THE EFFECTS OF EXERCISE AND EXERCISE TRAINING ON CIRCULATING INSULIN-LIKE GROWTH FACTORS AND THEIR BINDING PROTEINS. P.M. Jakeman*, S. Jeal**, S. Cwyfan-Hughes*** and J.M.P. Holly*** *Department of Physical Education and Sport Science, University of Limerick, Ireland; **School of Sport & Exercise Sciences, University of Birmingham, Birmingham, UK; ***Department of Surgery, Bristol Royal Infirmary, Bristol, UK. INTRODUCTION

The insulin-like growth factors (IGFs) IGF-I and IGF-II have metabolic effects comparable to insulin and hypoglycaemic effects that are potentially 50-100 fold that of insulin. Circulating IGFs are associated with plasma binding proteins (IGFBPs) which are thought to regulate their bioactivity. Modification of the binding protein affinity for IGFs in the circulation thereby provides a subtle mechanism by which the insulin-like actions of IGFs can be controlled in relation to the metabolic requirements of the target tissues. The majority of IGFs are tightly bound to IGFBP-3 whereas IGFBP-1 contains the major source of unsaturated IGF binding sites in plasma. This study was conducted to investigate whether (i) the circulating concentration and distribution of IGFs and their binding proteins were modified by exercise and (ii) whether this response was altered in endurance trained athletes. METHODS

Using a randomised design four endurance-trained (ET; mean ±SD; VO2 max 74.4 ± 1.4 ml kg\(^{-1}\).min\(^{-1}\)) and four non-endurance trained (NT; VO2 max 50.2 ± 1.9 ml kg\(^{-1}\).min\(^{-1}\)) healthy young males undertook a prolonged treadmill exercise trial at 60% of their VO2 max to volitional fatigue on two occasions. Each exercise bout was separated by at least 7 days. On the day of the exercise trial subjects reported to the laboratory after an overnight fast. Blood samples, via indwelling cannulae, were collected at rest, every 60 min during exercise and at fatigue. Serum IGF-I, IGF-H, IGFBP-1 and IGFBP-3 were measured by specific radioimmunoassay and the data analysed by repeated measures ANOVA. Significance was accepted at the 0.05 level. The study was approved by the South Birmingham Health Authority Research Ethics Committee. RESULTS

The repeated exercise trials were found to be highly reproducible and for clarity the data have been presented as the mean ± SD at rest, for common time points during exercise and at fatigue. The circulating concentration of IGFs (IGF-I + IGF-II) was 16% higher in the endurance-trained subjects at rest and did not change in response to exercise. The data for the binding proteins (IGFBP-1 and IGFBP-3) was, however significantly different in the endurance-trained and non-trained subjects. Resting IGFBP-3 levels were approximately 20% lower and IGFBP-1 levels 12 fold higher in the endurance trained subjects. In response to the exercise challenge the pattern of reponse was similar for both groups of subjects. Exercise induced a slight, but non-significant, decrease in IGFBP-3 concentration and a large increase in IGFBP-1 concentration (Figure 1).
Figure 1. Serum IGFBP-1 and IGFBP-3 during prolonged exercise in trained and non-trained subjects (Significant difference: * from rest; * ET vs NT, * P<0.05.)

DISCUSSION
The changes in circulating IGFs and IGFBPs in response to exercise confirms our previous finding during prolonged cycle exercise to exhaustion (Hopkins et al 1994). The main finding of the present study was a modification of the binding proteins in the endurance-trained athletes with significantly lower circulating levels of the high affinity binding protein IGFBP-3 and significantly higher levels of the low affinity binding protein IGFBP-1. We propose that a higher concentration of the low affinity binding protein IGFBP-1 could facilitate the actions of IGFs by increasing the bioavailability of IGFs to the target tissues. With the known high density of receptors for IGF in muscle these modifications in the distribution of IGF within the circulation could facilitate glucose uptake into muscle during exercise. REFERENCE