

# The effects of honest and dishonest placebo ingestion immediately prior to $\text{VO}_{2\text{peak}}$ and handgrip strength testing

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**Objectives:** The purpose of this study was to examine the effects of both known (“honest”) and unknown (“dishonest”) placebo ingestion on  $\text{VO}_{2\text{peak}}$  to see if placebo ingestion would influence the test outcome by influencing the psychological component of this test. A secondary purpose was to examine these effects on isometric handgrip strength. We hypothesized that placebo (honest or dishonest) ingestion prior to a  $\text{VO}_{2\text{peak}}$  test would increase  $\text{VO}_{2\text{peak}}$  compared to a control condition. We further hypothesized that isometric handgrip strength would be greater during both conditions of acute placebo ingestion compared to a control condition.

**Design:** In a randomized, cross-over, counterbalanced design, subjects performed three trials: exercise tests with honest placebo, exercise tests with dishonest placebo, exercise tests only (control condition).

**Method:** 41 subjects (28 males) aged  $24 \pm 7$  years were tested. RM ANOVAs ( $3 \times 1$ ) were used to analyze  $\text{VO}_{2\text{peak}}$  and handgrip strength across conditions. RM ANOVAs ( $3 \times 1$ ) were used to determine if test order influenced  $\text{VO}_{2\text{peak}}$  and handgrip strength. ( $\text{Alpha} = 0.05$ ).

**Results:** No differences were found across conditions for either  $\text{VO}_{2\text{peak}}$  ( $p = 0.360$ ) or handgrip strength ( $p = 0.474$ ). Further, no differences were found for trial order for either  $\text{VO}_{2\text{peak}}$  ( $p = 0.766$ ) or handgrip strength ( $p = 0.067$ ).

**Conclusions:** Administration of both an honest and a dishonest placebo immediately prior to  $\text{VO}_{2\text{peak}}$  and handgrip testing resulted in no differences in performance compared to each other or a control trial. The  $\text{VO}_{2\text{peak}}$  test is a robust exercise test not influenced by immediately-prior pre-workout supplement consumption.

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Key words: exercise testing ■ supplement consumption ■ belief

## INTRODUCTION

A placebo is a pharmacologically inert substance that, despite chemical inactivity, can impact the body.<sup>1</sup> Placebos have helped reduce doses of attention deficit hyperactivity syndrome medication, relieve pain<sup>2</sup>, and reduce irritable bowel syndrome symptoms<sup>3</sup>. With regard to exercise performance, placebos have improved laboratory-assessed performance in running<sup>4</sup>, cycling<sup>5,6</sup>, and strength activities<sup>7,8</sup>. For a review on the topic of the effects of placebos in sports performance, see Beedie, et al.<sup>9</sup> The ability of placebos to reduce physical pain may be the mechanism by which placebos improving exercise performance may function.<sup>10</sup> Interestingly, pain reduction has been found both when subjects were blinded to their treatment being placebo (a “dishonest” placebo trial) and when subjects were told that they were taking a placebo (an “honest” placebo trial).<sup>11,12</sup>

The  $\text{VO}_{2\text{max}}$  test is considered the gold standard test of maximum aerobic capacity. The  $\text{VO}_{2\text{peak}}$  test is a variant of the  $\text{VO}_{2\text{max}}$  test in which slightly less stringent criteria is used to determine termination.  $\text{VO}_{2\text{max}}$  is physiologically dependent on both active tissue’s ability to extract oxygen from the circulation and from central cardiac factors including pericardial distensibility.<sup>13</sup> Clearly this test also involves ability to tolerate pain, as anyone who has ever conducted or performed a

$\text{VO}_{2\text{peak}}$  test can attest. Thus, some component of psychological motivation is involved in the performance of the test. Indeed, one termination criteria of the  $\text{VO}_{2\text{max}}$  test is achievement of a rating of perceived exertion greater than 17 on the original Borg scale of 6-20.<sup>14</sup> The idea that a central governor designed to prevent catastrophic physiological failure is what limits  $\text{VO}_{2\text{peak}}$  has also been proposed.<sup>15</sup>

