International Journal of Strength and Conditioning

https://doi.org/10.47206/ijsc.v5i1.373

Acute Percussive Massage Device Use Does Not Improve Anaerobic Performance

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ABSTRACT

This study investigated the effects of acute percussive massage (PM) on anaerobic performance. Twenty-nine collegiate athletes (16 men, 13 women) between the ages of 18 and 22 participated in this study. Participants were randomly assigned to either the PM group (PMG) or a resting control group (CG). All subjects completed three Wingate Anaerobic tests (WAnT) against 8% of their body mass, with each test separated by 3 minutes of rest. During the 3 minutes of rest, the intervention group had PM applied to the quadriceps and hamstrings on each leg for 30 seconds each while the CG rested passively for the full three-minute period, lying supine and prone for 1 minute each, mimicking the body position during the rest period in the PMG. For both groups, there was a significant main effect for time over the three WAnTs on peak power ($F(2,50) = 36.69$, $p < 0.01$, $\eta^2 = .595$) mean power ($F(2,48) = 147.85$, $p < 0.01$, $\eta^2 = .860$), and fatigue index ($F(2,48) = 9.464$, $p < 0.01$, $\eta^2 = .283$). No group differences were observed between the PMG and CG ($p > 0.05$). These findings show that acute PM does not improve anaerobic performance or delay fatigue more than passive rest.

Keywords: massage gun; Wingate; power output; fatigue

INTRODUCTION

Percussive massage (PM) therapy, specifically involving self-use devices, has become common practice in the general population as well as rehabilitative and athletic settings. These percussive massage devices (PMDs) are relatively affordable and marketed as a means to improve performance, delay fatigue, and improve recovery. In a recent survey of 425 healthcare professionals, mainly including physical therapists and certified athletic trainers, the majority reported using PMDs for reasons including injury prevention, warm-up, recovery, performance enhancement, and therapeutic treatment (Cheatham et al., 2021). However, use of these devices was primarily due to collaboration with other professionals who used these devices as well as individual's own experiences – not based on empirical evidence. Surprisingly, despite the popularity of PMDs, peer-reviewed research is limited.

To date, a relatively low number of studies have investigated the effects of PMDs on aspects of performance. A recent systematic review (reviewing 11 studies) highlighted that researchers have investigated outcomes such as fatigue (measured via surface electromyography or perceived effort), strength (measured via dynamometer, countermovement and drop jumps, total repetitions, or movement velocity), and range of motion/flexibility (Ferreira et al., 2023). And while not only has the number of performance-based studies on such a popular device been relatively sparse, findings have also been inconsistent. Currently, research suggests that PMDs tend to lead to improvements in range of motion and flexibility while impacting strength and performance very little (Alvarado et al., 2022; Ferreira et al., 2023; Jemni et al., 2014; Konrad et al., 2020; Kurt, 2015; Sands et al., 2006; Sands et al., 2008; Sands et al., 2008; Szymczyk et al., 2022), though not all studies demonstrate these effects (Kurt et al., 2015). However, due to the limited and equivocal results, these findings should be interpreted and applied cautiously.

While there have been only a few reports of improvements in various aspects of strength following the use of PMDs, these findings are still worth examining. For example, it has been reported that even though speed, power, and effort appear to be unaffected by PMDs, strength index and total number of repetitions during multiple sets of the bench press were higher following the use of PMDs (García-Sillero et al., 2021; Konrad et al., 2020). Researchers have suggested these findings may be due to aspects such as post-activation potentiation as well as greater blood flow – previously observed and reported in other whole-body vibration training studies (Cochrane et al., 2010; Lythgo et al., 2009). While these specific mechanisms were not explored, it is possible that the improvements in performance (especially strength and power) were more of a secondary result from intra-set recovery following the use of PMDs in these early studies (García-Sillero et al., 2021; Konrad et al., 2020; Wang et al., 2022). And while these are promising results with respect to bench press performance, it remains unclear if these findings should be applied to other types of performance, such as sprinting.

Therefore, the purpose of this study was to examine the effects of intra-set percussive massage therapy on repeated Wingate Anerobic test (WAnT) performance in collegiate athletes. It was hypothesized that for each subsequent WAnT, peak power and mean power would decrease and fatigue index would increase in both groups, but that PMD use would lead to smaller changes (i.e. less overall power loss) compared to passive rest.

