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ARTICLE ORIGINAL

The effect of body fluid balance on cycling peak power

Influence de l'état d'hydratation sur le pic de puissance en cyclisme

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Summary
Objective. — Dehydration impairs aerobic performance but the influence of dehydration and rehydration on cycling peak power is contradictory. The purpose of the study was to evaluate both the influence of body dehydration and the influence of rehydration on the level of cycling peak power.
Methods. — Cycling peak power (CPP) was measured 3 times in 12 healthy males: in baseline testing, next after dehydrating the body using passive heat exposure (sauna), and after the sauna, with simultaneous hydration (in random order).
Results. — The level of total work, CPP and time to attain peak power were comparable with the dehydration (1.9% of body mass) during and after the sauna combined with the systematic replenishment of isotonic drinks, and was significantly ($P < 0.05$) higher (with the exception of the time to attain cycling peak power) in relation to the initial measurement. The absolute CPP increased about 20 W on average after dehydration, and 25 W on average after the sauna with rehydration. The relative cycling peak power significantly increased after dehydration (11.6 ± 0.6 W·kg-1) and after passive heat exposure with rehydration (11.6 ± 0.7 W·kg-1) in comparison to the initial level (11.2 ± 0.4 W·kg-1).
Conclusion. — The present results suggest that CPP was not affected by body fluid balance alterations. The research results show that moderate dehydration does not impair cycling peak power.

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MOTS CLÉS
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Exercice supramaximal

Résumé
Objectifs. — L'état de déshydratation altère les performances aérobies, alors que les effets de la déshydratation-réhydratation restent contradictoires. Le but de cette étude a été d'évaluer l'influence à la fois de la déshydratation et de la réhydratation sur le pic de puissance développé au cours d'un exercice de pédalage.
Méthodes. — Le pic de puissance (PP) a été mesuré 3 fois au cours d'un exercice de pédalage, chez 12 hommes en bonne santé, et dans 3 circonstances différentes : dans les conditions standards, après une déshydratation induite par l'exposition passive en sauna, et après un enchaînement déshydratation/réhydratation. L'ordre d'exposition à ces 3 situations a été défini de manière aléatoire.
Résultats. — Le travail total, le PP et le temps mis pour atteindre ce pic de puissance ont été similaires dans les situations de déshydratation (perte de 1,9 % du poids corporel) et de déshydratation/réhydratation au moyen de boissons isoosmolaires. Par contre, les valeurs mesurées du travail total et du PP ont été supérieures à celles mesurées dans les conditions standard ($p < 0,05$). Les valeurs du PP ont augmenté approximativement de 20 W après la déshydratation, et de 25 W à l'issue de la situation de déshydratation/réhydratation. Les valeurs relatives de PP ont augmenté après la déshydratation et après la déshydratation/réhydratation (valeurs respectives de $11,6 \pm 0,6\ W \cdot kg^{-1}$ et $11,6 \pm 0,7\ W \cdot kg^{-1}$) comparativement aux valeurs standard qui étaient de $11,2 \pm 0,4\ W \cdot kg^{-1}$.
Conclusion. — Les valeurs de PP mesurées au cours d'un exercice de pédalage ne semblent pas être affectées par les perturbations de l'équilibre hydrominéral. Un état modéré de déshydratation n'altère pas les valeurs de PP.

Introduction

The negative influence of the body's dehydration on aerobic performance is well documented [1—7]. The dehydration of 2% of total body mass significantly decreases the aerobic performance [2]. On the other hand, previously published data concerning the influence of dehydration and rehydration on anaerobic performance is contradictory [8]. In some of the published data, we can observe a decrease in anaerobic power [3,7,9—11], whereas in other studies, there is no evidence showing the impairment of anaerobic power due to dehydration [12—14]. From analysis of the published research, we can infer that the method of triggering the body's dehydration (sauna, diuretic medicine, physical effort or hot baths), the kind and amount of applied liquid, and obviously, the level of dehydration, have a decisive influence on the obtained results. The various results obtained in the research mainly evaluated muscle strength or anaerobic performance and usually took only the effects of dehydration into account. However, the results might have been affected by other factors such as the choice of participants (active or inactive in sports), dehydration combined with diet, dehydration through effort that causes muscle fatigue, or test type [8]. Therefore, the interaction between testing modes, dehydration modes and levels, hyperthermia or not, performance and recovery duration can strongly influence the interpretation of the final results.

This study was designed to elucidate the separated and combined effects of hypohydration and hyperthermia on cycling peak power (CPP) when passive heat exposure is used. The objective is important for many sports and occupations where hypohydration induced by passive heat exposure occurs and high levels of anaerobic power are required (i.e. strength-speed-power activity). While in a sauna, only three factors that can influence the level of anaerobic power have impact on the body: dehydration; high temperature causing hyperthermia; increased muscle temperature. For this reason, the aim of the study was to evaluate the influence of body dehydration in a sauna, as well as the influence of rehydration on the level of cycling peak power.

Methods

Participants

Procedures were carried out in accordance with the ethical standards of the committee responsible for human experimentation and with the Helsinki Declaration of 1975, as revised in 1983. All participants were given information on the procedures and signed an informed consent form approved by the local Ethics Committee.

Twelve healthy, non-training but physically active males (light to moderate exercise ≥ 3 times per week) aged 24—25, participated in the study. The average body height of the participants was 180.27 ± 3.3 cm; average body mass was 78.44 ± 8.33 kg. Fat-free body mass was on average 66.38 ± 5.6 kg, and the body fat percentage was 15.13 ± 3.67%. The body mass index (BMI) ran at a level of 24.14 ± 2.55.

Procedures

The sauna was chosen to dehydrate the volunteers. The research comprised measurements of indicators of body composition and cycling peak power in the 10-s maximal cycling sprint (MCS). Prior to the main part of the study, the males were familiarized with the exercise test. During the main part of the study, the cycling peak power