The handgrip test is an isometric assessment of upper body strength. Previous work suggests that consuming placebos believed to be steroids, caffeine, or amino acids improved measures of muscular function compared to control conditions.<sup>8,9,16,17</sup> The handgrip test is simple and does not result in large muscle fatigue. Thus, the handgrip test can be performed prior to a  $\text{VO}_{2\text{peak}}$  test without influencing performance on the  $\text{VO}_{2\text{peak}}$  test. It is unknown how performance on this test is influenced by placebo ingestion.

Many athletes and recreational exercisers consume sports supplements desiring to improve performance. The purpose of this study was to examine the effects of both honest and dishonest placebo ingestion on  $\text{VO}_{2\text{peak}}$  values to see if placebo ingestion would influence the test outcome by affecting the psychological component of this test. We hypothesized that ingesting placebo pills prior to performing a  $\text{VO}_{2\text{peak}}$  test would subjectively limit subject’s pain during exercise and

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**Table 1.**  $VO_{2peak}$  and Handgrip.

	Control	Honest Placebo	Dishonest Placebo
Respiratory Exchange Ratio Peak	1.09 ± 0.05	1.09 ± 0.05	1.08 ± 0.05
Heart Rate Peak (bpm)	186 ± 11	189 ± 11	189 ± 11
$VO_{2peak}$ (ml*kg <sup>-1</sup> *min <sup>-1</sup> )	46.2 ± 9.3	46.7 ± 10.0	46.6 ± 10.0
Handgrip strength (kg)	95 ± 21	97 ± 27	95 ± 27

Values are presented as mean ± standard deviation. n = 41 for respiratory exchange ratio peak and  $VO_{2peak}$ . Due to periodic heart rate monitor malfunction, for heart rate peak, n = 29.

thereby potentially increase  $VO_{2peak}$  as compared to a control condition. Importantly, our tests were  $VO_{2peak}$  tests that terminated at volitional fatigue, although  $VO_{2peak}$  was later confirmed by high peak heart rate and respiratory exchange ratio (RER) values (Table 1). A secondary purpose of our study was to examine the effect of placebo ingestion on isometric handgrip strength. We hypothesized that both honest and dishonest placebo ingestion would improve handgrip strength similarly compared to a control condition.

## METHODS

### Experimental Approach to the Problem

In a randomized, cross-over, counterbalanced design, subjects performed three trials: exercise tests with honest placebo, exercise tests with dishonest placebo, exercise tests only (control condition). On visit one, height and weight were taken and a questionnaire on supplement use and beliefs and exercise habits was administered. All three trials were within two weeks of each other with ≥ 48 hours between visits.

### Subjects

41 subjects (28 males) aged 24 ± 7 years were tested. Height was 174.6 ± 80.2 cm and weight was 80.2 ± 17.0 kg. The Lindenwood University – Belleville Institutional Review Board approved this study (Reference # 00042) and informed consent was obtained from all participants. Potential subjects were excluded if they required medical clearance based on the American College of Sports Medicine screening algorithm for exercise participation.<sup>18</sup>

### Trials

In the honest placebo condition, a subject was told that she was taking a placebo and it truly was a placebo. In the dishonest placebo condition, a subject was told that she was taking a pre-workout supplement but it was actually a placebo. In the control condition, no pill was given. The following standardized scripts were used for the two placebo conditions:

*Honest Placebo:* Prior to today's exercise, you will take one placebo capsule. A placebo is a substance that has no significant physiological effect. Do you understand what a placebo is?

*Dishonest Placebo:* Prior to today's exercise, you will take one capsule of the pre-workout supplement. This supplement may increase your exercise performance.

