International Congress Series 1304 (2007) 167–170

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Relationship between serum kynurenine concentration and exercise performance

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Abstract. We have hypothesized that a close correlation exists between tryptophan metabolism, exercise performance and mood. Before and after a 20-km run, a POMS test and serum L-kynurenine determination were performed. Serum L-kynurenine concentration was negatively correlated with running distance. After running, scores for Vigor and serum L-kynurenine concentration were correlated ($r=0.556$); subjects with higher L-kynurenine concentrations tended to have higher scores for Vigor. In this study, we attempted to confirm this hypothesis. The present results suggest a close correlation between tryptophan metabolism, exercise performance and mood.

Keywords: Serum kynurenine concentration; Regular exercise; Exercise performance; Mood

1. Introduction

The main pathway for tryptophan (Trp) metabolism in the central nervous system and peripheral tissue is the kynurenine (KYN) pathway, while the involvement of the serotonin pathway is small [1]. Newsholme et al. [2] proposed that serotonin produced from Trp in the brain is the main compound involved in exercise-induced central fatigue. Since then, it has been generally accepted that cerebral serotonin levels control exercise-induced central

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0531-5131/
doi:10.1016/j.ics.2007.07.044

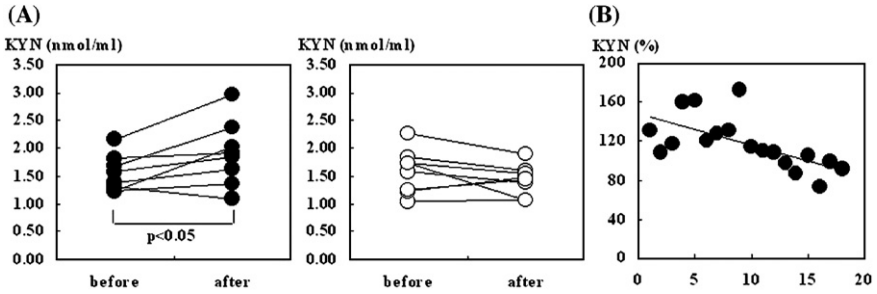

Fig. 1. Relationship between serum KYN concentration and exercise performance. In the long-distanced running, (A) serum KYN concentration increased with regular running habits (left) but did not increase in those subjects without exercise habits (right), (B) the change ratio of serum KYN before and after a 20 km run and the order of subjects were efficiently correlated ($r=0.504$).

fatigue. However, we found that levels of KYN in peripheral blood correlate well to exercise-induced subjective performance [3]. This suggests that exercise affects gluconeogenesis originating from Trp, that KYN pathway enzymes activated by exercise modify Trp to prevent it from passing the blood brain barrier, or that some Trp metabolites in peripheral organs produce neurotransmitters, energy source or fatigue substances.

Most of the early metabolic enzymes of the KYN pathway are tryptophan 2,3-dioxygenase (TDO: EC1.13.11.11), while some are indoleamine 2,3-dioxygenase (IDO: EC1.13.11.42). TDO exists in the liver and is activated by increased cortisol levels [4] as well as increased free Trp due to exercise. IDO is widely found in macrophages and organs other than the liver and is activated by factors that are released into blood by exercise, such as NO, free radicals and IFN gamma [4]. In other words, the KYN pathway appears to be activated by exercise [5]. We reported the possibility that long-term exercise habits affect Trp metabolism.

There have been few studies investigating the relationship between exercise and peripheral Trp metabolites, and ours is the first study to examine the relationship between KYN levels and exercise performance [5]. The objective of the present study is to determine

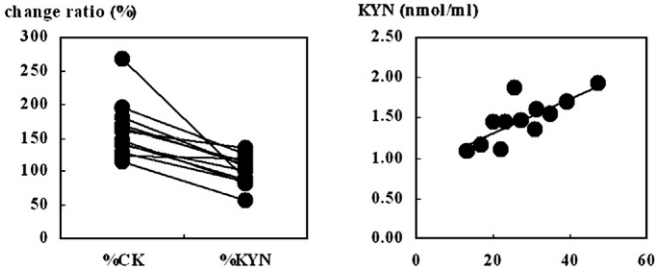

Fig. 2. Correlation between serum CK activity and serum KYN concentration after running 20 km ($r=0.761$) (left). CK activities of all subjects were increased but KYN concentrations were increased with 58% subjects and decreased with 42% subjects (right).