BRIEF REVIEW

Effect of Postactivation Potentiation on Explosive Vertical Jump: A Systematic Review and Meta-Analysis

Ward C. Dobbs, Danilo V. Tolusso, Michael V. Fedewa, and Michael R. Esco

Department of Kinesiology, The University of Alabama, Tuscaloosa, Alabama

Abstract

Dobbs, WC, Tolusso, DV, Fedewa, MV, and Esco, MR. Effect of postactivation potentiation on explosive vertical jump: a systematic review and meta-analysis. *J Strength Cond Res* 33(7): 2009–2018, 2019—The primary aim of this systematic review and meta-analysis was to quantify the magnitude of the effect of postactivation potentiation (PAP) on explosive vertical power while accounting for the nesting of multiple effects within each study. This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Statement (PRISMA). Original research articles published by January 18, 2018, were located using an electronic search of 4 databases and yielded 759 original publications. Data were extracted and independently coded by 2 authors (W.C.D. and D.V.T.). The standardized mean effect size (ES) was calculated by subtracting the pre-treatment mean from the post-treatment mean and dividing by the pooled SD, adjusting for small sample bias. Multilevel random-effects model was used to aggregate a mean ES and 95% confidence interval (CI) for PAP on vertical jump performance. The cumulative results of 179 effects gathered from 36 studies indicate that PAP does not improve vertical jump performance (ES = 0.08, 95% CI −0.04 to 0.21, $p = 0.197$), with moderate heterogeneity. Moderator analysis indicated that rest intervals between 3 and 7 minutes provided favorable performance outcomes (ES = 0.18, 95% CI 0.05 to 0.31, $p = 0.007$). Conversely, rest intervals less than 3 minutes (ES = −0.15, 95% CI −0.31 to 0.01, $p = 0.052$) or performing isometric contractions (ES = −0.52, 95% CI −0.89 to −0.14, $p = 0.007$) may be detrimental to performance. Meta-regression indicated that rest interval was the only moderator significantly associated with ES ($\beta = -0.04$, 95% CI −0.57 to −0.02, $R^2 = 14.31\%$, $p < 0.001$). When appropriate PAP guidelines are followed, an increase in vertical jump performance may be achieved.

Key Words postactivation potentiation, explosive power, warm-up

Address correspondence to Ward C. Dobbs, wcdobbs@crimson.ua.edu.

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Introduction

Explosive power, often assessed as vertical jump, is an important metric of performance within most sports (9,10,19,64,80). For instance, Loturco et al. (9) found vertical jump height to be strongly correlated with sprinting speed in 22 elite sprinters. Similarly, Carlock et al. (10) found vertical jumping ability to be highly correlated with weightlifting performance. In addition, explosive vertical power is a foundational component of vital movements in many team sports, such as rugby, volleyball, basketball, and soccer (5,13,60,71,81). Therefore, factors that increase explosive power are important in regards to athletic conditioning. Specifically, these factors are of significance to practitioners looking to develop various training strategies to enhance explosive power as it relates to athletic performance.

The warm-up phase is a vital component of explosive muscular performance. A variety of modalities are used during a warm-up, such as dynamic stretching and low-intensity exercise. Recently, voluntary muscular activations at maximal or near-maximal intensities have been incorporated into warm-up phases as an attempt to increase neuromuscular force development, a phenomenon referred to as postactivation potentiation (PAP) (58). Numerous studies have shown the benefits of PAP. For instance, PAP stimuli have been suggested to improve sprint performance, jumping capacities, and other power-related movements (2,7,16,21,24,47,48,77). However, it is understood that a PAP stimulus also induces a state of fatigue, requiring a sufficient rest period before performing a subsequent explosive movement (57). Therefore, the optimal duration and intensity of a PAP stimulus, in combination with subsequent rest periods, should be considered for specific individuals because the presence of fatigue may outweigh the potential benefit if not properly prescribed.

