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Pulmonary function studies in Nigerian sportsmen

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Summary

Lung function studies in Nigerian sportsmen were performed during the Western State Sports Festival.

The sportsmen comprise 259 males and 151 females. They were made up of secondary school students, University undergraduates, young clerical and technical workers and soldiers. The forced vital capacity (FVC) and forced expiratory volume in 1 s (FEV_1) were performed using the wedge bellows vitalograph.

The results of the investigation are presented. It was observed that the mean FVC and FEV_1 values were lower than the predicted mean values of normal Nigerians when matched for age, sex, height and weight. However, the mean observed FVC value of athletes was higher than the observed FVC value of non-athletes. It was also noted that the mean FVC value of the sportsmen correlates with their sporting events, which are determined by the extent of regular and strenuous physical training.

Résumé

Au cours du Festival des Sports du Western State, Nigéria, nous avons effectue des recherches sur las fonction respiratoire des athlètes nigérians.

Parmi les athlètes étudiés, il y avait 259 hommes et 151 femmes, élèves du secondaire, étudiants, jeunes techniciens et employés de bureaux, et soldats. La capacité vitale à l'expiration et le volume d'expiration en une seconde ont été mesures au moyen d'un vitalographe à soufflet.

Nous presentons ici les résultate de cette recherche. Nous avons pu observee que les resultats moyens obtenus étaient inferieurs aux estimations des résultats moyens des Nigérians en général, classés par catégories de sexe, d'age, de taille et de poids. Cependant, la capacité vitale moyenne observée chez les athletes était supérieure à celle observée chez les non-athlètes. Il est également apparu que la capacité vitale moyenne des sportifs dépend directement de leur activité sportive, qui est fonction de leur entrainement sportif regulier et de la violence de leurs efforts physiques.

Introduction

Lung function studies in people of negro origin have been carried out by several investigators Johannsen & Erasmus (1968); Abramowitz *et al.* (1965); Smillie & Augustine (1926); Roberts & Crabtree (1927); Hearn (1968); Paul & Fletcher (1960). Comparison with Caucasians has shown that the mean lung function values of the people of African descent are much lower. Similarly, in Nigerians, studies by Oduntan (1970), Femi-Pearse & Elebute (1971) have revealed that the normal values are similar to those of South African bantu, and are lower than those of the Caucasians.

Few pulmonary function studies have been reported on sportsmen Dreyer (1919); Gordon, Levine & Wilmaers (1924); White & McGuire (1925). Due to increase in their physical activity incidental to regular physical training, the mean lung function studies of sportsmen (athletes), may be higher than those of non-athletes. Stuart & Collings (1939), found that the mean vital capacity of athletes was significantly higher than the mean vital capacity of non-athletes. This, they attributed to the increased development of respiratory musculature incidental to regular physical training. There are no reports on the lung function tests in African sportsmen. This paper

presents the results of lung function tests performed during routine medical examination on 410 athletes, during the 1975 annual sports festival in the Western State of Nigeria.

Materials and Methods

Four-hundred and ten athletes comprising 259 males and 151 females, from nearly all sporting events were included in this study. The athletes were made up of secondary school students, University undergraduates; young clerical and technical workers and soldiers. The selection was based only on those participants who presented voluntarily at the medical centre of the stadium for the tests. All the participants did not have any symptom referable to the respiratory and cardiovascular systems at the time of the study. Pulse and blood pressure were taken by two of us. The heart and the lungs of all the participants were examined and found to be normal before the lung function tests were performed. The height in inches and the weight in pounds were also recorded on all of them. Electrocardiographs were also recorded on all of them. The spirometric studies were performed with the subject sitting down using the single breath wedge bellows vitalograph (Vitalograph Limited, Buckingham, England). The purpose of the test was explained to each subject, and the method of carrying out the test demonstrated. Each participant had the test performed three times and the largest of the three values was selected. The forced vital capacity (FVC) and the forced expiratory volume in 1 s (FEV_1) were read off the vitalograph chart. The predicted normal values matched with age, sex, and height were derived from the prediction formula of Myers (1923) and Miller & Johnson (1959).

