RELATIONSHIP OF VITAL CAPACITY AND SELECTED ANTHROPOMETRIC VARIABLES TO TWO-MILE RUN TIME

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Vital capacity has been investigated widely during the last century (Hutchinson, 1846; Dreyer, 1919; Hewlett and Jackson, 1922; Cureton, 1936) and attempts have been made to relate it to physical fitness status (Cureton, 1936; Davis, 1959). Attempts were made to determine the effects of training on vital capacity without great success (Davis, 1959; Adams, 1968; Wilmore *et al.*, 1970). Barring pathological conditions, the questions of the contribution of vital capacity to athletic performance and the association between anthropometric parameters and vital capacity were yet unsolved.

Review of Literature

Initial investigation (Hutchinson, 1846) determined strong relationships between vital capacity and height and weight, with height being the most consistent. Contraindicatively, Dreyer (1919) found that weight exhibited the most consistent relationship with vital capacity. Hewlett and Jackson (1922) found the correlations of vital capacity with weight and with height to be approximately equal. Cureton (1936) indicated that the two variables contributed 75 per cent to the variance of the vital capacity but failed to state which contributed the most. Lemon and Moersch (1924) found that vital capacity was more a function of body surface area than of either height or weight taken singularly.

Early investigation of the relationship of vital capacity to athletic performance was inconclusive (Gordon, Levine, and Wilmaers, 1924). More recent studies (Davies, 1959; Costill, 1964) have concluded that there is no relationship between vital capacity and endurance performance.

Methodology

A random sample was obtained from the male population of Appalachian State University. The 24 subjects were enrolled in an athletics class (track and field).

All subjects were tested for vital capacity using a Collins Vitalometer. Each subject was given three trials and the maximum volume recorded. Each sample was allowed to stand for 20 minutes to equilibrate to ATPS. It was converted to a BTPS volume using the calculations given by Slonin and Chaplin (1967).

Other selected anthropometric data were taken on each subject at the time of vital capacity evaluation. Body surface area (BSA) was derived according to DuBois (1936). Ratios between vital capacity and body surface area (VC/BSA), weight (VC/WT), and height (VC/HT) were also calculated.

All subjects ran two miles together on a 440-yard synthetic track. They were timed to the nearest full second.

Data were analyzed using the Pearson product-moment correlation.

Results

The means, standard deviations, and ranges of all measurements are given in Table 1. The correlation matrix for all data is presented in Table 2. The data generally agreed with that reported by other investigators (Dreyer, 1919; Hewlett and Jackson, 1922; Cureton, 1936; Costill, 1967; Adams, 1968). Seven subjects were track athletes, six participated in other forms of athletics, and 11 were untrained students. Figure 1 indicates the relationship between vital capacity and 2-mile run time.

TABLE 1. Means, standard deviations, and ranges of variables

Variable	Units	Mean	S.D.	Range
Age	yrs.	21.41	2.02	18.66-26.33
Height	ins.	68.94	1.92	64.00-75.00
Weight	lbs.	155.19	16.63	126.25-203.00
BSA	sq. m.	1.85	0.11	1.65-2.14
Vital Capacity	l.	5.39	0.59	4.16-6.61
VC/Ht.	l./in.	78.33	7.51	65.84-93.17
VC/Wt.	l./lb.	34.90	3.11	29.14-40.62
VC/BSA	l./sq. m.	2.90	0.22	2.49-3.30
2-mi. run	mins.	13.30	2.00	9.86-16.40

Discussion

Numerous investigators have reported specific relationships between vital capacity, anthropometric parameters, and endurance performances. Most authorities agreed that vital capacity was so highly related to other anthropometric measures and so insignificantly associated with performance that it should be considered only as an anthropometric variable. No one is willing to state firmly whether vital capacity causes increased performance or whether performance created a larger

vital capacity, although Astrand and Rodahl (1970) did state that training during the adolescent years will eventually increase vital capacity.

In addition, Astrand (1952) found a close association between vital capacity and maximal oxygen intake in 190 subjects over an age range of 7 to 30 years old. However, the relationship was spurious since persons with a given vital capacity exhibited a wide range of maximal VO_2 . In short, no prediction of maximal VO_2 could be made from vital capacity because of the unreliable association within specific age groupings. On the other hand, it is necessary to have substantial vital capacity in order to reach the higher levels of ventilation required in larger maximal VO_2 (Saltin and Astrand, 1967).

Ricci (1967) has stated that vital capacity must be related to body size in order to be a meaningful index of

fitness. This study supported that conclusion. Cureton (1947) further stated that each person should be compared to a norm based on his own vital capacity and his BSA; however, no attempt was made to do so in this study.

Conclusions

Within the limits of this study, it was concluded that:

1. Vital capacity was unrelated to two-mile run time ($r=.029$).
2. Vital capacity/BSA ratio was not related to two-mile run time ($r=-.288$).
3. Vital capacity/wt ratio was significantly related to two-mile run time ($r=-.593$).
4. Body surface area (BSA) was significantly related to vital capacity ($r=.742$).

Figure 1 Relationship between Vital Capacity and Two-Mile Run Time

TABLE 2. Correlation matrix*

	Ht.	Wt.	BSA	VC	VC/BSA	VC/Wt.	VC/Ht.	2-mi. Run
Age	.401	.416	.452	.546	.420	.180	.515	-.142
Ht.		.579	.781	.631	.298	.112	.453	-.009
Wt.			.956	.669	.189	-.348	.602	.512
BSA				.742	.260	-.210	.629	.394
VC					.838	.456	.974	.029
VC/BSA						.834	.892	-.288
VC/Wt.							.505	-.593
VC/Ht.								.029

*Correlations of .404 (.05 level) and .515 (.01 level) were significantly different from zero.

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