# Journal of Medical Sciences

ISSN 1682-4474

science alert

ANSInet
an open access publisher
http://ansinet.com

Research Paper

*JMS (ISSN 1682-4474) is an International, peer-reviewed scientific journal that publishes original article in experimental & clinical medicine and related disciplines such as molecular biology, biochemistry, genetics, biophysics, bio-and medical technology. JMS is issued eight times per year on paper and in electronic format.*

*For further information about this article or if you need reprints, please contact:*

Marwan S.M. Al-Nimer
Department of Pharmacology,
College of Medicine,
Al-Mustansiriya University,
P.O. Box 14132, Baghdad, Iraq

Tel: 07902600291

J. Med. Sci., 7 (8): 1345-1349
15th November, 2007

# Gender Differences in Psychomotor Performance After Six Minutes Cycling Exercise

Marwan S.M. Al-Nimer and Hayder M.K. Al-Kurashy

The purpose of the present study was to explore the effect of interaction between gender and cycling exercise on the psychomotor performance. Fourteen young subjects (7 women and 7 men) underwent 6 min cycling at constant speed of 30 m $min^{-1}$ and then their psychomotor performance was assessed after exercise. Results show that 6 min cycling exercise is significantly ($p<0.05$) improved the critical flicker fusion threshold tasks in women but not in men. The effect of exercise on sensorimotor performance does not reach to the level of significance ($p>0.05$). We conclude that six minute cycling exercise at a constant speed and work interacts with gender in improving the cognitive function.

**Key words:** Reaction time, flicker fusion, cycling exercise

ANSInet
Asian Network for Scientific Information

Department of Pharmacology, College of Medicine,
Al-Mustansiriya University, P.O. Box 14132, Baghdad, Iraq

## INTRODUCTION

The effects of exercise on psychomotor performance and cognitive function have been studied using wide variety of task modalities.

The influence of exercise as external factor is differed in respect to function of employed exercise protocols (Tomporowski, 2003). As a result of interaction between visual stimulus intensity and the exercise, the Critical Flicker Fusion (CFF) frequency threshold is increased (Davranche *et al*., 2005). In general, the alerting effect of exercise is noticed during modest intensity of short duration (aerobic and anaerobic exercise) (Brisswalter *et al*., 2002). This alerting effect is disappeared when long term sub-maximal exercise, leading to considerable and a persistent form of central fatigue, was practiced (Presland *et al*., 2005). Although at exhaustion level of exercise both the information processing and memory function were depressed but the increment in CFF threshold did not correlate with central fatigue (Presland *et al*., 2005). Moreover, Grego *et al*. (2005) found significant decrease in CFF performance at 120 min of exercise when compared with first 20 min.

Moderate sub-maximal cycling or intermittent exercise improved choice reaction time task (Davranche and Audiffren, 2004; Greig *et al*., 2007). Cycling exercise modified both peripheral motor and sensory processes (Davranche *et al*., 2006). This improvement during exercise is most likely explained by increase arousal state due to elevation of the plasma cortical concentration of catecholamines (Chmura *et al*., 1998; Grego *et al*., 2004). There were evidences that reaction time task did not improve after exercise (McMorris *et al*., 2005a) or with low exercise intensity (Davranche and Audiffren, 2004).

In present study we test the hypothesis that the improvement of integrative activity of central nervous system and sensorimotor performance followed 6 min cycling exercise seemed to interact with gender factor. The CFF-test and Choice Reaction Time (CRT) task are used in this study.

## MATERIALS AND METHODS

The study was conducted in department of pharmacology, college of medicine, Al-Mustansiriya University in Baghdad-Iraq during 2005. An independent scientific committee revised and approved the study protocol and the information provided to the volunteers. Subject's written consent was obtained prior to the enrollment in the study. A total number of 14 healthy volunteers (7 females and 7 males) are able to comply with the study protocol and who had provided written informed consent, were allocated from medical students of the same class.

All volunteers were free from any psychiatric disorders, epilepsy or evidence of drug addiction (including alcohol) or any disorder that interfered with CFF-test and CRT task. The subjects had a mean age of 20±0.3 years (20-21 years range).

The study involved two assessments of CFF-test and CRT task, one before exercise (baseline measurement) and the other immediately after 6 min anaerobic cyclic exercise.

