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HEART RATES DURING FEMALE PHYSICAL EDUCATION LESSONS

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INTRODUCTION

Physical fitness is an important pre-requisite for optimum physical, mental and social well-being (WHO 1968). The development of fitness is an objective peculiar to the physical education curriculum and is based on the biological principle, first proposed by Roux a century ago, that organs are both maintained and developed by functional stress. Minimum levels of stress have been recommended by many authors (Karvonen et al, 1957; Roskamm, 1967; Wilmore, 1974), but evidence of the actual intensity of a physical education lesson is scarce. However the development of miniaturised recording equipment now makes it possible to monitor physical activity and compare the actual responses with the prescribed minimum.

This pilot study uses heart rate (fH) as the index of intensity and describes the reactions of two groups of girls during physical education lessons.

METHODS

Seventeen subjects took part; 10 female physical education students chosen at random (PE) aged 19-20 years, and 7 school-girls (SG) aged 12-16 years, regarded by the school staff as enthusiastic participants in physical education lessons.

Heart rates were recorded in two ways; (A) the habitual physical activity of the PE group only was monitored over two separate 36 hour periods with the SAMI/HR device (Baker et al, 1967). The recording cells were changed so that mean fH was obtained during work (i.e. timetabled sessions), leisure and sleep; (B) activity during 24 practical sessions (17 for the PE group, 7 for the school-girls) was monitored by a Parkes telemeter. Heart rates were recorded on to tape and subsequently replayed through a Washington pen-recorder; the 15 beat method (Åstrand and Rodahl, 1970) was used to obtain minute by minute fH.

The activities monitored depended on the timetable and availability of subjects and investigators; they included 5 gymnastic, 6 games, 1 dance and 5 Union games sessions for the PE group, and 1 keep-fit, 2 athletics, 2 netball, and 2 badminton sessions for the SG group.

The Cochran and Cox approximation of student 't'-test (Ferguson, 1966) was used to test the significance of the difference between means.

RESULTS

PE Group

a) SAMI results

The data from both recording periods appear in Table I. The results are not significantly different.

TABLE I

Means and S.D.'s of fH (b.min) During Habitual Physical Activity of the P.E. Group

	Work	Leisure	Sleep
I	93.6	87.2	61.4
	± 3.98	3.97	2.10
II	92.8	91.6	61.9
	± 4.60	3.61	2.20

b) Telemeter results

A total of 854 minutes of activity was monitored, with the breakdown as follows; gymnastics 241 minutes, games 319 minutes, dance 30 minutes and Union games 264 minutes. Mean fH and duration of the activity are summarised in Table II.

TABLE II

Means and S.D.'s of Duration of and fH During Telemetred Sessions of the P.E. Group

	Time (min)	fH (b.min)
Gym	48.2	106.3
	± 16.6	16.0
Games	53.2	121.6
	± 22.0	16.9
Union Games	52.8	124.6
	± 20.7	6.9

The only significant difference is between fH during gym and Union games ($p < 0.05$).

SG Group

The telemetry data for the seven school girls is summarised in Table III.

TABLE III

Means and S.D.'s of Duration of and fH During Telemetred P.E. Lessons of the S.G. Group

Time (min)	fH (b.min)
25.1 ± 7.7	129.7 12.3

The mean duration of the lessons was clearly less than the PE group, and although mean fH was higher than for any of the PE group sessions the difference was only significant during gymnastics ($p < 0.02$).

DISCUSSION

The understandable assumption that the PE group would have a level of activity of above average is not supported by the mean fH derived from the SAMI recordings. Comparisons with other student groups, shown in Table IV, show this clearly.

TABLE IV

Mean fH (b.min) During Habitual Physical Activity of Student Groups

Group	W	L	S
PE n = 10	93	89	61
1 General Course Students n = 5	86	91	68*
2 University non-athletes n = 12	99	95	69*
2 University athletes n = 13	82*	82*	67*

1 = Bradshaw – unpublished results.
2 = Diament et al, 1968.
* = $p < 0.05$ compared with PE group results.