Researchers have attempted to identify various moderators that facilitate the greatest performance potential to offset the effects of fatigue (9,11,27,37,41,43,46,49,50,63,73,79). Four meta-analyses have been performed with the intention of revealing the most appropriate volume of a given PAP stimulus on power output (27,43,63,79). However, the results of the studies are equivocal because it relates to the key prescriptive factors of a given PAP stimulus. For example, optimal rest interval recommendations have been suggested between 8 to 12 minutes (27), 7 to 10 minutes (43,79), and 5 to 7 minutes (63). The discrepant findings are likely related to the fact that the results were derived from investigations that included both untrained and trained subjects (27,43,79). This method of clustering potentially masks the impact of training status, which has been shown to directly relate to the effect of PAP on athletic performance (28). Specifically, trained individuals require a relatively higher stimulus to recruit higher threshold motor units during a given PAP movement (57). Thus, it is likely that a resistance movement used as a PAP protocol should use a load of at least 80% 1 repetition maximum (1RM) (59,74). Furthermore, it is likely that most practitioners using a PAP movement will be working with trained athletes. Because the results of the previous meta-analyses were derived from studies that included untrained populations and have not accounted for the nesting of multiple effects within a single study, additional research is needed specifically focusing on a trained population and accounting for the correlation of multiple measures presented in the same study.

The intent of this review was to add to the recent body of literature on PAP and the methods that facilitate the greatest increase in explosive power. The specific purpose of this investigation was to quantify loads and rest ratios for PAP stimuli to elicit the greatest effect of vertical jump performance in trained individuals. It was hypothesized that the trained individuals will produce higher performance measures and require shorter rest periods than previously noted (27,43,79) at intensities ≥80% 1RM due to their ability to counteract the inhibitory response of fatigue (57).

Methods

Experimental Approach to the Problem

The rationale for this review is for practitioners and sport scientists working with trained athletes to better understand the loads and rest ratios appropriate to optimize the use of PAP on a given athlete's explosive power–related performance as measured through vertical jump. This meta-analysis was conducted according to the criteria and recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis Statement–PRISMA (44). Articles published by January 18, 2018, were located using searches of PubMed, SPORTDiscus, Physical Education Index, and Web of Science using the term "postactivation potentiation." The electronic keywords were intentionally broad to increase the sensitivity of the database search. Duplicate publications were removed, and the references of retrieved articles were manually reviewed to identify additional relevant records not identified through the initial database search.

Subjects

One-hundred seventy-nine effects were collected from 36 studies (5 ± 4 effects per study), with data available for 608 participants (18 ± 17 participants per effect) (1–3,6,8,12,15,17,18,21–23,25,26,30,34,37,38,40–42,46,49–55,62,69,70,73,77,78). Study characteristics are provided in Table 1. The conditioning activities reported included: dynamic squat (n = 135, 75%), concentric-only squat (n = 22, 12%), isometric leg press (n = 12, 7%), dynamic deadlift (n = 9, 5%), and isometric squat (n = 1, <1%). Additional descriptive characteristics are presented in Table 2.

Procedures

The inclusion criteria for the systematic review was as follows: (a) peer-reviewed publication; (b) available in English; (c) investigated the acute effect of voluntary muscle contraction–induced PAP on vertical jump performance; (d) involved participants with at least 1 year of lower-body resistance training; (e) using a potentiating stimulus ≥80% 1RM; and (f) provided enough information to derive an effect size (ES). Excluded records had the following: (a) non–peer-reviewed; (b) not available in English; (c) were a meta-analysis or review article; (d) did not provide measures of acute performance on vertical jump; (e) PAP was elicited through electrical stimulation; (f) subjects did not have a minimum of 1-year resistance training; (g) used a potentiating stimulus <80% 1RM; and (h) did not provide enough information to derive an ES. A total of 759 publications were identified through the search process. A flowchart of study selection is provided in Figure 1. Initially, studies were excluded based on title and abstract, with the eligibility of remaining publications determined after full-text review with the assistance of a second reviewer (D.V.T.).

The following data were extracted from each publication when provided by the authors: age, height, body mass, training status, load lifted, sets, repetitions, rest interval, sex, mode of PAP (dynamic or isometric), sample size, and vertical jump performance. When raw data were not provided, estimated values were obtained from figures provided in the original publication (1,3,6,12,15,17,22,30,42,46,52,62,69,73,78). All data were extracted by 2 authors (W.C.D. and D.V.T.). A 2-way (effects × raters) intraclass correlation coefficient for absolute agreement was calculated to ensure interrater reliability of PAP on vertical jump performance ES. The intraclass correlation of all 179 effects was ≥0.95, and increased to 100% after adjustments were made due to disagreements between the 2 reviewers.