The placebo was 300 mg of dextrose supplying 1.3 kcal/

capsule (Sigma Chemicals). Subjects were told the dishonest placebo was actually a placebo only after data collection termination. Placebos were administered immediately prior to the handgrip test. The  $VO_{2peak}$  test was then performed. A handgrip test was chosen as a strength test that would minimally affect  $VO_{2peak}$ .

### Exercise Tests

#### Handgrip Test

The same Lafayette handgrip dynamometer was used for all testing. Subjects used their self-described dominant hand and stood with their elbow bent at ninety degrees; grip size was adjusted. The best value from three handgrip trials was recorded.

#### $VO_{2peak}$ Test

A maximum aerobic exercise test was performed following standard procedures.<sup>14</sup> A ParvoMedics metabolic cart collected and analyzed expired gases. Subjects ran at a self-selected pace on a Woodway treadmill and grade was increased by 1.5 % every two minutes until volitional fatigue. Maximum heart rate,  $VO_{2peak}$ , and RER<sub>peak</sub> were recorded.

### Questionnaire

Subjects wrote answers to the following questions on their first visit: 1) What, if any, nutritional or sports supplements do you currently take? 2) What, if any, nutritional or sports supplements have you used in the past? 3) On a scale of 1-10, please rate how important sports supplements are for an active person to consume (1 = not important; 10 = essential) and 4) Please describe your typical weekly exercise.

### Statistics

Repeated Measures ANOVA (3 × 1) was performed on  $VO_{2peak}$  and handgrip strength across trials. Next, RM ANOVA (3 × 1) was performed on  $VO_{2peak}$  and handgrip strength collapsed across conditions to see if a testing order effect existed. As sphericity was violated in the testing order comparison for  $VO_{2peak}$  only, Greenhouse-Geisser was used. A final ANOVA (3 × 1) was performed on the subset of subjects (n = 11) who rated the importance of supplements for active people as ≥ 7. Alpha was set at 0.05. Differences between conditions were also calculated for both  $VO_{2peak}$  and handgrip strength.

**Table 2.** Order of trial effect with testing condition ignored.

	First Trial	Second Trial	Third Trial
VO <sub>2peak</sub> (ml*kg <sup>-1</sup> *min <sup>-1</sup> )	46.2 ± 9.6	46.5 ± 9.5	46.4 ± 9.7
Handgrip strength (kg)	93 ± 22	97 ± 26	97 ± 26

Values are presented as mean ± standard deviation. n = 41.

## RESULTS

### Subject Characteristics Derived from Questionnaire

Many subjects were NAIA athletes: hockey (n = 11), soccer (n = 6), swimming (n = 6), football (n = 3), tennis (n = 2), cross-country (n = 2), baseball (n = 1). 36 subjects regularly strength trained and 35 aerobically exercised. Supplement used were protein powder (n = 31), not-further-described “pre-workout” (n = 20), BCAA (n = 13), creatine (n = 9), multivitamin (n = 6), fish oil (n = 4), “vitamin B” (n = 1), iron (n = 1), CLA (n = 1), glutamine (n = 1), and “testosterone” (n = 1). Subjects responded to “On a scale of 1-10, please rate how important sports supplements are for an active person to consume (1 = not important; 10 = essential)” with an average score of 6 ± 3.

### VO<sub>2peak</sub> and Handgrip

No main effects were found across conditions. Further, no main effects were found with values collapsed across conditions and order of trials analyzed (Table 2). The differences between conditions were as follows for VO<sub>2peak</sub>: honest – control = 0.5 ± 2.1, dishonest – control = 0.3 ± 2.8, honest – dishonest = 0.1 ± 2.8 (ml\*kg<sup>-1</sup>\*min<sup>-1</sup>; mean ± standard deviation). The differences between conditions were as follows for handgrip strength: honest – control = 2 ± 11, dishonest – control = 1 ± 11, honest – dishonest = 1 ± 10 (kg; mean ± standard deviation).