The University athletes appear to be the least active, but since trained athletes tend to have lower fH at rest and for a given work load an alternative to the mean fH is needed. If work and leisure fH are related to sleeping fH (Diament et al, 1968) the ratios, given in Table V, indicate that the PE group is the most active.

TABLE V

Mean W/S, L/S Ratios of Student Groups

Group	W/S	L/S
PE	1.52	1.46
General Course	1.26**	1.34**
University Non-Athletes	1.43	1.38
University Athletes	1.44	1.44

** = $p < 0.01$ compared with PE group results

This result is not entirely unexpected, but gives limited information on the value of particular physical education lessons as agents for organic development. Karvonen suggests a minimum of approximately 30 minutes continuous whole body activity producing fH > 140 b.min, 5 times a week. Clearly the PE group's mean working fH of 93 b.min falls short of the prescribed minimum. But it is possible that 30 minutes of strenuous activity went undetected in the 8 hour recording period. An example illustrates this point. Assume a mean working fH of 90 b.min over 8 hours recording; add 30 minutes of training at fH 140 b.min; the result is an fH of 92.9 b.min for the whole period.

Monitoring individual sessions should be more informative, but averaging fH obtained by telemetry may also disguise the true stress of physical education session. The results show that mean fH during particular activities rarely exceeded 140 b.min, but this may be the result of wide variations in recording time. A graphical display of minute by minute fH (Figures 1-3) enable the total time that fH exceeds the training threshold to be calculated and thus give a better measure of the intensity of the session.

Using this approach peak fH clearly exceeded minimum levels but the total time seldom approaches the suggested 30 minutes in any one session. Out of the 854 minutes of PE group activity that were monitored, fH exceeded 140 b.min for a total of 140 minutes, about a quarter of the recommended time. Indeed, during six sessions fH never exceeded 140 b.min.

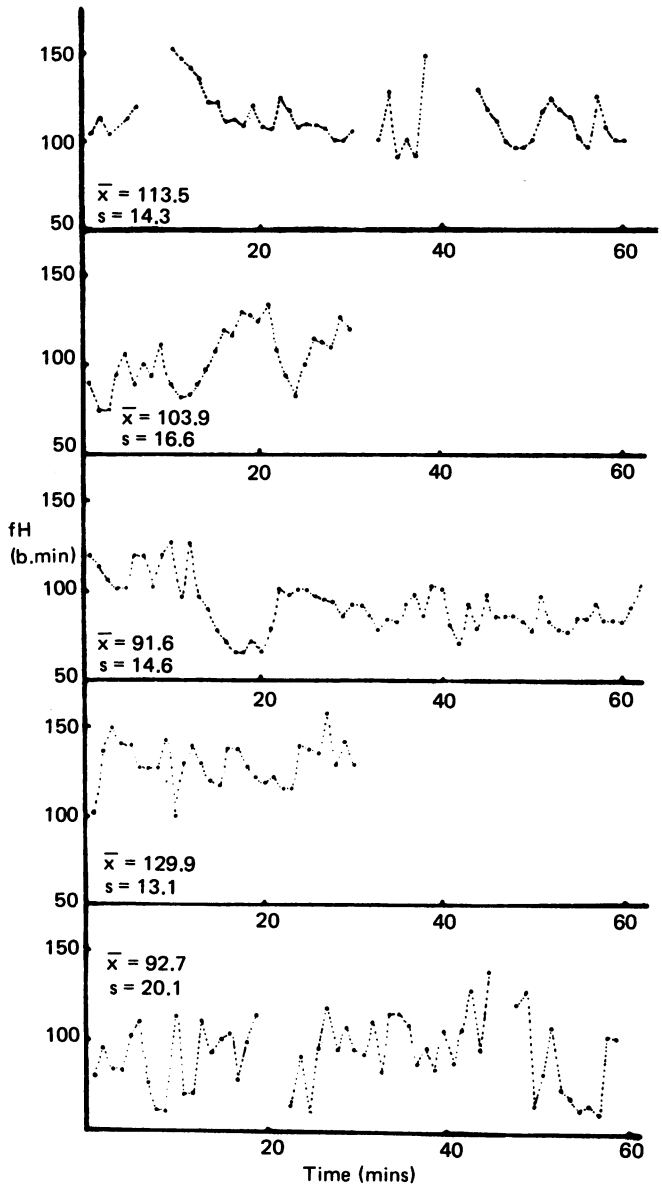

Figure 1. Heart Rates during Gymnastics.