Statistical Analyses

Hedges' d ES was calculated by subtracting the mean (M) change in pre and post stimulus and dividing the difference by the pooled SD, and adjusted for small-sample bias (29). Thus, a positive ES denoted an increase in vertical jump performance after potentiation, whereas a negative ES denoted a decrease. A multilevel, random-effects model with

Table 1. Studies included in the analysis.*

Study	N	Mode of activity	Sets/reps/intensity	Rest interval (min)
Arias et al. (1)	15	Deadlift	1 × 5 × 85%	0.25, 2, 4, 6, 8, 10, 12, 14, 16
Batista et al. (2)	15	Isometric leg press	1 × 1 × MVIC	4
			1 × 3 × MVIC	
Bauer et al. (3)	24	Parallel squat	1 × 4 × 90%	0.25, 1, 3, 5, 7, 9, 11
			2 × 4 × 90%	
			3 × 4 × 90%	
Berning et al. (6)	13	FI squat	1 × 1 × 150%	4, 5
Birch et al. (8)	25	Parallel squat	1 × 3 × 93%†	4
Chen et al. (12)	10	Parallel squat	1 × 5 × 87%†	4
Crewther et al. (15)	9	Parallel squat	1 × 3 × 93%†	0.25, 4, 8, 12, 16
Deutsch & Lloyd (18)	30	Parallel squat	2 × 3 × 85%	3
de Villareal et al. (17)	12	Parallel squat	2 × 3 × 85%‡	5
			2 × 2 × 90%‡	
Esformes et al. (21)	27	Quarter squat	1 × 3 × 93%†	5
		Parallel squat		
Evetovich et al. (23)	31	Parallel squat	1 × 3 × 85%	8
			1 × 3 × 93%†	
Gougoulis et al. 2003	20	Half squat	1 × 2 × 90%‡	<1
Golas et al. (25)	13	Keiser squat	4 × 4 × 80%	6‖
Golas et al. (26)	16	Parallel squat	1 × 1 × 80%‡	3
			1 × 1 × 90%‡	
			1 × 1 × 100%‡	
Hester et al. (30)	14	Parallel squat	1 × 5 × 80%	1, 3, 5, 10
Hirayama et al. (34)	14	Parallel squat	1 × 1 × 80%‡	1
		Isometric squat	1 × 1 × MVIC‡	
Jensen et al. (37)	21	Parallel squat	1 × 5 × 87%†	0.17, 1, 2, 3, 4
Jones & Lees (38)	8	Parallel squat	1 × 5 × 85%	3, 10, 20
Khamoui et al. (40)	16	Parallel squat	1 × 2–5 × 85%§	5
Kilduff et al. (41)	23	Parallel squat	1 × 3 × 93%†	0.25, 4, 8, 16, 20
Kilduff et al. (42)	20	Parallel squat	3 × 3 × 87%	0.25, 4, 8, 16, 20, 24
Lowery et al. (46)	13	Parallel squat	1 × 3 × 93%	<1, 2, 4, 8, 12
McCann et al. (49)	14	Parallel squat	1 × 5 × 80%†	4, 5
Mitchell et al. (50)	11	Parallel squat	1 × 5 × 87%†	4
Moir et al. (51)	11	Parallel squat	1 × 3 × 90%	9‖
Mola et al. (52)	11	Parallel squat	1 × 3 × 93%†	0.25, 4, 8, 12, 16, 20
Naclerio et al. (53)	15	Parallel squat	1 × 3 × 80%	1, 4
			3 × 3 × 80%	
Naclerio et al. (54)	11	Parallel squat	1 × 1 × 90%	0.25, 1, 2, 3, 5, 8, 12
			1 × 3 × 90%	
			2 × 3 × 90%	
O'Grady et al. (55)	29	Parallel squat	1 × 4 × 87%†	6
Seitz et al. (62)	18	Parallel squat	1 × 3 × 90%	0.25, 3, 6, 9, 12
Suchomel et al. (69)	16	Concentric squat	1 × 2 × 90%‡	<1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Sygulla et al. (70)	29	Parallel squat	1 × 3 × 90%	5
Thomas et al. 2017	11	Parallel squat	3 × 3 × 93%‡	8
Tsolakis et al. (73)	23	Isometric leg press	3 × 3 × MVIC	0.25, 4, 8, 12
Weber et al. (77)	12	Parallel squat	1 × 5 × 85%	<1
West et al. (78)	36	Parallel squat	3 × 3 × 93%	8

*% = percentage of one repetition maximum; MVIC = maximal voluntary isometric contractions; FI = functional isometric.
†Percentage based on max repetitions.
‡Multiple sets at varying intensities were performed before the listed stimulus.
§Repetition represents the range of multiple trials with different repetitions.
‖Rest interval is the average of multiple individualized rest intervals.