## DISCUSSION

Contrary to our hypothesis, administration of both an honest and a dishonest placebo pill immediately prior to VO<sub>2peak</sub> and handgrip testing had no effect on the outcome of either test (Table 1). This finding occurred despite most subjects believing sports supplements were important for an active person to consume. To address the possibility that a learning affect could have confounded results, differences in results between the first, second, and third trial (with trial condition ignored) were examined and no differences were found, suggesting that trial order did not confound the results (Table 2).

With regard to the VO<sub>2peak</sub> test, several possible explanations exist for our findings. The simplest explanation is that this test was accurately estimating aerobic capacity and was thus robust to our tinkering with its psychological component. This in itself is an important finding as it downplays the importance of motivation with regard to this test. One criticism of the VO<sub>2max</sub> test is the subjective decision made by a subject of when to stop the test which appears to involve both psychological and physiological components.<sup>19</sup> Our finding suggests these psychological components were stable across

trials. When a subject believed she had ingested a beneficial sports supplement, she performed no better on this test than when she had ingested no pill or when she believed she had ingested a placebo. This finding contrasts to findings from studies utilizing true performance measures such as cycling time trials or one repetition maximum lifts as outcome variables.<sup>9</sup>

A VO<sub>2max</sub> test terminates when a subject shows a plateau in VO<sub>2</sub> with an increase in heart rate and an RER greater than 1.15. A VO<sub>2peak</sub> test may terminate in the absence of these indicators as long as there is the presence of a failure of heart rate to increase with an increase in exercise intensity, a venous lactate concentration exceeding 8 mmol/L, or a rating of perceived exertion (RPE) greater than 17 on the original 6-20 Borg Scale.<sup>14</sup> In the present study, tests terminated at volitional fatigue as determined by RPE. All subjects did achieve high RER<sub>peak</sub> and high maximum heart rates with no difference in these values between conditions (Table 1).

Evidence has suggested that ingesting a placebo, even knowing that it is placebo can have substantial effects.<sup>12,20</sup> This type of placebo administration is known as an “honest” placebo.<sup>12</sup> It was thought in this study that these psychological effects might reduce fatigue during VO<sub>2peak</sub> testing and thus allow subjects to achieve a higher VO<sub>2peak</sub>. Further, it was hypothesized that giving subjects a dishonest placebo would lead to attainment of a higher VO<sub>2peak</sub> value. Several exercise performance studies have found improvements in performance following dishonest placebo supplementation.<sup>9</sup> As previously stated, this was not the case in the present study for either the VO<sub>2peak</sub> test or for the handgrip test.

Many factors may have influenced our results. We told subjects that they were taking a “pre-workout supplement” that “may increase your exercise performance.” We did not specify a type of supplement or how it could increase performance as other studies have done.<sup>7,8,21</sup> Previous work in highly trained subjects has found strength improvements following placebo supplementation when subjects thought they were taking steroids.<sup>7,8</sup> Other work has found strength improvements in college students when they thought they were taking amino acids<sup>17</sup>, and caffeine<sup>16</sup>. Thus, it is possible that had we told subjects our placebo was one of these substances, we may have seen different results. The color of our capsules (white) may have also affected our results. It is possible that we may have seen differences had we used yellow, or orange pills which have been associated with a stimulating effect.<sup>22</sup> Finally, our results may have been affected by the highly athletic nature of our sample. These subjects may have been more accustomed to pushing through physical pain than the

general population and thus performed the  $VO_{2peak}$  test reliably well. It would thus be instructive to repeat our protocol on a less athletic population.

### CONCLUSION

Administration of both an honest and a dishonest placebo pill immediately prior to  $VO_{2peak}$  and handgrip testing resulted in no differences in performance compared to each other or a control trial. The  $VO_{2peak}$  test was found to be a robust exercise test not influenced by belief in immediately-prior pre-workout supplement consumption. Future studies should investigate this effect in a less athletic population as well as investigate the effects of honest versus dishonest placebos in more traditional evaluations of athletic performance such as cycling time trials or one-repetition maximums.

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### CONFLICT OF INTEREST

The authors report no conflicts of interest or funding sources.

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