**CFF test:** CFF test, as a measure of overall central nervous system activity, was carried on by the Leeds psychomotor test battery. A training period of the test was allowed and encouraged. The unit of Leeds psychomotor test battery is operated in darkened room, the device records and immediately calculates and lists the results. The tester includes 4 red light emitting diodes placed into the corners of a 10 mm square over a black panel. The subject should sit in front of CFF to ensure a distance of 1 m from the eyes to the instrument, so that it can be visualized binocularly and projected in the retinal area and then is required to discriminate flicker in the light. The flicker occurs at a constant frequency, rising or falling (from 1 Hz to 12-50 Hz). On a rising trial the subject sees the four red light flickering and should press the button as soon as they appear to fuse (ascending) i.e., fusion threshold, while on a falling trial the light initially appear to be fused and the subject is required to press the response button as soon as he/she perceives the flicker (descending) i.e., flicker threshold. Individual thresholds are determined by the psychological method of limits on five ascending (flicker to fusion) and five descending (fusion to flicker) scale (Schwartz, 2004). To ensure the reliability of the CFF test, the same apparatus, methodology and experimental techniques were used.

The average of ascending and descending flicker-fusion frequency thresholds representing the classical sensory sensitivity criterion was calculated for each subject. In addition, the mean ascending and descending threshold difference (fusion (ascending)-flicker (descending) was individually calculated to assess the subjective judgment criterion (Davranche and Pichon, 2004). A decrease in the CFF threshold is indicative of a reduction in the overall integrative activity of the central nervous system.

**Psychomotor performance test:** Leeds psychomotor performance instrument was used to assess the psychomotor performance in term of CRT. The CRT task in milliseconds is used as indicator of sensorimotor performance assessing the ability to attend and respond to a critical stimulus. Subjects place the index finger of their preferred hand on a central button and are instructed to extinguish the response button immediately in front of the light as quickly as possible. The mean of 10 consecutive presentations is recorded as a response measure of three components of reaction times: Recognition, motor and total reaction times. Recognition Reaction Time (RRT) is the time takes for the subject to notice the light begins i.e., the time between stimulus onset and the subject's lifting of his finger from the start button. Motor Reaction Time (MRT) indicates the movement component of this task and is the time between subjects' lifting of his finger from the start button and touching the response button. Total Reaction Time (TRT) is the sum of RRT and MRT.

**Exercise test:** The exercise test is done by cycling on an ergometer (TUNTURI:83501, OY Ltd., Germany). This type of ergometer allows the user to measure time, pulse, distance, energy consumption (Kcal), effort (watt) and speed. Pulse is measured by using ear pulse sensor. The subject is asked to perform cycling task at 75 watt power and a constant speed of 30 m $min^{-1}$ for 6 min, then the CFF test and CRT task are immediately assessed. The pulse rate is increased after cycling from 67±3 to 81±4 (in women) and from 73±3 to 87±3 (in men).

**Statistical analysis:** The results are described as mean±SD and they are analyzed by using Student's t-test (paired and unpaired two tailed) and simple correlation test staking probability of less than 0.05 as the lowest limit of significance.

## RESULTS AND DISCUSSION

Table 1 showed no significant differences ($p>0.05$) in baseline data of CFF frequency threshold i.e., there was insignificant difference in integration activity of central nervous system between males and females.

The ascending (fusion) threshold was significantly ($p<0.05$) improved by 6 min cycling exercise in females while it was significantly ($p<0.05$) deteriorated in males. Cycling exercise did not show significant ($p>0.05$) effect on descending (flicker) threshold both in males and females (Table 1).

The classical sensory sensitivity criterion was not significantly ($p>0.05$) altered by 6 min cycling exercise in both sexes while subjective judgment criterion was significantly ($p<0.05$) improved in females but not in males (Table 1). There were significant correlations between the measurements before and after cycling for classical sensory sensitivity criterion ($R = 0.757$, degree of freedom = 12, $p<0.05$) and subjective judgment criterion ($R = 0.555$, degree of freedom = 12, $p<0.05$). There were no significant ($p>0.05$) differences between males and females in their baseline reaction times (Table 2). Although 6 min cyclic exercise improved the MRT in females and males by 10.5 and 0.5%, respectively but the difference did not reach to the level of significance ($p>0.05$) (Table 2). Six minutes cyclic exercise showed negligible effect on RRT in both sexes (Table 2).

Six minutes cycling exercise is significantly enough to improve the integrative activity of central nervous system in women while the sensori-motor performance, in both sexes, does not significantly alter.