Table 2. Combined study characteristics reported as mean ± *SD* and range.*

Intensity (% 1RM)	Repetitions performed	Sets performed	Rest interval (min)	Age (y)	Body mass (kg)	Height (cm)	Female (%)
89.9 ± 0.1 (80–150)	3.1 ± 1.3 (1–5)	1.4 ± 0.7 (1–4)	5.7 ± 4.7 (0.17–24)	22.8 ± 2.2 (18–26.5)	82.4 ± 8.9 (56–107.3)	179.1 ± 2.2 (174–187)	12.8 (0–100)

*RM = repetition maximum.

reduced maximum-likelihood estimation adjusting for between-study variance and the correlation between effects nested within studies using the metafor package (*rma.mv* function) (76) in *R* (56) was used to generate an overall mean ES and 95% confidence interval (CI), for potentiation on vertical jump performance according to standard procedures (36,66). In the attempt to identify sources of potential heterogeneity, a priori moderators (e.g., rest interval, sets,

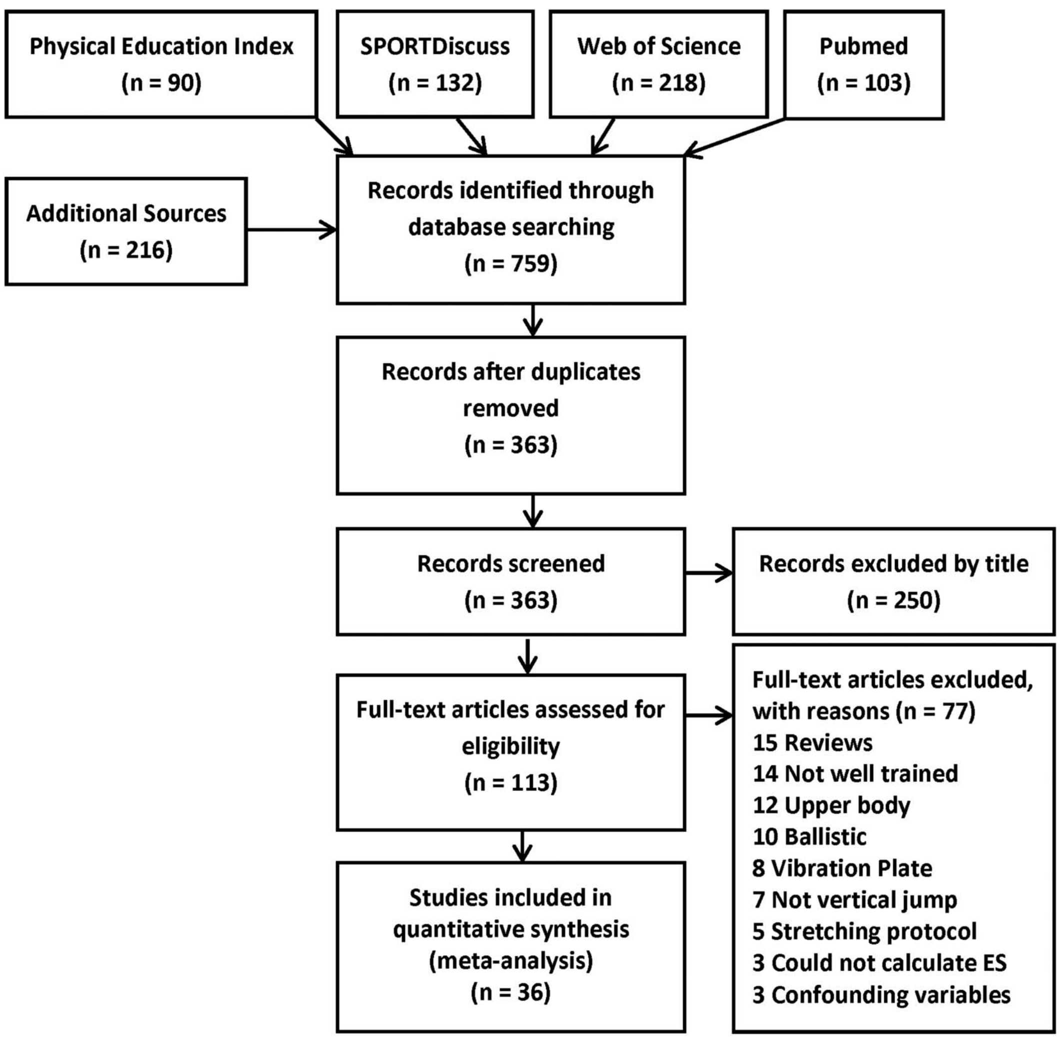

Figure 1. Flowchart of study selection. ES = effect size.

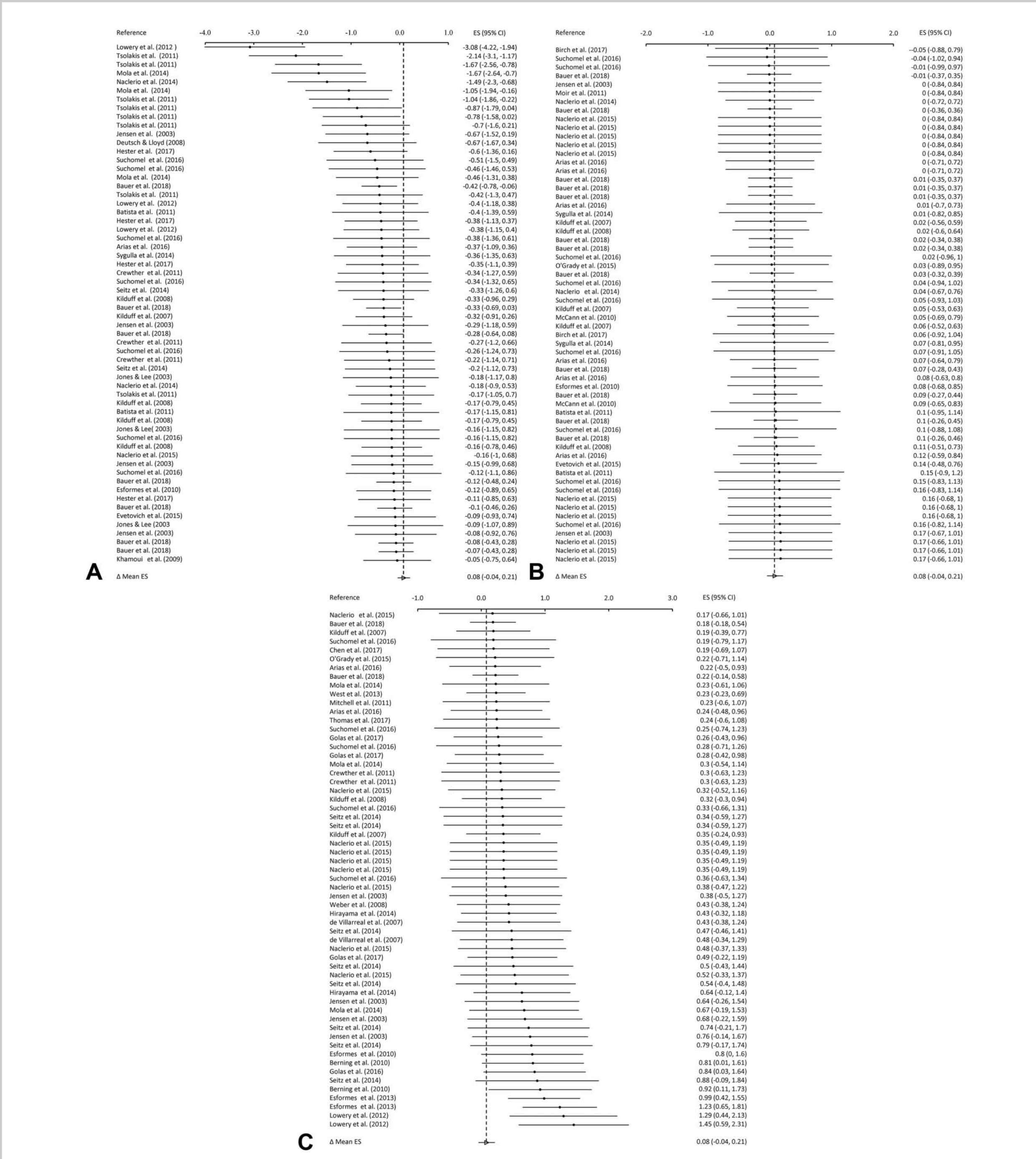

Figure 2. A) Forest plot of Hedges' *d* effect size. B) Forest plot of Hedges' *d* effect size. C) Forest plot of Hedges' *d* effect size. CI = confidence interval; ES = effect size.