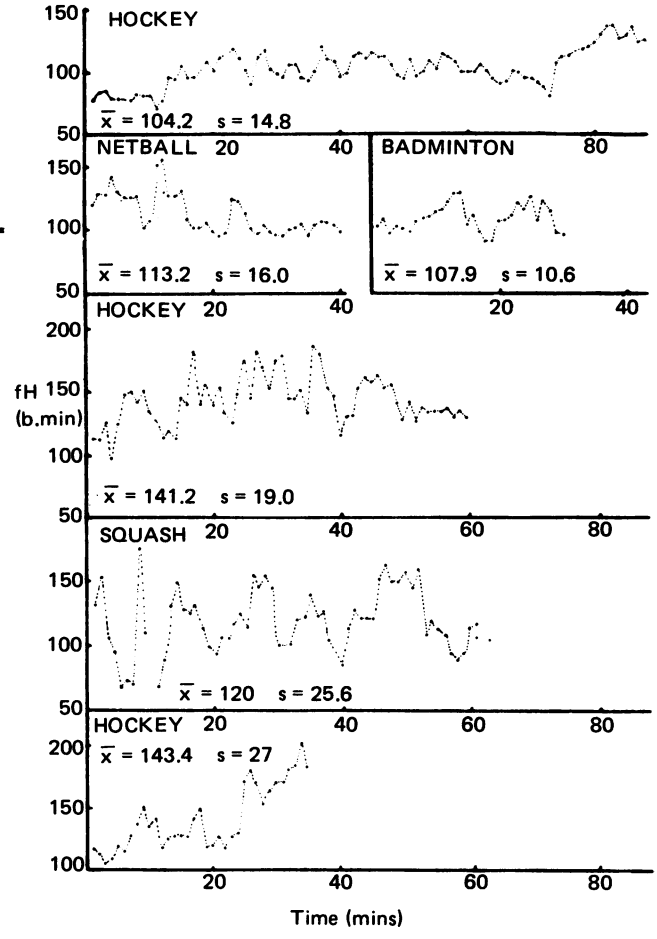

Figure 2. Heart Rates During P.E. Practicals

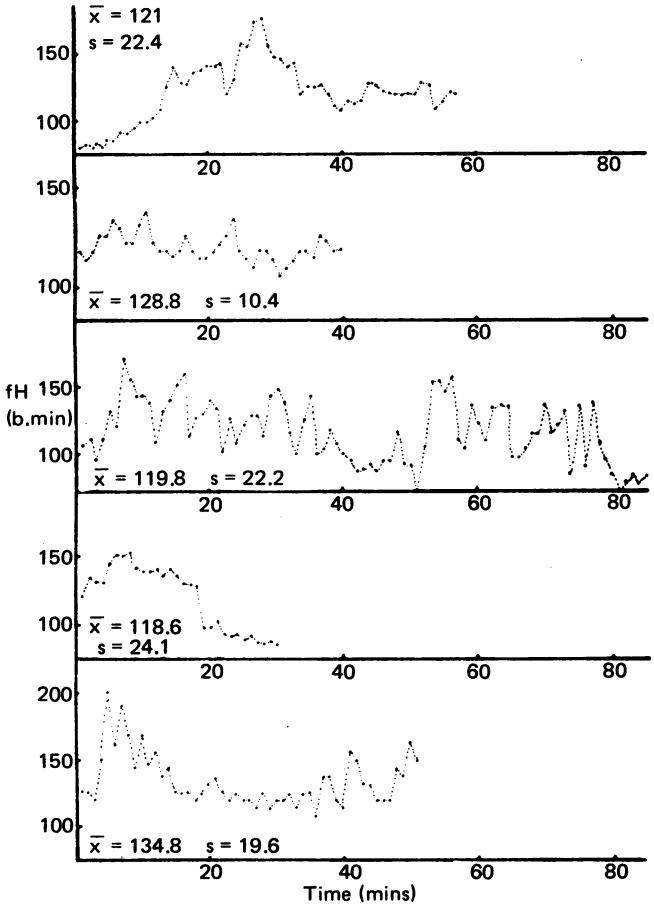

Figure 3. Heart Rates During Union Games

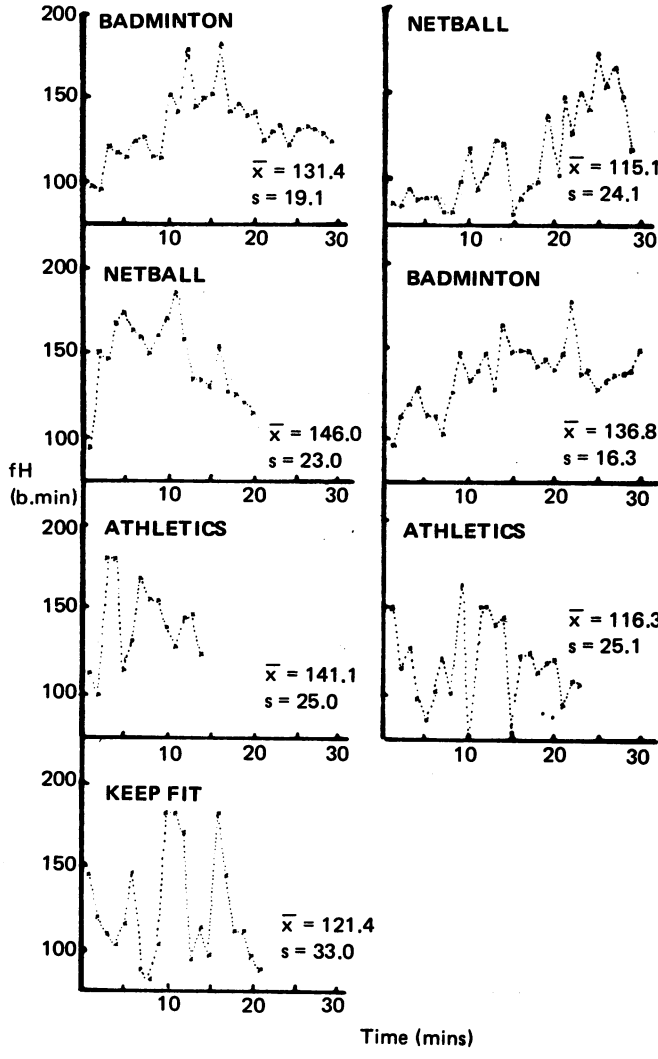

Figure 4. School Girl Heart Rates during P.E. Lessons

Furthermore Karvonen's general level of 140 b.min may be too low for healthy young subjects (Roskamm, 1967). Following Roskamm's procedure for obtaining individualised training fH, i.e. fHt = fHrest + 0.07 (fHmax − fHrest), the time working fH exceeded the minimum training rate fell to 37 minutes.

It may be argued that students taking a course of teacher-training are atypical, spending time observing and discussing rather than striving for organic improvement. This may be so, but the data from the SG group (Figure 4) are not markedly different. Out of the 176 minutes observed fH exceeded 140 b.min for 61 minutes and Roskamm's criterion for 13 minutes.

This evidence suggests that the physical education sessions monitored were not physiologically demanding enough to promote organic development to any marked degree. It is possible that neither the institutions, nor the individuals are representative but clearly further work in this area is necessary if physical education is to retain the unique quality it claims.

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