Results

The age and sex distribution of the athletes studied are shown in Table 1. It is a young population as indicated by the fact that more than 70% of them are below the age of 20. The youngest was 10 years old and the oldest 41. Table 2 shows a summary of the measured variables as well as the means of the predicted values of both the FVC and FEV_1. Male athletes have significantly higher mean FVC and FEV_1 than the females ($P < 0{\cdot}001$ in each case). The highest FVC value is 5·1 litres and the lowest is 1·2 litres. Fifteen of the participants—all of them males—out of 410 have FVC values above 4 litres, which is above the mean of

TABLE 1. Age and sex distribution of athletes

Age group (years)	Males (No.)	Males (%)	Females (No.)	Females (%)	Total (No.)	Total (%)
10–14	55	21·2	59	39·1	114	27·8
15–19	110	42·5	82	54·3	192	46·8
20–24	46	17·8	7	4·6	53	12·9
25–29	33	12·7	3	2·0	36	8·8
30–34	8	3·1	—	—	8	2·0
35 & over	7	2·7	—	—	7	1·7
Total	259	100·0	151	100·0	410	100·0

TABLE 2. Summary of measured variables

Variable	Male			Female		
	Mean	s.d.	No.	Mean	s.d.	No.
Age (yrs)	19·20	5·92	259	15·17	3·08	151
Height (ins.)	67·08	5·90	259	63·74	3·49	151
Weight (lbs.)	122·52	24·67	259	111·83	21·25	151
FVC (litres)	3·24	0·82	259	2·35	0·55	151
FEV_1 (litres)	2·79	0·54	259	2·12	0·45	151
Systolic BP	124·23	40·23	259	118·50	19·62	151
Diastolic BP	75·60	10·14	259	72·87	10·12	151
Mean of predicted values						
FVC (litres)	3·43	0·25	259	3·18	0·31	151
FEV_1 (litres)	3·13	0·32	259	2·54	0·28	151

TABLE 3. Forced vital capacity (litres) by age groups

Age Groups	Male			Female		
	Mean	s.d.	No.	Mean	s.d.	No.
10–14	2·35	0·52	55	2·06	0·46	59
15–19	3·34	0·84	110	2·50	0·54	82
20–24	3·63	0·68	46	5·03	0·34	7
25–29	3·67	0·57	33	2·53	0·68	3
30–34	3·78	0·34	8	—	—	—
35–39	3·28	0·54	6	—	—	—

TABLE 4. Pearson coefficient of linear correlation between FVC and stated variables

	Males	Females
FVC vs. age	0·40*	0·45*
FVC vs. height	0·47*	0·55*
FVC vs. weight	0·63*	0·14
FVC vs. diastolic BP	0·32*	0·20
FVC vs. systolic BP	0·02	0·07

*$P<0.01$

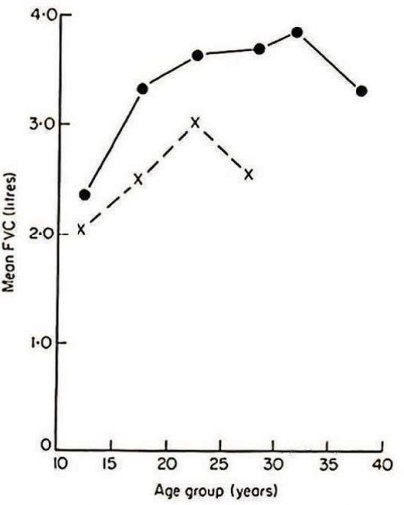

FIG. 1. Relationship between FVC and age group: ●—● males; ×– – –× females.

the predicted value for all the participants. Table 3 and Fig. 1 show the variation of the mean FVC values over age. There is a steady rise of FVC with advancing age up to the age group 30–34 years for males and 20–24 years for females. Thereafter, the mean values start to fall. The correlation between age and FVC is further demonstrated in Table 4, in which are shown Pearson's correlation coefficients between FVC and each of the variable—age, height, weight, diastolic and systolic blood pressures. For males, FVC correlated positively and