reps, mode, and strength) were tested within the multilevel model (75). The observed association between rest interval and vertical jump was assessed as a linear and quadratic relationship. For inclusion within the multilevel meta-regression analysis, rest interval was centered at 5.7 minutes (the average of the aggregate data) and squared to account for the proposed quadratic relationship of rest interval and PAP within athletes and trained individuals in previous analyses (63,79). The I^2 statistic was used to calculate heterogeneity among studies (32,33). Egger's test was calculated to determine

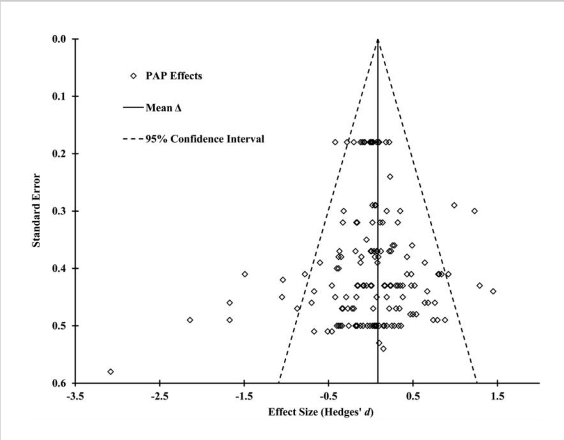

Figure 3. Funnel plot of Hedges' *d* effect size vs. standard error denoting outliers. PAP = postactivation potentiation.

the presence of publication bias (20). All data are represented in M ± *SD* unless otherwise indicated.

Results

The cumulative results of 179 effects published before January 18, 2018, indicated that PAP induced by heavy loads does not improve vertical jump performance (ES = 0.08, 95% CI −0.04 to 0.21, $p = 0.197$). Heterogeneity was indicated if the Q statistic reached significance of $p < 0.05$ and sampling error accounted for <75% of observed variance (29). I^2 value is classified as low, moderate, or high, based on values equal to 25%, 50%, or 75%, respectively. The effect of PAP on vertical jump performance showed moderate heterogeneity ($Q_{178} = 258.557$, $p < 0.001$, $I^2 = 31.16\%$, 95% CI 16.94%–42.94%) with sampling error accounting for 68.84% of the observed variance. The variability among effects is presented in the forest plot in Figure 2.

A priori subgroup comparison of the categorical variables indicated that significant heterogeneity was accounted for by the mode of PAP movement (dynamic vs. isometric) and the rest interval. No other moderators were found to explain a significant amount of the observed heterogeneity (all $p >$ 0.05). The analysis of exercise mode showed a moderate negative effect when PAP stimulus was induced by an isometric contraction (ES = −0.52, 95% CI −0.89 to −0.14, $p =$ 0.007) compared with a trivial positive effect when using a dynamic movement (ES = 0.17, 95% CI 0.01 to 0.33, $p =$ 0.133). Rest intervals between 3 and 7 minutes after stimulus showed the greatest increase in potentiation (ES = 0.18, 95% CI 0.05 to 0.31, $p = 0.007$) compared with rest intervals of less than 3 minutes (ES = −0.16, 95% CI −0.31 to 0.01, $p =$ 0.052), between 8 and 12 minutes (ES = 0.03, 95% CI −0.12 to 0.18, $p = 0.676$), and greater than 12 minutes (ES = 0.04, 95% CI −0.22 to 0.31, $p = 0.742$). Furthermore, when examining the rest interval expressed as a continuous variable, the multilevel meta-regression found rest interval ($\beta = -0.04$, 95% CI −0.57 to −0.02, $R^2 = 14.31\%$, $p < 0.001$) to be the only moderator significantly associated with change in vertical jump performance after PAP.

