Heart rate variability, blood glucose concentration and aerobic fitness in moderate and highly physically active men and women

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Introduction

Heart rate variability (HRV) has been associated with cardiac autonomic health (Kleiger *et al.*, 2005). In addition, regular aerobic exercise has shown to be effective in improving blood glucose concentration (BGC) in men and women (Goulet *et al.,* 2005). However, little is known about the relationship between HRV, BGC and aerobic fitness in respect of different physical activity levels. Therefore the aim of the present study was to assess the relationship between HRV, blood glucose concentration and estimated maximal oxygen consumption (Est. VO_2max) in moderate and highly physically active men and women.

Figure 1. Blood glucose meter similar to that used in the present study.

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Methods

Subjects: Moderate (MA), (n=4) (mean $\pm s$) age: 25.0 ± 3.6 years; height: 1.74 ± 0.07 m; body mass: 75.2 ± 6.9 kg and highly physically active men and women (HA), (n=8) age: 24.3 ± 2.7 years; height: 1.75 ± 0.11 m; body mass: 67.9 ± 17.8 kg agreed to participate after giving informed consent. BGC was measured by means of a blood glucose meter (Fig. 1) after the ingestion of a 50 g glucose solution in 200 mL of water over 2-hours (Fig. 2). Est. VO_2max was assessed with a 6-min submaximal cycle ergometer test (Åstrand and Rhyming,1954). Heart rate and R-R intervals (RRI, ms) during 20-minutes quiet lying was measured using a short-range telemetry system (Polar S810i, Kempele, Finland). R-R interval data was analysed using time- and frequency-domain analysis together with non-linear (Poincaré plot, Fig.3) techniques (HRV Analysis Software, University of Kuopio, Finland).

Results

The Est. VO_2max was higher for HA *vs*. MA, 3.75 ± 0.72 *vs*. 2.98 ± 0.69 L min^{-1} respectively (NS). The RRI was greater in HA *vs*. MA (Table 1). There were no significant differences in time or frequency domain measures, except for LF ms^2. Similarly non-linear analysis failed to show any difference between groups (Table 1).
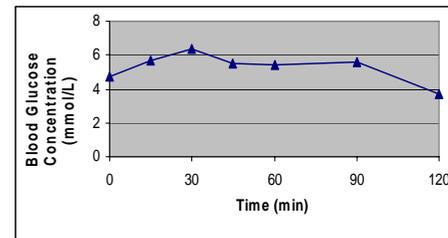

Figure 2. Blood glucose concentration over a 2h period of time.

Measure	MA	HA
TD (HR, b min^{-1})	66 ± 12	59 ± 7
TD RRI (ms)	936 ± 163	1039 ± 123
TD SDNN (ms)	55 ± 16	63 ± 13
FD HF (ms^2)	293 ± 231	740 ± 903
FD LF (ms^2)	487 ± 207	950 ± 512*
FD LF/HF ratio	2.35 ± 1.82	4.85 ± 5.71
Poincaré SD1 (ms)	32.8 ± 11.8	43.8 ± 16.3
Poincaré SD2 (ms)	89.8 ± 31.1	89.9 ± 20.4
Poincaré SD1/SD2 ratio	0.40 ± 0.21	0.49 ± 0.16

Table 1: TD, time-domain measures (SDNN; standard deviation of normal to normal [RR] intervals); FD, frequency-domain measures (HF: Total high frequency power, LF: Total low frequency power). Poincaré plot measures (SD1: Short-term HRV; SD2: Long-term HRV).* Significant difference between groups (P=0.05, Independent t-test).
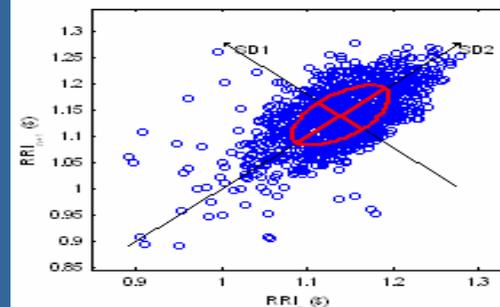

Figure 3. Poincaré plot from an HA individual.

Conclusion and Personal Evaluation

Parasympathetic activity was higher in HA *vs*. MA (Table 1), however, non-linear analysis (Fig. 3) failed to reveal significant differences between HA and MA. This may reflect underlying biological plasticity in young humans and the small numbers available for analysis. Having the chance to be an undergraduate research student has been a very interesting and exciting experience. I have had the opportunity to transfer the academic skills I have gained so far into real and concrete scientific settings. This research is still ongoing and it will be the basis for my final year interdisciplinary project here at Oxford Brookes University. I am sure this research project will greatly improve both my CV and the chance to obtain a place for a PhD studentship in Exercise Biochemistry once I have completed my undergraduate studies.