Most authors explored the beneficial effect of submaximal exercise at variable percents of maximal oxygen uptake ($VO_2$ max) (Harada *et al*., 2004; Kayser, 2003; Petruzzello *et al*., 2001; Petruzzello and Tate, 1997). In this work, the assessment marker of $VO_2$ max is not used and it substituted with 6 minutes anaerobic cycling, at constant speed of 30 m $min^{-1}$ and 75 watts effort, in an attempt to explore the significant importance of six minutes cycling. Such exercise is not enough to illicit metabolic (like blood lactate) or hormonal changes (McMorris *et al*., 2005b, 2006) as mentioned by others. Literature survey revealed that the effect of 6 min cycling exercise on cognitive function is not reported by authors. An exercise test of two 60 sec maximal cycling bouts has been reported but such type of exercise induces some metabolic changes (Crowe *et al*., 2006). Therefore the reported results may be solely related to the direct effect of exercise rather than from the effects of body response to the exercise. Women had non significant lower baseline flicker and fusion thresholds than men. Blatter *et al*. (2006) found that women, independent of age, exhibited significantly slower reaction times than men in psychomotor vigilance task performance.

Six minutes cycling at a constant speed of 30 m $min^{-1}$, can be considered as a low-intensity exercise, interact with gender factor in enhancing the cognitive function in women. The results reported in this work are in agreement with the results of Davranche and Audiffren (2004) who found that cycling improved the cognitive performance as assessed by CFF test. Also Raghuraj and

Table 1: The results of critical flicker fusion frequency threshold test

| | Females (n = 7) | | Males (n = 7) | |
|---|---|---|---|---|
| Variables | Before cycling | After cycling | Before cycling | After cycling |
| Ascending (fusion) threshold frequency (Hz) | 29.925±1.107 | 31.210±0.756* | 30.112±1.918 | 29.928±1.893* |
| Descending (flicker) threshold frequency (Hz) | 33.200±2.311 | 31.036±2.439 | 33.936±2.423 | 33.982±2.723 |
| Mean of fusion (ascending) + flicker (descending) | 31.562±1.266 | 31.123±1.155 | 32.023±1.436 | 31.955±1.665 |
| Δ = fusion (ascending)-flicker (Descending) | -3.275±2.591 | 0.174±2.776* | -3.823±3.295 | -4.053±3.303 |

The results are expressed as Mean ± SD of number of observations.* $p<0.05$

Table 2: The results of psychomotor performance test

| | Females (n = 7) | | Males (n = 7) | |
|---|---|---|---|---|
| Variables | Before cycling | After cycling | Before cycling | After cycling |
| Total reaction time (msec) | 552±29 | 535±30 | 540±38 | 537±23 |
| Recognition reaction time (msec) | 333±33 | 337±34 | 327±6 | 329±31 |
| Motor reaction time (msec) | 219±30 | 196±4 | 213±38 | 208±35 |

Telles (1997) showed that CFF threshold is significantly varied with the pattern of exercise in 12-16 years old girls. Girls who had learned yoga for 6 months showed significant improvement in CFF test in comparison with those who had physical activity training for 6 months.

The baseline data of choice reaction time showed non-significant difference between women and men. In respect to the pattern and type of test, Mekarski *et al.* (1996) showed that men were slower than women over trial blocks of some 46 milliseconds while Lock and Berger (1993) demonstrated that men were reacted faster than women in simple reaction time task. This discrepancy may be related to the fact that women were more variable in reaction time than men (Reimers and Maylor, 2006). However, there is no doubt that there is a difference in reaction time task between men and women. Li *et al.* (2006) found that there is regional activation of motor circuitry brain areas in men while the visual association area is activated in men during Stop Signal Performance task as assessed by functional magnetic resonance image.

Six minutes cycling exercise failed to show significant improvement on MRT or RRT. Similar results were reported by Brisswalter *et al.* (2002). Small benefit of exercise on CRT task was observed during exercise but not after it and at intensity higher than that reported in this research.

Further study is recommended to practice mild cycling exercise on patients complained from defect in their cognitive functions in an attempt to improve their quality of life.

## CONCLUSIONS

We conclude that 6 min cycling exercise at a constant speed and work is interacted with gender and this interaction is sufficient to improve the cognitive function but not the sensorimotor performance.

## REFERENCES


Blatter, K., P. Graw and M. Munch *et al.*, 2006. Gender and age differences in psychomotor vigilance performance under differential sleep pressure conditions. Behav. Brain. Res., 168: 312-317.

Brisswalter, J., M. Collardeau and A. René, 2002. Effects of acute physical exercise characteristics on cognitive performance. Sports Med., 32: 555-566.

Chmura, J., H. Krysztofiak and A.W. Ziemba *et al.*, 1998. Psychomotor performance during prolonged exercise above and below the blood lactate threshold. Eur. J. Applied Physiol. Occup. Physiol., 77: 77-80.

