HEART SHADOW SIZES OF FEMALE PHYSICAL EDUCATION STUDENTS

H.N.Bleasdale, M.B.E., M.B., Ch.B., Director, Mass Radiography
Unit, Liverpool
and

H. Thomason, M.Sc., D.L.C., Lecturer, Human Performance Laboratory,
Physical Education Section, University of Salford

Introduction

Frequent reports of x-rays taken from groups of sportsmen and control groups of non-participating subjects state that there is a significant difference in heart shadow size between them.

Mellerowicz (1956), Karvonen (1959) and Beckner & Winsor (1954) all report findings that support this statement. Most of their subjects were male: however Karvonen did state that the hearts of female athletes responded to training in the same way as men.

Schlant (1967) states that, "In trained athletes the resting pulse is often slow and there may even be mild hypertrophy and dilation of the heart as a consequence of the chronic increased work requirements upon the heart. There is no evidence that this (physiological) hypertrophy is detrimental to the individual."

In the present study an attempt was made to determine whether or not the heart shadow size of female physical education students differed from that of female non-physical education students.

Method

Population

For the purpose of this study two sample populations were used.

1. Population A - students of physical education undergoing a three year course. They were regarded as different from the normal population in respect of their yearly physical work load.

Group 1	n = 100	1964 - 1967 entry
Group 2	n = 100	1965 - 1968 entry

2. Population B - students undergoing a three year university course with no physical education.

Group 3	n = 100	1965 - 1968 entry
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(This group was regarded as part of the normal population and acted as the control group).

X-Ray Recording Methods

Mellerowicz and Karvonen, reporting on work carried out with different groups of subjects, maintain that valid roentgenologic evidence can be obtained when subjects are in the standing position, in the postero-anterior projection. There is general agreement, however, that the heart silhouette is smaller in the standing than in the supine position, and it is imperative that each investigator of this problem of heart size gives orientation of his procedure.

X-Ray of Heart Shadows

Heart shadows x-rays were recored on 100mm xray film by a Phillips x-ray apparatus with an Odelca camera attachment, the exposures being automatically controlled according to the tissue density by a photo-electric timing device. The tube distance from the fluorescent screen was 37 inches. There was no tube tilt. All exposures were made at full inspiration and were postero-anterior projections. Subjects were in a standing position.

It is realised that the cardiac diameter is apparently increased by a tube distance of 36 inches when compared with that seen on a film taken at a tube distance of 72 inches. It was felt, however, in this particular instance, that as comparison between 100mm film only was being made and the whole population had been treated similarly, the technique employed would be satisfactory. The cost of the investigation had to be considered when it was borne in mind that a box of 50 of the 100mm films cost £1. 2. 6d. whereas 15 ins x 12 ins films cost £5.18s. for 25.

Recordings were taken on one occasion only during the first year, of each students course.

Cardiac Shadow Measurement

All measurements were taken direct from the x-ray plates. An x-ray measuring caliper, calibrated in millimeters, was used.

The cardiac diameter was measured at its widest point. The diameter of the internal rib cage was measured along the sample line. All measurements were recorded in millimeters.

From the measurements obtained the percentage of the cardiac diameter to the internal rib cage was calculated.

Statistics

All the data obtained was subjected to the following statistical tests:

a) Descriptive - The descriptive statistics used were as follows:

1. the parameter of location - sample mean - $\bar{x}_n$

2. the parameter of distribution - the standard deviation - s_n .

b) Inferential - Standard one-way analysis of variance testing the significance of the overall difference between group means, after Ferguson 1966, was used. When an overall significance was found the differences between two or more groups were tested using the Scheffs test for multiple comparison of means, after Edwards (1960).

Computer programmes were constructed for the above statistical tests, for the University of Salford KDF9 computer.