METHODS

Procedure

Participants visited the laboratory for a single visit and were instructed to refrain from any high-intensity exercise at least 24 hours prior and to avoid caffeine intake at least 4 hours before. During their visit, participants were randomly allocated by a computerized random number generator, stratified by sex, to either the control group (CG) or the percussive massage group (PMG). Participants then performed three WAnTs each separated by 3 minutes of rest, during which they underwent PM or lay passively.

Participants

Twenty-nine young adults (16 men, 13 women) between the ages of 18 and 22 years completed participation in this study. Participant characteristics can be found in Table 1. All participants were members of intercollegiate athletic teams, including women's track and field, men's track and field, women's basketball, men's basketball, women's soccer, men's soccer, women's volleyball, softball, baseball, and football. Each participant gave written consent to participate in the study per guidelines of the Human Investigations Committee of the University. None of the participants had any previous knowledge of the research hypotheses and expected study outcomes. Once enrolled in the study, all procedures were thoroughly explained to the participant. Mass and height were measured to the nearest 0.1 kg and 0.1 cm, respectively, and BMI was calculated.

Wingate Anaerobic Test

The sprint exercises were completed on a cycle ergometer (Monark Ergomedic 984E, Stockholm, Sweden). The ergometer was adjusted to fit the participant to ensure their leg was just short of fully extended at the bottom position. The participant then completed a four-minute warm-up at approximately 60 rpm at a resistance corresponding to 2.0% of body mass. Immediately at the end of this warm-up, the participant was asked to accelerate to maximum pedaling rate. Following the establishment of maximum pedal rate, the participant pedaled against no resistance for one additional minute before the first WAnT.

Table 1. Participant Characteristics (mean ± SD)

	Full Sample (*n* = 29)	**Control (*n* = 14)**	**Percussive Massage (*n* = 15)**
Sex	M = 16 F = 13	M = 8 F = 6	M = 8 F = 7
Age (yr)	20.2 ± 1.4	20.2 ± 1.3	20.2 ± 1.6
Mass (kg)	79.2 ± 18.5	76.7 ± 13.7	81.5 ± 22.9
BMI	24.9 ± 4.4	22.8 ± 7.4	26.2 ± 5.2

To begin the first of three WAnTs, the participant was asked to accelerate toward maximal pedal rate, and the resistance was automatically applied when the pedal rate reached within 10 rpm of their previously recorded maximal pedal rate. The participant pedaled as fast as he or she could for 30 seconds against a resistance corresponding to 8% of body mass (Katch et al., 1977). This protocol was the same for female and male participants. Verbal encouragement was provided throughout the test. Peak power relative to body mass (PP), mean power (MP), and fatigue index (FI) were calculated for each test. Between trials 1 and 2 and then again between trials 2 and 3, subjects underwent 2 minutes of PM by a trained research assistant or passive rest.

Percussive Massage

Immediately upon completion of the WAnT, participants in the PMG walked from the cycle ergometer and lay on a plinth. PM was applied starting 30 seconds after the end of the WAnT. PM was applied using a SuperQ Fascial Gun (model KH-320) device. PM was applied bilaterally to the hamstrings and quadriceps, over the entire muscle, each for 30 seconds. Following PM, the participant returned to the cycle ergometer, with the next WAnT beginning 30 seconds after the end of PM. Following the second WAnT the PM protocol was repeated again prior to the third and final WAnT.

Passive Rest

Immediately upon completion of the WAnT, participants in the CG walked from the cycle ergometer and lay on a plinth. The participant rested passively for the full three minute period, lying supine and prone for 1 minute each, mimicking the body position during the rest period in the PMG.

Statistical Analysis

Data on PP, MP, and FI were analyzed using a 2 (group) x 3 (time) repeated measures analysis of variance (ANOVA). Post hoc analyses were performed using the Bonferroni correction when appropriate to examine differences between the PMG and CG. Effect sizes were also calculated and classified as small (.02), medium (.13), or large (.26 or greater) (Bakeman, 2005). Statistical analyses were performed using SPSS (IBM SPSS Statistics, version 26). Statistical significance was set at $p \leq 0.05$.

RESULTS

Before conducting the final analyses, data were screened for normality. All data were normally distributed for each group as assessed by the Shapiro-Wilk's test ($p \geq 0.05$) and visual inspection of the data. Levene's test of homogeneity of variance was also non significant ($p \geq 0.05$). No significant differences were observed between the two groups for any demographic variable ($p > 0.05$).

