01$) weak positive and negative correlation with MAP and PR respectively. Weight and BMI both had a weak negative correlation with respiratory rate which were both significant ($p<0.05$,$p<0.01$).

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Table 1: Sportsmen recruited for the study

Sport type	Frequency	Percentage (%)
Athletics	31	8.8
Basket Ball	12	3.4
Football	262	74.0
Boxing	10	2.8
Handball	5	1.4
Judo	3	0.8
Karate	7	2.0
Long Race	3	0.8
Martial arts	2	0.6
Swimming	1	0.3
Sprint race	3	0.8
Taekwondo	6	1.7
Wrestling	9	2.5
TOTAL	**354**	**100.0**

Table 2: Comparison of the effect of duration of service of sportsmen on anthropometric, respiratory and cardiovascular parameters

Duration of Sports (years)	Mean Age (years)	Height (m)	Weight (Kg)	BMI (Kg/m^2)	RR (Cycles/ min)	PEFR	SBP (mmHg)	DBP (mmHg)	MAP (mmHg)	Pulse Rate (beats/ min)
1 – 4	22.46 ±0.25	1.71 ±0.00	66.96 ±0.66	22.75 ±0.17	19.01 ±0.27	579.45 ±5.25	120.22 ±0.82	69.65 ±0.66	86.51 ±0.62	64.18 ±0.88
5 – 8	22.65 ±0.30	1.70 ±0.00	66.06 ±0.67	22.69 ±0.17	18.44 ± 0.30	580.50 ±6.15	124.24 ±1.02	71.32 ±0.87	88.82 ±0.83	61.79 ±1.10
>8	25.06 ±0.44	1.71 ±0.01	67.26 ±0.94	22.89 ±0.29	18.97 ± 0.43	587.02 ±11.06	122.27 ±1.20	74.14 ±0.97	90.18 ±0.88	59.98 ±1.41

Table 3: Correlation between the different parameters in sportsmen

Parameter	Correlation (r)	P - value
BMI vs Age	0.361	*P<0.01*
BMI vs Exercise Duration	0.034	*P<0.524*
Exercise Duration vs MAP	0.175	*P<0.01*
Exercise Duration vs Pulse rate	-0.140	*P<0.01*
BMI vs MAP	0.151	*P<0.01*
BMI vs Pulse rate	0.168	*P<0.01*
Pulse rate vs MAP	0.048	*P>0.05*
BMI vs PEFR	0.369	*P<0.05*
BMI vs RR	-0.152	*P<0.01*
Height vs PEFR	0.217	*P<0.01*
Respiratory Rate vs Weight	-0.118	*P<0.05*

DISCUSSION

This study was conducted using 354 apparently healthy males who engaged in different categories of sports in Calabar, Cross River State, Nigeria. Comparison of anthropometric, respiratory and cardiovascular indices in these sportsmen who were categorized into 3 groups based on the duration of sport performance in years showed results in PEFR and MAP that were not significant across all groups. The muscle mass and by extension BMI of sportsmen remained at a fairly constant value due to their frequent physical activity [4]. The above might serve as a possible explanation for the insignificant values in MAP and PEFR obtained despite the duration of sports activity.

BMI strongly correlated positively with PEFR and age (Table 3); a correlation which was statistically significant ($p<0.01$ and 0.05 respectively). The result obtained for correlation between BMI and PEFR was in

agreement with previous studies conducted on diverse population groups including athletes, obese children and obese patients with asthma [18,19,20]. In contrast, another study reported a negative correlation between BMI and PEFR in healthy women [21]. The strong correlation between BMI and PEFR obtained in this study is probably due to the attenuation of respiratory function decline in athletes which results in better lung elastic recoil, chest muscle power, and the total compliance of the chest wall and lungs, which were achieved through physical training [22]. The strong correlation between PEFR and height in the result (table 3) which was consistent with the findings of other researchers [23,24,25], might also explain the positive correlation between BMI and PEFR since height is an important factor in the growth of the respiratory airway passages and increases in both expiratory muscle effort and chest volume.

BMI as also observed from the results was found to have a weak positive correlation with exercise duration which was not significant ($p>0.05$). This slight increase in BMI in response to increase in exercise duration may be due to the fact that BMI of sportsmen is principally accounted for by muscle mass rather than fat [26]. MAP and pulse rate were also observed to have a weak positive correlation with BMI which was significant ($p<0.01$). This finding agreed with results from a previous study involving school children [27]. This can be explained logically in terms of the correlation result observed between exercise duration with both MAP and BMI which showed weak positive correlations (table 3). Since exercise duration of sportsmen did not significantly alter BMI in this study and by extension MAP (as muscle mass is an important factor in athletes that brings about an increase in BMI), therefore it can be logically inferred from the correlations obtained that MAP and pulse rate will change very little in the event of slight increases in BMI.

Further work on physical fitness of the sportsmen which is assessed using maximal oxygen consumption (VO_2max) can be done in a future study. This would provide an insight into correlational relationships between this variable with cardiovascular and respiratory indices.

CONCLUSION

In conclusion, this study although confirming a previous study that there exists a correlational relationship between BMI and PEFR in sportsmen [18], has also shown that duration of sports service does not significantly alter the cardiovascular and respiratory indices measured.

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