UNIVERSIDADE FEDERAL DE MINAS GERAIS

ESCOLA DE EDUCAÇÃO FÍSICA, FISIOTERAPIA E TERAPIA OCUPACIONAL

TERMORREGULAÇÃO E PERFORMANCE EM RATOS DURANTE EXERCÍCIO PROGRESSIVO EM DIFERENTES FASES DO CICLO CIRCADIANO

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BELO HORIZONTE

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Trabalho de conclusão de curso elaborado pelo aluno de graduação em Educação Física **Frederico Sander Mansur Machado**, sob orientação do Prof. Dr. Cândido Celso Coimbra (ICB – UFMG).

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Trabalho de Conclusão de Curso aprovado pela Escola de Educação Física, Fisioterapia e Terapia Ocupacional (EEFFTO) da Universidade Federal de Minas Gerais (UFMG) como requisito parcial para obtenção do grau de Graduado em Educação Física, em ____ de Julho de 2010.

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RESUMO

O presente trabalho tem o objetivo de analisar a temperatura corporal interna (T_b) e a atividade locomotora espontânea (ALE) além da performance durante o exercício incremental até a exaustão em ratos machos em diferentes fases do ritmo circadiano.

Os ritmos circadianos da atividade locomotora e temperatura corporal de ratos Wistar adultos (n = 11) foram registradas continuamente através de um sensor de telemetria (G2 E-Mitter Mitter Mini-Empresa, Oregon, EUA) implantado intraperitonealmente. Após a avaliação do ritmo circadiano, os animais foram familiarizados ao exercício em esteira motorizada durante cinco dias consecutivos e, em seguida, submetidos ao protocolo de teste incremental de exercício até a fadiga no início da fase clara e escura do ritmo circadiano claro/escuro. Cada teste foi separado por três dias. Os animais começavam correndo a uma velocidade inicial de 10 $m.min^{-1}$ e aumentos de 1 $m.min^{-1}$ a cada 3 min eram realizados até a fadiga. A inclinação da esteira foi mantida constante em 5^o. As temperaturas pré-exercício e pós-exercício foram monitoradas. O tempo total de exercício (TTE), carga de trabalho realizado (W) e a temperatura interna (ΔT_b) foram registrados.

Como esperado, as médias circadianas de ALE e T_b observadas durante escuras foram maiores quando comparadas as da fase clara. A ALE durante a fase escura foi aproximadamente 70% superior ao correspondente da fase clara ($p < 0,0001$). A T_b observada durante a fase escura foi maior do que a observada durante a fase clara ($p<0,0001$). Por outro lado, o exercício realizado no início da fase clara apresentou um tempo total de exercício (TTE), hipertermia (ΔT_b), taxa de aumento de temperatura e taxa de acúmulo de calor maiores do que os observados durante a fase escura ($p<0,05$). A TTE durante a fase clara foi aproximadamente 10% maior ($p<0,05$) do que os observados durante a fase escura. O trabalho realizado foi 30% maior ($p<0,01$) durante a fase clara do que o observado em relação à fase escura. Todas as variáveis de temperatura relacionadas ao exercício apresentaram diferenças significativas entre as fases. A taxa de aumento de temperatura ($^oC.min^{-1}$) da fase

escura foi superior a observada durante a fase clara (*p<0,05*). A taxa de armazenamento de calor foi 80% (*p<0,01*) maior do que a da fase escura correspondente. Os animais com maior carga de trabalho durante a fase escura apresentou os melhores resultados de carga de trabalho também durante a fase clara (r=0,89, *p<0,001*). Uma relação direta da atividade locomotora espontânea circadiana e a capacidade de exercício foi observada apenas durante a fase clara mostrando uma relação positiva entre ALE (específica à fase clara) e o W realizado (r = 0,75, *p<0,01*).

Em conclusão, os resultados mostraram que ratos em condições ambientais normais de temperatura apresentaram melhor desempenho em protocolos de exercício progressivo durante a fase inicial do período claro e esta foi acompanhada por diferenças na termorregulação pré e pós-exercício. Além disso, apesar das diferenças entre a capacidade de exercício e termorregulação em duas fases circadiano, atividade locomotora espontânea circadiana estão relacionadas com a capacidade de exercício apenas durante a fase clara.

ABSTRACT

The aims of the present study were to analyze responses to incremental exercise in male rats in different phases of light/dark circadian rhythm of body temperature (T_b) and spontaneous locomotor activity (LA).

Circadian locomotor activity and body temperature of adult male Wistar rats (n=11), were continuously recorded using an previously implanted (i.p.) telemetric sensor (G2 E-Mitter Mini-Mitter Company, Oregon, EUA). After circadian rhythm recording, animals were familiarized to a motor-driven treadmill during five consecutive days and then submitted to an incremental exercise test protocol until fatigue during early light and dark-phases of activity. Each test was separated for 3 days. During the graded test, animals started running at an initial speed of 10 $m.min^{-1}$ and increased by 1 $m.min^{-1}$ every 3 min until fatigue. Treadmill inclination was held constant at 5^o. Pre-exercise and post-exercise temperature was monitored. Time to fatigue (TTF), workload (W) and body temperature (ΔTb) were registered.

As expected, circadian dark-phase LA and T_b were higher when compared to light-phase. Dark-phase LA was 70% higher than light-phase correspondent ($p<0.0001$). Dark-phase T_b was higher than light-phase ($p<0.0001$). In contrast, light-phase exercise time to fatigue (TTF), hyperthermia (ΔT_b),body heat rate (BHR) and heat storage rate (HSR) were higher than dark-phase ($p<0.05$). Light-phase TTF was 10% higher ($p<0.05$) than dark-phase. It was observed a 30% higher ($p<0.01$) light-phase W compared to dark-phase. Temperature exercise-related variables showed significant differences between phases. Dark-phase body heat rate was higher than light-phase correlate ($p<0.05$). Light-phase heat storage rate was 80% higher ($p<0.01$) than dark-phase correspondent. Animals with higher workload during dark-phase also showed better workload results during light-phase (r=0.89, $p<0.001$). There was a direct relationship of circadian activity and exercise capacity at light phase with a positive relationship between LA and W (r=0.75, $p<0.01$).

In conclusion, results demonstrated that rats under normal environmental conditions showed better graded exercise performance during early light-phase and this was accompanied by differences in thermoregulation pre and post-exercise. Besides, despite the differences between exercise capacity and thermoregulation at two circadian phases, circadian locomotor activity was related to exercise capacity only during light-phase.

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