Peak Power

Data for PP are displayed in Figure 1. There was no significant group x time interaction for PP, $F(2,50) = .501$, $p > 0.05$, $\eta^2 = .020$. The main effect of time was significant $F(2,50) = 36.69$, $p < 0.01$, $\eta^2 = .595$. PP for trial 2 (mean = 12.7 w/kg) was significantly lower than trial 1 (mean = 14.5 w/kg) while PP for trial 3 (mean = 11.2 w/kg) was significantly lower than trials 1 and 2. No significant differences were noted between the PM and the CG, $F(1,25) = 2.628$, $p > 0.05$, $\eta^2 = .095$.

Mean Power

Data for MP are displayed in Figure 2. There was no significant group x time interaction for MP, (2,48) = .054, $p > 0.05$, $\eta^2 = .002$. The main effect of time was significant $F(2,48) = 147.85$, $p < 0.01$, $\eta^2 = .860$. MP for trial 2 (mean = 6.74 w/kg) was significantly lower than trial 1 (mean = 8.3 w/kg) while PP for trial 3 (mean = 5.6 w/kg) was significantly lower than trials 1 and 2. No significant differences were noted between the PMG and the CG, $F(1,24) = 1.177$, $p > 0.05$, $\eta^2 = .047$.

Fatigue Index

Data for FI are displayed in Figure 3. There was no significant group x time interaction for FI, $F(2,48) = .075$, $p > 0.05$, $\eta^2 = .003$. The main effect of time was significant $F(2,48) = 9.464$, $p < 0.01$, $\eta^2 = .283$. FI for trial 1 (mean = 71.9%) was significantly lower than FI for trial 2 (mean = 77.0%) and trial 3 (mean = 77.8%). No significant differences were noted between the PMG and the CG, F(1,24) = .988, $p > 0.05$, $\eta^2 = .040$

