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Effect of the pacing strategy during half-duration resistance test on the mechanic, metabolic and cardio-respiratory response

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ABSTRACT

Objective: Changes in pacing rhythm are translated into functional and metabolic changes that can be significantly reflected in the final results of an athlete.
Method: Ten male subjects, with moderate performance level (age: 25.2 ± 2.2 years; VO_{2max}: 56.9 ± 5.7 ml kg^{-1} min^{-1}), performed four 5-min races with different pacing strategies: constant-pace (CP), record-pace (RP), kicker-pace (KP), incremental-pace (IP).
Results: The cardio-respiratory response did not show statistically significant. There were statistically significant differences ($p \leq 0.05$) in the energetic efficiency among the protocols CP vs. RP, CP vs. KP and RP vs. IP. When results were analyzed by partials (1-min duration phases), significant differences were observed in the energetic efficiency during the 3rd-min among CP vs. KP, RP vs. KP and KP vs. IP. These significant differences were extended to the 4th-min when comparing CP vs. IP, CP vs. KP, KP vs. RP and KP vs. IP. In the last minute of the test, there were significant differences among CP vs. KP. No significant differences were found in any of the variables assessing anaerobic metabolism (accumulated oxygen deficit, oxygen debt, oxygen uptake kinetics and blood lactate) between both protocols.
Conclusions: Results suggest that the main functional systems response are significantly affected by the pacing strategy used by middle-level subjects during middle-distance running.

Efecto de la estrategia en carrera durante un test de resistencia de media duración en la respuesta mecánica, metabólica y cardiorespiratoria

Palabras clave:
Test de resistencia
Respuesta metabólica
Respuesta cardiorespiratoria
Respuesta mecánica
Estudiantes

RESUMEN

Objetivo: Los cambios en el ritmo de carrera se traducen en cambios funcionales y metabólicos que pueden reflejarse significativamente en los resultados finales de un atleta.
Método: Diez sujetos varones, con un nivel medio (edad: 25.2 ± 2.2 años; VO_{2max}: 56.9 ± 5.7 ml•kg^{-1}•min^{-1}), llevaron a cabo carreras de 5 minutos con diferentes estrategias: ritmo constante (RC), ritmo récord (RR), ritmo kicker (RK) y ritmo incremental (RI).
Resultados: La respuesta cardiorespiratoria no mostró diferencia estadísticamente significativa. Hubo diferencias estadísticamente significativas ($p \leq 0.05$) en la eficiencia energética entre los protocolos CP vs. RP, CP vs. KP and RP vs. IP. Cuando los resultados se analizaron por parciales (fases de un minuto de duración), se observaron diferencias significativas en le eficiencia energética durante el tercer minuto entre RC vs. RK, RR vs. RK y RK vs. RI. Estas diferencias significativas se extendieron al cuarto minuto cuando se compararon RC vs. RI, RC vs. RK, RK vs. RR y RK vs. RI. En el último minuto del test, hubo diferencias significativas entre RC vs. RK.

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No se encontraron diferencias significativas en ninguna de las variables que valoran el metabolismo anaeróbico (déficit de oxígeno, deuda de oxígeno, cinética del consumo de oxígeno y lactato en sangre) entre ambos protocolos.
Conclusiones: Los resultados sugieren que la respuesta de los principales sistemas funcionales se ve afectada significativamente por la estrategia de carrera empleada por un grupo de sujetos de nivel intermedio durante una carrera de media distancia.

Efeito da estratégia de corrida durante teste de resistência de meia-duração na mecânica, resposta metabólica e cardio-respiratória

R E S U M O

Palavras-chave:
Teste de resistência
Resposta metabólica
Resposta cardiorrespiratória
Resposta mecânica
Estudantes