Crowe, M., A.S. Leicht and W.L. Spinks, 2006. Physiological and cognitive responses to caffeine during repeated, high intensity exercise. Int. J. Sport Nutr. Exerc. Metab., 16: 528-544.

Davranche, K. and A. Pichon, 2004. Critical flicker frequency threshold increment after an exhausting exercise. J. Sport. Exerc. Psychol., 27: 674-697.

Davranche, K. and M. Audiffren, 2004. Facilitating effects of exercise on information processing. J. Sports Sci., 22: 419-428.

Davranche, K., B. Burle, B. and M. Audiffren *et al.*, 2005. Information processing during physical exercise; a chromatic and electrometric and electromyographic study. Exp. Brain Res., 165: 532-540.

Davranche, K., M. Audiffren and A. Denjean, 2006. Distributional analysis of the effect of physical exercise on a choice reaction time task. J. Sports Sci., 24: 323-329.

Grego, F., J.M. Vallier, M. Collardeau, S. Bermon, P. Ferrari and M. Candito *et al.*, 2004. Effects of long duration exercise on cognitive function, blood glucose and counterregulatory hormones in male cyclists. Neurosci. Lett., 364: 76-80.

Grego, F., J.M. Vallier and M. Collardeau *et al.*, 2005. Influence of exercise duration and hydration status

on cognitive function during prolonged cycling exercise. Int. J. Sports Med., 26: 27-33.

Greig, M., D. Marchant, R. Lovell, P. Clough and L. McNaughton, 2007. A continuous mental task decreases the physiological response to soccer-specific intermittent exercise. Br. J. Sports Med., Published on line 21 May 2007.

Harada, T., S. Okagawa and K. Kubota, 2004. Jogging improved performance of a behavioral branching task: Implications for prefrontal activation. Neurosci. Res., 49: 325-337.

Kayser, B., 2003. Exercise starts and ends in the brain. Eur. J. Applied Physiol., 90: 411-419.

Li, C.S., C. Huang and R.T. Constable *et al*., 2006. Gender differences in the neural correlates of response inhibition during a stop signal task. Neuroimage, 32: 1918-1929.

Lock, L.K. and R.A. Berger, 1993. Influence of sex, presentation order and trial blocks on young adults' simple and type-C reaction times. Percept. Mot. Skills, 76: 1199-1210.

McMorris, T., C. Hill, J. Sproule, J. Potter, J. Swain and G. Hobson *et al*., 2005a. Supra-maximal effort and reaction and movement times in a non-compatible response time task. J. Sports Med. Phys. Fitness, 45: 127-133.

McMorris, T., S. Delves and J. Sproule *et al*., 2005b. Effect of incremental exercise on initiation and movement times in a choice response, whole body psychomotor task. Br. J. Sports Med., 39: 537-541.

McMorris, T., J. Swain and M. Lauder *et al*., 2006. Warm-up prior to undertaking a dynamic psychomotor task: Does it aid performance? J. Sports Med. Phys. Fitness, 46: 328-334.

Mekarski, J.E., T.R. Cutmore and W. Suboski, 1996. Gender differences during processing of the stroop task. Percept. Mot. Skills, 83: 563-568.

Petruzzello, S.J. and A.K. Tate, 1997. Brain activation, affect and aerobic exercise: An examination of both state-independent and state-dependent relationships. Psychophysiology, 34: 527-533.

Petruzzello, S.J., E.E. Hall and P. Ekkekakis, 2001. Regional brain activation as a biological marker of affective responsivity to acute exercise: Influence of fitness. Psychophysiology, 38: 99-106.

Presland, J.D., M.N. Dowson and S.P. Cairns, 2005. Changes of motor drive, cortical arousal and perceived exertion following prolonged cycling to exhaustion. Eur. J. Applied Physiol., 95: 42-51.

Raghuraj, P. and S. Telles, 1997. Muscle power, dexterity skill and visual perception in community home girls trained in yoga or sports and in regular school girls. Indian J. Physiol. Pharmacol., 41: 409-415.

Reimers, S. and E.A. Maylor, 2006. Gender effects on reaction time variability and trial-to-trail performance: Reply to Deary and Der (2005). Neuropsychol. Dev. Cogn B Aging. Neuropsychol. Cogn., 13: 479-489.

Schwartz, S.H., 2004. Visual Perception. McGraw-Hill, USA.

Tomporowski, P.D., 2003. Effect of acute bouts of exercise on cognition. Acta Psychol. (Amst), 112: 297-324.