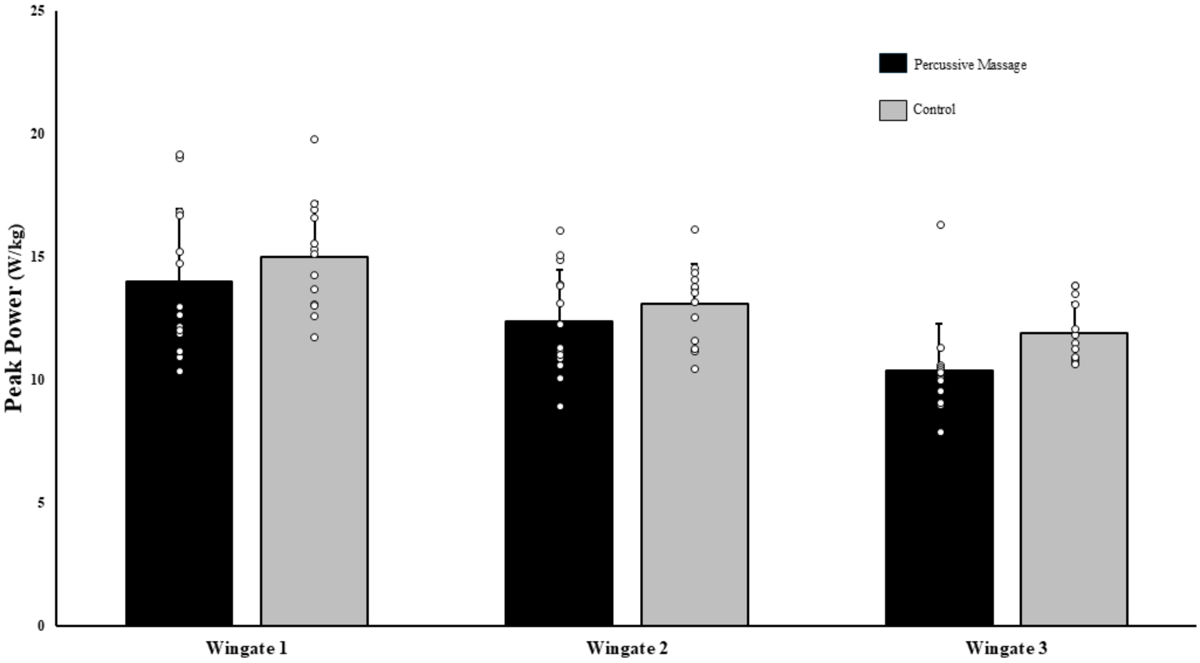

Figure 1. Peak Power

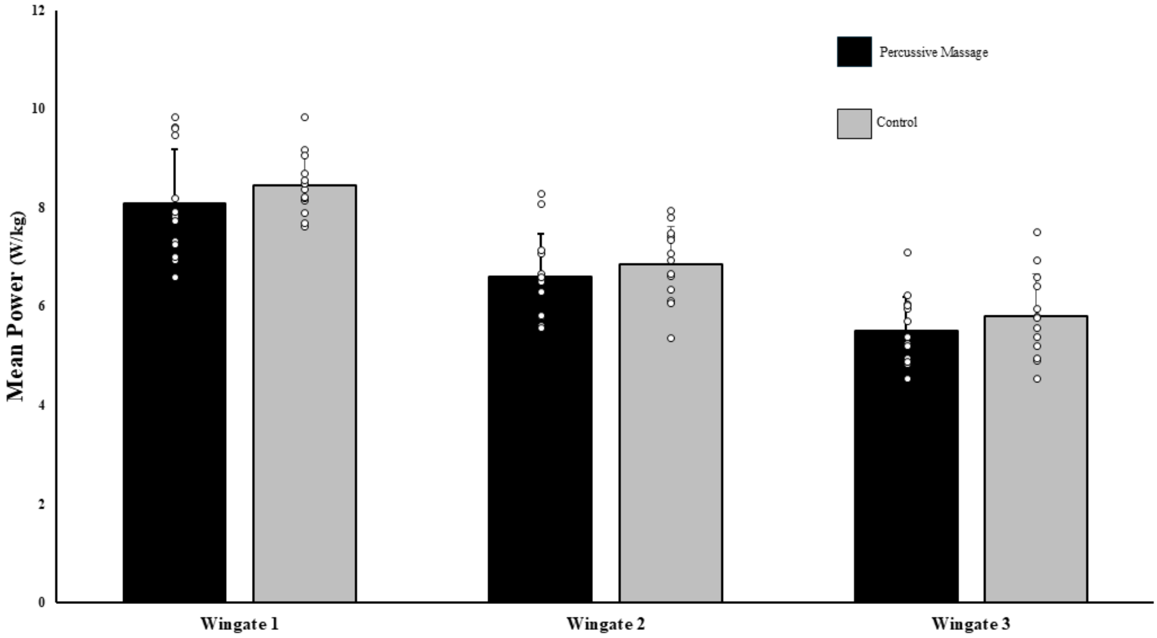

Figure 2. Mean Power

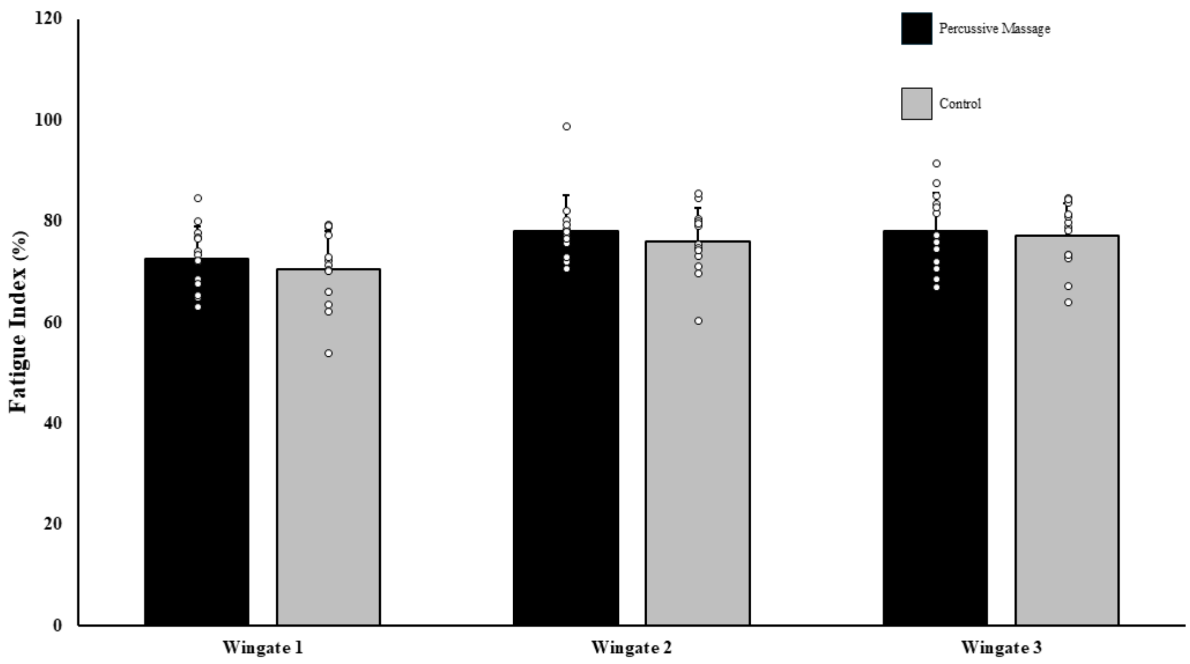

Figure 3. Fatigue Index

DISCUSSION

The purpose of this study was to examine the effects of intra-set percussive massage on repeated Wingate Anerobic test (WAnT) performance in collegiate athletes. The results of this study highlight that PMD use does not enhance or preserve performance on consecutive WAnTs. While it was hypothesized that both groups would see reduced PP and MP in trials 2 and 3, it was also hypothesized that the PMG would see a smaller reduction in PP and MP in trials 2 and 3 as a result of the PM. However, both the PMG and CG had significant decreases in PP and MP across the three trials with no differences between the groups. These findings are similar to previous research that reported PM did not improve maximum voluntary torque, speed, or power compared to passive rest (Canbulut et al., 2023; García-Sillero et al., 2021; Konrad et al., 2020).

In addition to performance enhancement (i.e., higher PP and MP), it has also been suggested that PMDs might aid in recovery. Previous work has highlighted that following various fatiguing exercise protocols, PM helped improve contraction time while others have reported PM led to more total number of repetitions in the bench press and strength outcomes following muscle soreness (García-Sillero et al., 2021; Trainer et al., 2022; Wang et al., 2022). However, these earlier findings were not supported by this current study. A 24% drop in power (from trial 1 to trial 3) was noted for the PMG while the CG had an average drop in power of 19% suggesting that PM does not delay fatigue any more than passive rest. It is worth noting that the specific characteristics of PM in the current study are different than in those studies. For instance, duration (15 seconds in Garcia-Sillero et al., 2021, 5 minutes in Trainer et al., 2022, and Wang et al., 2022) and location (those studies examined upper body muscle groups such as the trapezius and rotator cuff) differed from the current study.

