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Research Article

Naproxen Sodium Does Not Affect Aerobic Capacity

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Abstract

A within-subject repeated measures design study was conducted to measure the effect of oral naproxen sodium on physical performance during exercise. Fifteen recreational runners, nine males (mean age 30.8 years) and six females (mean age 26.9 years) participated in the study. A modified Bruce graded exercise treadmill test was conducted during weeks 1, 5, and 7. The participants ingested two 220 mg naproxen sodium tablets each morning and 12 hours later for a total of 880 mg per day during weeks 3, 4, and 5. The subjects were retested 2 weeks after stopping the drug. $\dot{V}o_2$max, respiratory exchange ratio (RER), ventilatory threshold (VT), heart rate (HR), and respiration rate (RR) were measured. Tests were terminated either when the runner reached voluntary exhaustion or when subject reached $\dot{V}o_2$ max as determined by either one or both of the following criteria: 1) A plateau of ≥ 2 ml·kg $^{-1}$**·min** after an increase in workload, 2) a peak RER value ≥ 1.1. Analyses of all physiologic variables revealed no statistical differences between treatments suggesting that oral naproxen sodium has no effect on aerobic capacity during maximal exercise.

Keywords: NSAIDs; Exercise Performance; $\dot{V}o_2$max

Introduction

Non-steroidal anti-inflammatory drugs (NSAIDs) are the most common class of over-the-counter medication used in the United States with more than 30 billion doses consumed annually [1,2]. Non-steroidal anti-inflammatory drugs are commonly used by athletes for their analgesic and anti-inflammatory effects. Although several studies have been conducted to determine the effect of naproxen on muscle soreness, injury and muscle strength [3,4], little is known about its effect on aerobic exercise performance. The aim of this study was to determine the effect of naproxen sodium on exercise performance in runners as measured by $\dot{V}o_2$max.

Frequent use of NSAIDs by professional, Olympic, college and high school athletes has been reported [5-10]. Similarly, use of NSAIDs by triathletes and distance runners has been reported [10-12]. The prevalence of NSAID consumption among athletes has ranged from 12% to 93% [11]. NSAIDs were the most commonly used drugs by Canadian athletes who participated in the Atlanta and Sydney Olympics [13]; they were the most frequently used drugs by athletes selected for anti-dop-

ing testing during the 2007 Pan-American Games [7]; and were second only to vitamin ingestion in athletes randomly selected for drug testing at the 2000 Sydney Olympic Games [6].

Athletes commonly use NSAIDs to alleviate the signs and symptoms of musculoskeletal injuries, particularly overuse injuries. They often take these drugs in inappropriate amounts and for prolonged periods of time [4,10]. Among 196 triathletes and 452 high school football players who reported NSAID use during a three month period, 7.7% and 15% respectively reported daily use [9,11]. Additionally, athletes have reported taking several NSAIDs concomitantly [6].

Studies on the untoward effects of a variety of NSAIDs have been reported [1,2,14-17] but few studies on the effect of NSAIDs on athletic performance have been reported [4,18,19]. The effect of aspirin on performance has been studied [12,20,21] but no effect was found. While both aspirin and naproxen are classified as COX-1 and COX-2 inhibitors, the structural configuration of the two differs significantly. In particular, the binding energy properties differ with naproxen, the more stable of the two. Since naproxen is more often the NSAID preferred by athletes, a study of the effect of naproxen on aerobic capacity is needed. We report the first study of the effect of naproxen sodium on aerobic capacity as measured by maximal oxygen uptake in runners.

To determine the effect of NSAIDs on aerobic capacity, we measured the $\dot{V}o_2$max of recreational runners before, during and after the intake of one of the classes of NSAIDs, naproxen sodium. $\dot{V}o_2$max is considered by exercise physiologists as the "gold standard" for assessing cardiopulmonary fitness [1]. Therefore, if $\dot{V}o_2$max was either increased or decreased by the ingestion of naproxen, this would be an important finding for both the athletes and the sport governing bodies. Our hypothesis was that naproxen sodium does not affect $\dot{V}o_2$max.

