Moderate altitude has no effect on choice reaction time in international rugby players

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Abstract

There are only a few conflicting reports on the effects of moderate altitude on cognitive factors that could affect sporting performance. An investigation of choice reaction time in international rugby players at various altitudes was therefore carried out. The results suggest that moderate altitude has no significant effect on this parameter in highly trained competitive athletes.

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While it is well demonstrated that high altitude environments can result in psychological changes in unacclimatised individuals, relatively little research has been carried out into the effects of moderate altitude on cognitive factors that could affect sporting prowess.¹ For example, very slight impairment of concentration and reaction time may result in devastating effects on top quality athletic performance. The literature appears to indicate that increasing altitude is associated with prolongation of reaction time,^{2,3} particularly above 4000 m, although at more moderate altitudes, investigators have reported either no effect,⁴ or, paradoxically, slight improvements in psychomotor performance.⁵ Most of these studies have focused on extreme altitudes. Denison *et al.*,⁶ however, reported decrements in choice reaction time and learning at 2438 m, but more recently Paul and Fraser⁷ found no impairment at 3658 m.

As there appeared to be a relatively scant and conflicting literature on the subject, we carried out an empirical investigation of the effects of moderate altitude on choice reaction time in international rugby players, at sea level, during acclimatisation and before competitive play at altitude in South Africa.

Methods

Twenty six members of the Scottish international rugby squad participated as subjects. All were men of mean (SD) age 27.9 (3.4) years. The experiment involved a within subject repeated measures design. Each subject was assessed on five occasions: on two occasions in Edinburgh, Scotland, in order to provide baseline data at sea level (assessment 1 on 21 April 1995, assessment 2 on 29 April 1995), in Spain in the Pyrenees at an altitude of 1000 m in order to provide some degree of

acclimatisation (assessment 3 on 4 May 1995) and twice in Pretoria, South Africa (assessment 4 on 23 May 1995 and assessment 5 on 10 June 1995) at an altitude of 1600 m. Choice reaction time was measured using a Toshiba Lap Top IBM compatible portable computer. The Continuous Performance Task as described by Frith *et al.*⁸ was employed. Briefly, a series of large letters appeared in the middle of the computer screen at a rate of one per second. The subjects were instructed to press the space bar of the computer as quickly as they could whenever they saw an X but not to press the space bar when presented with any other letter, thus measuring choice reaction time. The letters appeared in a random order. The mean time taken to respond to ten Xs per subject was recorded in milliseconds.

Results

Figure 1 shows the results in a graphical form. There was no significant effect of time, altitude, or repeat assessment on choice reaction times: Edinburgh 1 (sea level) mean (SD) = 323.8 (43.2) milliseconds; Edinburgh 2 (sea level) 324.5 (43.6) milliseconds; Spain (1000 m) 325.6 (31.4) milliseconds; South Africa 1 (1600 m) 316.1 (31.0) milliseconds; South Africa 2 (1600 m) 316.7 (39.2) milliseconds; repeated measures analysis of variance, $F = 1.07$, $P = 0.38$.

Discussion

In this study we carried out assessments of choice reaction time in international rugby

Figure 1 Effect of altitude on choice reaction time in international rugby players.

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players on five occasions, twice at sea level, in order to create a baseline, and then again at 1000 m for acclimatisation and twice at 1600 m. There was no effect of time, repeat assessment, or altitude on choice reaction time. The results of this study therefore suggest that moderate altitude has no significant determinable effect on choice reaction time in highly trained international competitive athletes. It is possible that altitude did result in an increase in choice reaction time, but that this was cancelled out by the effects of practice/repeat assessment. We think this an unlikely explanation, as there was no significant improvement between assessments 1 and 2 (the baseline), where the greatest practice effects would have been expected. As stated in the Introduction, clear deleterious effects on psychomotor speed can be observed above 4000 m. However, it is still possible that subtle effects may occur at lower altitudes, but more sensitive measures would be needed to determine them.

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The shirt sign

I wish to describe "The shirt sign"—a new clinical sign in steroid abuse. This is a clinical observation made during examination of the respiratory system of known anabolic steroid users. The sign refers to the mode of removal of the shirt and may be of two varieties.

The T-shirt. Instead of reaching behind the neck and pulling the T-shirt over the head in a haphazard and often undignified fashion, the steroid user crosses his arms in front of his body to grip the lower hem of his shirt and removes it in a graceful, flowing motion accompanied by progressive isometric contraction of the exposed upper body musculature.

The buttoned shirt. Patients usually loosen the top two buttons and then rapidly pull the shirt over the head. The steroid user slowly unbuttons from the top downwards while

increasingly contracting latissimus dorsi and pectoralis major and, occasionally, deltoid muscles. This causes some difficulty in the undoing of the lower buttons as they disappear from view below the hypertrophied muscles. With the aforementioned muscles contracted, upper limb movement also becomes more restricted.

Auscultation of the respiratory system can be difficult as patients find it impossible to inhale fully and exhale smoothly while maintaining an impressive pose.

These observations are based on only two patients and I require validation in large scale case-control and prospective studies.

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