As stated previously, the number of studies that have examined PMDs is limited, which is one reason it is difficult to compare findings between studies (Ferreira et al., 2023). Moreover, in addition to so few studies, assessments of performance or fatigue (both of which are broad umbrella terms) have been measured via multiple ways such as contraction velocity, vertical jump, bench press, and range of motion. Therefore, the use of the WAnT as a measure of performance and fatigue is a strength of this study because it is a validated measure that relates strongly to high anaerobic power dependent sport and athletic performance and abilities (Hofman et al., 2017; Zupan et al., 2009). Furthermore, if future research also uses the WAnT as one performance metric, researchers will be able to compare more specific variables related to PMDs such as vibration frequency (i.e., number of oscillation cycles), duration of PM, acceleration, and motion in which PM is applied – all of which have really yet to be fully investigated (Cochrane, 2011; Ferreira et al., 2023). Other strengths of the current study are its inclusion of females, a quality that is lacking (though not absent) in similar studies (Garcia-Sillero et al., 2021; Konrad et al., 2020; Wang et al., 2022), as well as the inclusion of competitive athletes.

FUTURE RECOMMENDATIONS

Overall, the findings of this study provide no support for using PMDs as a means to improve or preserve anaerobic performance or delay fatigue on consecutive WAnTs. Although these devices are increasing in popularity and use, empirical evidence that supports PMDs usage to either improve performance outcomes or minimize fatigue remains sparse. Previous researchers have stated that it is still unclear how PMDs impact performance through neuronal, vascular, and mechanical mechanisms. Therefore, a better understanding of mechanisms of action might lead to clearer applications and research directions for these devices.

ACKNOWLEDGEMENTS

N/A.

CONFLICTS OF INTEREST

There are no conflicts of interest to report for this study.

FUNDING DETAILS

No funding was received for this study.

ETHICAL APPROVAL

This study received approval from the Human Investigations Committee of the University.

DATES OF REFERENCE

Submission - 13/05/2024
Acceptance - 23/07/2024
Publication - 16/05/2025

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