Methods

Participants

A one group within-subject repeated measures design was used. Fifteen recreational runners were recruited from a local running club and entered into the study (Table 1). All subjects were screened for exclusion criteria, i.e., risk for cardiovascular disease, hypertension, and pregnancy. Prior untoward effects of NSAIDs were solicited. Current medication usage, if any, was recorded. Daily activity logs were kept by the subjects throughout study to establish baseline activity levels and document confounding variables. Logs were reviewed by study personnel at each visit. All fifteen runners, 9 male (mean age 30.8 years with a $\dot{V}o_2$max of 58 ml·kg^{-1}·min^{-1}) and 6 female (mean age 26.9 years with a $\dot{V}o_2$max of 45.7 ml·kg^{-1}·min^{-1}) completed the trial (Table 1). The study was performed in accordance with the ethical standards and approved by the institutional IRB [22].

Table 1. Demographic Characteristics of Subjects (N=15).

Females	6
Males	9
Age (years)	27.9 (4)
Height (inches)	68.5 (3.9)
Weight	162.9 (33.7)
Resting HR (beats/min)	66 (11) CI (61, 72)
Max HR (beats/min)	176 (8.5) CI (171,180)
VO2 Max ml^{-1}/kg^{-1}/min^{-1}	50.4 (10.8) CI (44.9, 55.8)
RER (CO_2 /O_2) at Max	1.17 (0.06) CI (1.14, 1.2)
RPE_{10} at Max	8.9 (0.8) CI (8.4, 9.3)

Means, Standard Deviations and 95% Confidence Intervals (CI) ($p<0.05$)

Exercise Protocol and Data Collection

A modified Bruce graded exercise treadmill test (GXT) was conducted during weeks 1, 5 and 7. A Parvo Medic's True One 2400 metabolic cart was used to measure $\dot{V}o_2$max, respiratory exchange ratio (RER), ventilatory threshold (VT), heart rate (HR), respiration rate (RR) and rating of perceived exertion (RPE). The metabolic cart was calibrated before each trial. Tests were terminated either once the runner reached voluntary exhaustion or by the examiner if subject reached $\dot{V}o_2$ max as determined by either one or both of the following criteria: 1) A plateau of ≥ 2 ml·kg -1·min after an increase in workload, 2) a peak RER value ≥ 1.1 [23,24].

Two baseline graded exercise measurements, one week apart, were obtained prior to the dispensing of the drug. The first exercise served as a familiarization procedure since no subject had prior treadmill running experience while wearing a mouthpiece. Data obtained during the second exercise were used for baseline values. For two weeks following the second baseline treadmill test, the subjects logged their activities. At week 3 they began taking two 220 mg Naproxen tablets, from a personalized pharmacist prepared bubble pack, each morning and 12 hours later for a total of 880mg per day during and continued the intake during weeks 3, 4 and 5. The participants were retested at the end of week five and again at week 7 (two weeks after discontinuing the naproxen). Participants were asked to record and report any side effects during the trial. Daily activity logs were kept and reviewed by study personnel. Statistical analyses were performed using a repeated measures ANOVA design with a power estimation of 80% assuming a 5% VO2 max difference. The assumed alpha level was 0.05

with a sample size of 15-20 subjects. IBM SPSS Statistics version 19 for Windows (SPSS Inc, Chicago, IL, USA) was used for all statistical analyses.

Results

Mean $\dot{V}o_2$max at week 1 was 50.4 ml·kg^{-1}·min^{-1} (CI 44.5, 56.4) at week 5 was 52.1 ml·kg^{-1}·min^{-1} (CI 46.1, 58.2) and at week 7 was 53.0 ml·kg^{-1}·min^{-1} (CI 47.2, 59.0). The mean differences between baseline and week 5, between baseline and week 7, and between week 5 and week 7 were not statistically significant (Figure 1). No significance differences between trials for RER, VT as a percentage of $\dot{V}o_2$max, RPE, max HR, percent max HR at VT and CO2 production were found (Table 2). Participant activity logs revealed no changes in activity, drug or supplement usage, or illness during the study period.