Publication bias was acquired using Egger's test and a funnel plot, shown in Figure 3 (20). The funnel plot was created by plotting the treatment effects against standard error (68), as recommended when using the a standardized mean difference ES (4,31,67,68). The results from Egger's test suggested little evidence of publication bias ($p = 0.644$). Through visual inspection of the funnel plot, 16 effects were recognized as potential outliers, falling outside the 95% CI. All potential outliers were represented in 7 of the 36 studies (3,6,21,46,52,54,73). A sensitivity analysis removing all potential 16 outliers yielded a similar, yet significant result (ES = 0.07, 95% CI 0.00 to 0.13, $p = 0.038$), and eliminated the observed heterogeneity ($Q_{162} = 90.49$, $p > 0.99$, $I^2 = 0\%$).

Discussion

The results of the current study indicate that PAP does not significantly improve vertical jump performance; nevertheless, the current body of published literature has yielded inconsistent findings. Postactivation potentiation induced by heavy loads (≥80% 1RM) did not improve explosive power when measured as vertical jump performance; however, there was significant heterogeneity among the results, with 104 of the 179 (58.1%) effects greater than zero. Data extracted for this analysis indicated that rest intervals less than 3 minutes may impair vertical jump performance. Conversely, providing a rest interval between 3 and 7 minutes provided small but statistically significant improvement in vertical jump performance. Rest intervals beyond 7 minutes produced a trivial effect on vertical jump performance, suggesting that the potentiating effect of the heavy loaded stimulus had dissipated. Eleven of the 16 outliers were negative effects. Furthermore, of those 11 negative effects, 9 (82%) contained rest periods outside 3 to 7 minutes. Of the 5 positive effects that were outliers, 4 (80%) were performed at rest intervals within the 3 to 7 minute range. The primary findings of this meta-analysis were that vertical jump performance was primarily influenced by the length of the rest interval. These results suggest that practitioners should consider using 3 to 7 minutes rest before performance when using loads ≥80% 1RM.

Previous meta-analyses that have examined the effect of PAP on power output have also reported mode, rest intervals, number of sets, and training status as noteworthy moderators (27,43,63,79), but have failed to account for the correlation of multiple effects gathered from a single study. In the multilevel meta-regression analysis, the length of the rest interval explained the greatest amount of variation in the mean ES, and was the only variable associated with a change in vertical jump performance when accounting for all potential variables in the multivariate analysis. However, the subgroup comparisons may also provide noteworthy information valuable to the practitioner. For example, the current analysis supports dynamic movements as a preferable mode of PAP compared with isometric contractions. Our results are consistent with the meta-analysis by Seitz and Haff (63) who showed maximal isometric contractions to produce an ES of −0.09. One proposed explanation for overall negative mean effect of isometric contractions has been acknowledged by Tillin and Bishop (72) who suggest that isometric contractions recruit more higher threshold motor units but accrue greater amounts of fatigue. It is also possible that isometric stimuli fail to mimic the order of recruitment specific to the movement, as Hodson-Tole and Wakeling (35) suggest that motor unit recruitment can be task-dependent. Thus, isometric contractions may not potentiate motor unit recruitment patterns specific to the task of vertical jump, failing to provide a worthwhile stimulus to the muscle being tasked with the vertical jump performance. Interestingly, these data contradict the results from the study by Berning et al. (6) who noted a 5.1–5.5% increase in vertical jump 4 and 5 minutes after a dynamic warm-up with a 3-second functional isometric (FI) contraction. This warrants future investigation into the mechanisms applied through FI contraction and whether or not this stimulus should be classified as isometric or dynamic within future meta-analyses. However, it is notable that Berning et al. (6) prescribed rest intervals that are to be considered ideal within our results.

The current findings suggesting 3 to 7 minutes of rest as the most optimal rest interval for performance contradict that of 3 of the 4 previous meta-analyses (27,43,79). Gouvêa et al. (27) also performed a meta-analysis on vertical jump performance using loads ≥80% 1RM and reported that rest intervals of 4 to 7 minutes provided a trivial effect, whereas intervals of 8 to 12 minutes produced the greatest effect (ES = 0.24). Longer rest intervals (7–10 minutes) have also been identified as optimal (43,79). Wilson et al. (79) noted an ES of 0.70 on power with rest intervals of 7 to 10 minutes and an ES of 0.54 for the 3 to 7 minute rest intervals. However, both effects were larger than that reported within the current investigation. One proposed explanation for the larger overall effect reported by Wilson et al. (79) is the inclusion of Wingate measures of power output. As the current analysis only included measures of power derived from vertical jump height, peak power output, or displacement, the comparison of the effects between the 2 investigations may be influenced by the differences in measurement for calculating power. The longer rest intervals of 7–10 minutes (27,79) may be related to the inclusion of untrained subjects who would be more susceptible to fatigue. The exclusion of untrained individuals in this analysis may explain the shorter optimal rest interval because trained individuals have been shown to display faster recovery (65). In addition, Seitz and Haff (63) reported rest intervals of 5 to 7 minutes as the most optimal (ES = 0.49), which support our findings. Inclusively, all analysis reported similar findings that shorter intervals, immediately after stimulus up to 3 minutes, and rest intervals beyond 12 minutes provide a trivial response.