Objetivo: Alterações no ritmo de corrida se traduzem em mudanças funcionais e metabólicas que podem ser refletidas de forma significativa nos resultados finais de um atleta.
Método: Dez indivíduos do sexo masculino, com nível de desempenho moderado (idade: 25.2 ± 2.2 anos; VO2máx: 56.92 ± 5.7 ml · kg-1 · min-1), realizaram quatro corridas de 5 minutos com diferentes estratégias de corrida: velocidade constante, velocidade recorde, velocidade *kicher* e velocidade incrementada.
Resultados: A resposta cardiorrespiratória não demostrou estatisticamente significativa. Houve diferenças estatisticamente significativas ($p \leq 0.05$) na eficiência energética entre os protocolos CP vs. RP, CP vs. KP and RP vs. IP, quando os resultados foram analisados por parciais (1 min de duração). Foram observadas diferenças significativas na eficiência energética durante o 3°-min entre CP vs. KP, RP vs. KP e KP vs. IP. Estas diferenças significativas foram estendidas para o 4°-min na comparação CP vs. IP, CP vs. KP, CP vs. KP, KP vs. RP e KP vs. IP. No último minuto do teste, houve diferenças significativas entre CP vs. KP. Não foram encontradas diferenças significativas em nenhuma das variáveis que avaliam o metabolismo anaeróbico (déficit de oxigênio acumulado, débito de oxigênio, cinética do consumo de oxigênio e lactato no sangue) entre ambos os protocolos.
Conclusões: Os resultados sugerem que as principais respostas dos sistemas funcionais são afetadas significativamente pela estratégia de corrida usado por indivíduos de nível médio durante a meia-corrida de longa distância.

Introduction

The effort distribution and the energetic requirements during a cyclic modality are called *pacing* or *pacing strategy*,[1,2] thus being considered as a determinant factor in the final test result.[1,3,4] The pacing strategy is defined as the velocity variation during a pace by regulating the ratio of energy expenditure[4] and is proposed to be a marker of underlying physiological regulation.[5] The way of distributing the effort depends on the type of event or objective record, the performance duration,[2] the runners' characteristics resistant and the environment conditions.

There is no consensus about classifying the tactical variants that can be observed in the middle-distance and long-distance races,[6,7] although the most efficient *pacing strategy* in a middle distance running appears to be the *Parabolic-Shaped Pacing* (*U-Shaped*, *Reserve J-Shaped* and *J-Shaped*).[8] That is to say, a faster exit, followed by gradual decrease in the mean distance of the event and final acceleration.

In this type of tests, the velocity variations range between 5 and 10%.[9–11] Sometimes, the *U-shaped* strategy shows very low decreases in the race rhythm at half of the race, showing a tendency to a stable rhythm (*even pacing*). These race rhythm behaviors can be checked up on when analyzing the main international athletic competitions (Olympic Games, World Championships, European Championships or World Records).

Thus, voluntary or involuntary changes during the test rhythm are translated into functional and metabolic changes[2,12] that can even be significantly reflected in the final result as well as in the athlete's capacity.[13] However, there is no concrete knowledge about how does the organism respond to changes in the race strategy.[10] There is also no accurate idea of the objective causes that underlie the reasons why athletes are inclined to the use of either race strategy during competition. Neither is still not completely understood how athletes regulate their speed to optimize performance in supramaximal races such as middle-distance events.[10]

The aim of the present study was to detect, in intermediate level subjects, if changes in the race strategy (5-min treadmill running) cause changes in the mechanical of the race, energetic consumption, metabolic response and cardio-respiratory response during a middle-distance race performed at high (not maximal) intensity.

Method

Subjects

We evaluated 10 subjects, male physical education students (age: 25.2 ± 2.2 years; body weight: 69.8 ± 5.5 kg; height: 175.7 ± 3.2 cm; fat percentage: 8.2 ± 1.3%; VO_{2max}: 56.9 ± 5.7 ml kg^{-1} min^{-1}) with moderate performance level.

The study was approved by the Research Ethics ommitee of ULPGC (Spain), in accordance with the regulations of resolution of National Council on Ethics in Human Research and in accordance with the Declaration of Helsinki.

During the sample recruitment, the subjects were concretely informed about the investigation nature to which they were going to be submitted, as well as the possible risks of being experimental subjects. Once they accepted to be part of the study, they signed their agreement in a consent document. In this document, they expressed their accordance with what mentioned above, specifying the following aspects: (a) ethic criteria, in which the

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