TABLE 5. Forced vital capacity (litres) by sporting events

	Male			Female		
	Mean	s.d.	No. of Subjects	Mean	s.d.	No. of Subjects
Boxing	3·60	0·59	24	—	—	—
Cycling	3·43	0·70	19	—	—	—
Football	3·35	0·67	14	—	—	—
Hockey	3·33	0·48	12	2·32	0·36	16
Swimming	3·31	1·23	42	2·14	0·48	12
Volley Ball	3·26	0·46	11	2·70	0·24	4
Athletics						
(a) Mean (track and field events)	3·19	0·76	109	2·33	0·57	73
(b) Track events alone	3·30	0·80	57	2·22	0·19	41
(c) Field events alone	3·14	0·72	52	2·42	0·67	32
Basket ball	3·18	0·66	12	2·57	0·65	19
Cricket	2·83	0·62	15	—	—	—
Table tennis	2·71	0·50	15	2·30	0·37	8

significantly with weight ($r = 0.63$, $P < 0.01$), height ($r = 0.47$, $P < 0.01$), age ($r = 0.40$ $P < 0.01$) and diastolic blood pressure ($r = 0.32$, $P < 0.01$). For females only height ($r = 0.55$, $P < 0.01$) and age ($r = 0.45$, $P < 0.01$) show significant correlations with FVC. Table 5 shows mean FVC values by sporting events. It shows that male athletes practising such sporting events as boxing, cycling, football, hockey and swimming, which require maximal physical efforts have significantly higher FVC values ($P < 0.05$ for each comparison) than those engaged in less strenuous ones like cricket and table tennis. This differential in FVC, for female athletes engaging in strenuous and less strenuous events is not marked.

Table 6. Comparison of mean FVC with age groups in the present study with that of Femi-Pearse (1971)

	Present study (athletes) (litres)		Femi-Pearse (1971) (non-athletes) (litres)	
Age Groups	Male	Female	Male	Female
10–14	2·35	2·06	—	—
15–19	3·34	2·50	3·30	2·70
20–24	3·63	3·03	3·40	2·50
25–29	3·67	2·53	3·60	2·70
30–34	3·78	—	3·50	2·60
35–39	3·28	—	3·40	2·50

Discussion

This study revealed that the observed mean FVC and FEV_1 values are significantly lower than the predicted values for either sex ($P < 0.001$). It was also observed that the mean FVC values for females are lower than those of males of the same age group. Similar findings have been recorded in normal Nigerians by Femi-Pearse. Femi-Pearse had pointed out in his own study that anthropometric measurements such as age, height, and weight alone cannot explain the difference in the lung volume of both sexes. He stressed further that factors such as difference in muscle strength, size and shape of thoracic cage could play a part in determining the values.

The increase in forced vital capacity with increase in age which we observed in this study is similar to the findings of Bhattacharya & Banerjee (1966) among young adults in India and of Femi-Pearse among non-sporting Nigerians.

It is revealed from this study that there is significant correlation between age, height, weight and diastolic blood pressure on one hand and FVC on the other in the males. In the females, significant correlation is noted only between age and height on the one hand and FVC on the other. Similar findings were revealed in the study by Femi-Pearse on non-sporting Nigerians.

The mean FVC values of the male athletes in this study are higher than those of non-athletes of similar age groups, studied by Femi-Pearse. The values, however, in the female athletes, are not higher. This might probably be explained by the fact that the respiratory musculature of Nigerian female athletes has not been maximally developed because of inadequate and irregular physical training. The observation of Toyosi (1974) lends support to this explanation.

It has also been observed from this study that the FVC value of participants in athletics is lower than the value obtained in other sporting events like cycling and boxing, bearing in mind, the fact that the track events component of athletics require similar maximal physical efforts. The explanation lies in the fact that the FVC value obtained in athletics is the mean for both track and field events When taken separately, the value obtained in track events; as revealed in Table 5, is similar to FVC values obtained in events like boxing, cycling and swimming. Thus, the overall FVC value in athletics has been reduced by the FVC value in field events.

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