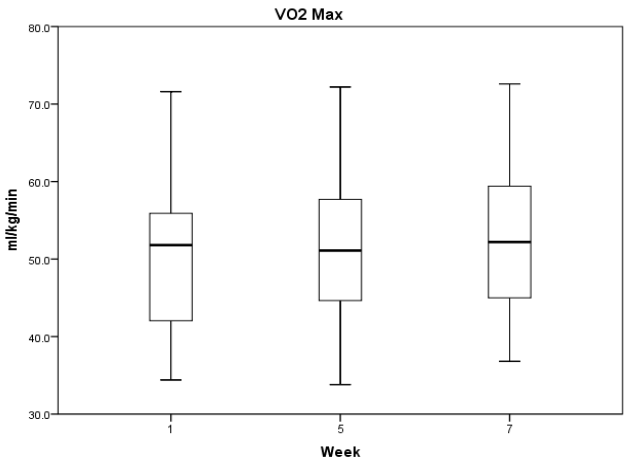

Figure 1. Mean Maximal Oxygen Consumption (VO2max) at Week 1, Week 5, and Week 7.

Table 2. Physiological Responses to Naproxen.

	Baseline	Week 5	Week 7
VO2max (ml·kg^{-1}·min^{-1})	50.4 (10.7) CI (44.5,56.4)	52.1(10.9) CI (46.1,58.2)	53.1 (10.6) CI (47.2,59.0)
VO2-1PE (ml·kg^{-1} ·min^{-1})	34.4 (9.1) CI (29.4,39.4)	32.8 (6.3) CI (29.3,36.4)	34.8 (6.0) CI (31.5,38.2)
HR Max (beats/min)	176 (8.5) CI (171,181)	176 (7.2) CI (172,180)	178 (7.5) CI (174,182)
HR 1PE (beats/min)	164 (10.9) CI (158,170)	158 (10.1) CI (153-164)	161 (10.9) CI (156,168)
RER Max (CO2/O2)	1.17 (0.05) CI (1.14,1.20)	1.19 (0.05) (1.17,1.22)	1.20 (0.06) CI (1.17-1.24)
RER 1min post	1.30 (0.11) CI (1.23,1.37)	1.35 (0.07) (1.30,1.39)	1.35 (0.11) CI (1.29,1.42)
Borg RPE_{10} max	8.9 (0.82) CI (8.4,9.3)	9.0 (0.73) CI (8.5,9.4)	9.1 (0.61) CI (8.7,9.4)
Bruce TM Time (min)	10.3 (1.4) CI (9.5,11.1)	10.5 (1.4) CI (9.7,11.3)	10.5 (1.4) CI (9.7,11.3)

Means, Standard Deviations and 95% Confidence Intervals (CI) ($p<0.05$)

Discussion

The frequent and often prolonged use of NSAIDs by athletes in various sports at all levels of completion calls in to question the possibility that these drugs may enhance or lessen performance. While the untoward effects of NSAIDs have been intensively studied, only the effect of aspirin on exercise performance has been reported. The authors were unable to find previous studies in the literature on the effect of naproxen on exercise performance as measured by $\dot{V}o_2$max during treadmill exercise. Naproxen neither enhanced nor lessened $\dot{V}o_2$max in a group of recreational runners.

Conclusions

Naproxen sodium did not have a significant effect on exercise performance in runners as measured by $\dot{V}o_2$max. There were, however, several limitations to the study design which need to be considered. Since a within subject protocol was employed, there was no placebo control, cross-over or dose variation which might limit the impact of any observed effect. Also, possible gender differences in aerobic capacity were not addressed.

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Approval of this study was granted by the University of Oklahoma Institutional Review Board. Signed informed consent was obtained from each participant.

Conflicts of Interest

The authors report no conflicts of interest.

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