Of the 3 meta-analyses that performed moderator analysis on the influence of sets, all contradict the findings of the current analysis of a null relationship and suggest multiple sets as providing the most beneficial increase in performance (43,63,79). One proposed explanation for the difference in results is that the present analysis only included PAP stimuli induced by ≥ 80% 1RM. The other noted analyses included moderate-intensity stimuli, which may induce less fatigue per set, and multiple sets may be required to reach full potentiation. This was documented by Wilson et al. (79) who noted the optimal performance (ES = 1.06) with multiple sets at moderate intensities (60–84%). However, an ES of 0.31 was also reported for high intensities (>85%), which is larger than that of the current findings. Training status has also been noted as a prospective component of PAP because athletes have been identified to have significantly higher force and power parameters compared with recreationally trained athletes. It has even been suggested that PAP may be a beneficial method for acutely increasing performance in athletes but not for recreationally trained individuals (14). Therefore, training status may factor into the prescription of single vs. multi-sets. As identified by Seitz and Haff (63), stronger individuals displayed a greater effect with single sets where weaker individuals exhibited a larger effect from multiple sets. The inclusion criteria for this meta-analysis required at least 1 year of resistance training because it was the intent to include subjects who where more highly trained on average. As a result, training status was not found to be a significant moderator, suggesting that the exclusion of subjects who possessed less than 1 year of training successfully controlled for the effect of training status within this analysis, which may account for the null effect of sets on vertical jump performance. Taken in the context of these previous reviews, the results of the current analysis should help guide practitioners. Training status, rest interval, load, mode, and sets may all potentially influence the effect of PAP; however, the length of the rest interval may be the strongest predictor of performance change within the training status and age range of the current analysis.

Several limitations are present within this analysis. Common within meta-analyses that derive ES estimates from pre- and post-aggregate data, the correlation between the repeated measures in the current analysis was inherently unknown and assumed to be moderate (61). Therefore, a positive effect with a high correlation between pre and post values may have been underestimated. Also, because untrained subjects were not of interest, these results cannot be generalized to samples that did not fit the given criteria. Although mode was found to have significant heterogeneity, only 15 of the 179 effects (8.4%) performed isometric contractions. Thus, the nonsignificant association between mode and vertical jump performance after PAP within the meta-regression may have been due to low power. It is also of note that training status has been described as a common moderator for the effect of PAP; yet, the data within PAP studies do not account for aerobic or anaerobic fitness level. Instead, the common practice is to imply fitness level based on years of training experience. This provides a gap in the literature because recovery has been noted as an aerobic phenomenon (39). Furthermore, the current analysis was unable to calculate relative strength due to a lack of reported 1RM values. Relative strength could be a moderator of interest, and future research should consider the evaluation of fitness parameters such as aerobic capacity and relative strength because these moderators are lacking consistency in the current literature.

Practical Applications

Practitioners who use PAP within their training protocol should be aware of the fatigue-potentiation relationship and the appropriate timing to achieve maximal performance (57). This analysis suggests that the length of the rest interval may be the most important factor contributing to performance due to PAP at intensities ≥80% 1RM in trained individuals and is optimized when using dynamic movements. Furthermore, rest intervals less than 3 minutes may have a negative impact on explosive power as measured through vertical jump performance. Likewise, isometric contractions may induce greater fatigue compared with dynamic movements, which inhibit the performance enhancement effect of PAP. However, results indicated that a worthwhile increase in vertical jump can be achieved if certain PAP guidelines are followed. Our analysis suggests that when using an intensity ≥80% 1RM, potentiation is optimized by using a dynamic movement and providing 3 to 7 minutes of rest in trained individuals.

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