Results

% Cardiac diameter/internal rib cage diameter

Population A - Group 1 (1964-67) n = 100

Group 2 (1965-68) n = 100

Population B (1964-67) n = 100

Analyses of Variance and Scheffe Tests

Analysis of variance of multiple group means

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio
Between groups	698.66	2	349.330	29.19xx
Within groups	4288.86	297	14.441	
Total	4987.52	299		

F significant at 95% level

For all groups

Mean = 44.04 S.D. = 4.084

<u>Population</u>	<u>Mean</u>	<u>St. Deviation</u>
Pop. A - group 1	46.08	3.87
group 2	43.63	3.66
Population B	42.41	3.86

Scheffe test for comparison of significance between individual group means

	<u>Population A</u>	<u>Population B</u>
	<u>1</u>	<u>2</u>
Population A - 1	20.78xx	46.64xx
2		5.15x
Population B		

x = significant at 90% level
xx = significant at 95% level

Analysis of variance combining population A, groups 1+2

<u>Source of Variance</u>	<u>Sum of Squares</u>	<u>Degrees of Freedom</u>	<u>Mean Squares</u>	<u>F Ratio</u>
Between groups	398.53	1	398.535	25.88xx
Within groups	4588.99	298	15.399	
Total	4987.52	299		

F significant at 95% level

For all groups

Mean = 44.04 S.D. = 4.084

<u>Population</u>		<u>Mean</u>	<u>St. Deviation</u>
Pop. A -	1+2	44.85	3.96
Pop. B -	3	42.41	3.86

Scheffe test for comparison of significance between group means

	Population A	Population B
	1 + 2	3
Population A	1 + 2	25.88xx
Population B	3	

xx = significance at 95% level

Discussion

From the results it can be said that a statistically significant difference between population A and population B exists in respect of heart shadow size at the 95% level. However, a statistically significant difference exists between groups 1 and 2 of population A at the 95% level in respect of heart shadow size.

Thomason, Hamley & Brooke (1968) using random samples from the same population A, and a population of female non-physical education students from a college of education with the same age range as population B, found that a statistically significant difference at the 95% level existed in respect of the resting R2 wave amplitude. This difference was not demonstrated at the second and subsequent recording sessions throughout the three year course. In fact a statistically significant linear regression trend at the 95% level was demonstrated in respect of R2 wave amplitude over the three year course. This may throw some light on the difference in heart shadow size between group 1 and 2. It was found in this population that after the first six months the amount of hard physical activity gradually decreased as a more creative and academic approach was taken in the course work.

Conclusion

Significant differences in heart shadow size between population A and population B were demonstrated. In the light of Thomason et al work on population A in respect of resting ecg wave amplitudes some inference may be placed on the assumption that girls with a harder physical work load have larger heart shadows and resting R2 wave amplitudes than those with less or no physical work loads.

References

- Beckner, G.L. & Winsor, T. 'Cardiovascular adaptation to prolonged physical effort! Circulation, 9: 835 (1954)
- Edwards, A.L. 'Experimental Design in Psychological Research' (Revised Edition) Holt Rinehart and Winston (1960).
- Ferguson, G.A. 'Statistical Analysis in Psychology and Education' (2nd Edition) McGraw Hill & Company, New York (1966).
- Karvonen, M.J. 'Effects of vigorous exercise on the heart Work and the Heart' (Edited by Rosenbaum, F.F. and Balknap. E.L.) Paul B. Hoeber, New York (1959)
- Mellerowicz. H. 'Vergleichende Untersuchungen uber das Okonomieprinzip in Arbeit und Leistung des trainierten Kreislaufs und sein Bedeutung fur die praventive und rehabilitative Medizin' Steinkopff, Darmstadt (1956)
- Schlant, R.C. 'Normal anatomy and function of the cardiovascular system The Heart, Arteries and Veins' (Editors Hurst and Logue) McGraw Hill & company, New York (1967).
- Thomason, H. Hamley, E.J. & Brooke, J.D. 'Modifications electrocardiographiques liees a la charge annuelle de travail physique chez de jeunes adultes de sexe feminin' Le Travail Humain, 31, 3-4, 344-345 (1968)