International Journal of Engineering & Technology, 7 (2.15) (2018) 161-164

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research Paper

Effects of Different Intensities of Weighted Vest Warming up Session on Physical Performances of Power Sports Athletes

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Abstract

Optimum physical performance is vital component for athletes to excellent in their sports. Weighted vest warming up is one of the ways to manipulate intensities of warming. The purpose of this was to investigate the effect of different intensities weighted vest warming up session on physical performances. Twenty participants from power sports athletes was did all weighted vest warming up protocol (a) wore weighted vest 6% of body mass,(W6),(b) wore weighted vest 12% of body mass (W12) (c) with body weight only or 0% of additional weight in intensities of warming up session (W0). All participants undergo cross over design and evaluated using vertical jump test, standing broad jump test, seated medicine ball toss test and 20m sprint test after finish each warming up sessions. 1-way, repeated-measures analysis of variance on the test result showed significant different of the effect different intensities of weighted vest warming up session on all physical performances test. In conclusion, usage of 6% and 12 % from body weight of additional weight on weighted vest warming up session can promote to improving physical performances.

Keywords: *Warming Up, Physical Performance, Post Activation Potentiation, Power Sports, Intensity.*

1. Introduction

Warming up prior to main activities is already a habit and common. Warming up is performed before the main activities to get good performance during training as well as during competition to reduce risk of injuries [1, 2]. Warming up session commonly consists of activities such as slow jogging, cycling, swimming and stretching [3-5]. Systematic and meta-analysis done by Fradkin et al. (6) stated that warming up session showed result of 79% improvement in performance, 3% showed no effect and surprisingly 17% showed negative effects. Fradkin et al. [6] stated that the variance effect of warming up session is related to unsuitable of activity in warming up session or intensity. As we can see, intensity of warming up session played an important role in contributing to good performances. Intensity of warming up session is a measurement of toughness of the activities which can be manipulated by several elements. Study by Wilburn et al. [7] used ventilator threshold (VT) as the parameter of the intensity of warming up session to see the effect on aerobic performance. Gourgoulis et al. [8], showed the difference intensity of load in term of one repetition maximum (1-RM) in squat movement prior to vertical jump performance.

Weighted vest can be one of the equipment used to manipulate load in warming up session. The used of weighted vest can increase the intensity of warming up session. Suitable and optimum effect of warming up session can be advantages on fitness and sports performance. The usage of weighted vest can be one of many ways to make warming up session as the positive aspect to enhance performances.

Warming up session using weighted vest is one approach to manipulate the intensity of warming up session. Study by Faigenbaum et al. [9] whose investigated the effect of using 4 different loads of weighted vest in warming up session among female high school volley ball players on explosive power performances. While Thompsen et al. [10] also investigated the acute effects of different warming up sessions with and without weighted vest on vertical jump and long jump performances in 16 athletic females.

Thompsen et al. [10] stated that positive effect of weighted vest warming up session on performance could be related to post activation potentiation (PAP) effect. Post activation potentiation appears to have its greatest effect on fast-twitch fibers [11], so it is most likely to affect activities such as jumping, sprinting, and throwing movements [12].

Post activation potentiation (PAP) referring to enhancer of neuromuscular state resulting from execution of high intensity loading of activities [12]. Definition of PAP showed the observation that promote in muscle twitch contraction force resulting to maximal or near to maximal voluntary contraction of muscles. Fatigue muscles due of contraction, will decrease performance while non-fatiguing muscle with high load and suitable duration may improve performances [13, 14].

According to Hodgson et al. [15] and Sale [16], maximum voluntary contraction will transiently increase peak torque of isometric muscles. Therefore, muscle force and rate of force development can be generated due to previous activation of muscles. It occurs

as well as the force and power induced high velocity shortening contraction and maximum velocity attained by evoked shortening contraction under high load. In other word, high arousal of nervous system, promote an increased in contractile function resulting from heavy load conditioning stimulus [17, 18]. This phenomenon is induced from maximum voluntary contractions, velocity-controlled maximal voluntary concentric and eccentric contraction, and also submaximal isometric contraction [19, 20].

PAP have two proposed mechanisms that are phosphorylation of myosin regulatory light chains which causes actin-myosin more sensitive to calcium released from the sarcoplasmic reticulum during muscle contraction proses [21, 22]. Thus, the force from contraction is increased. Besides that, this mechanism will be seen in strength training prior to plyometric exercises that causes increased synaptic excitation within the spinal cord, which resulted in increasing post-synaptic potential and subsequent increased force generating capacity of involved muscle groups [23].

Chen et al. [24] showed in their study that ten repetitions of drop jump before performing counter movement jump produced significance effect on performances. It showed that PAP has an induced effect on explosive power performance. Other than that, Turner et al. [25] used plyometric as PAP instrument to enhance sprint acceleration performance and it showed the significance effect.

Usage of weighted vest as additional intensities on warming up session was to gain the effect of PAP where it can improve physical performances. However, there is no clear evidence about the correct or suitable intensities to add on weighted vest in order to get improvement in physical performances. Hence this study intended to investigate the effect of different intensities of weighted vest warming up sessions on physical performance among power sport athletes. It was hypothesized that there was no significant difference of weighted vest warming up session's intensities on physical performances.

2. Methodology

This experimental study was designed with cross over design to determine the effects of different intensities of weighted vest warming up session on physical performances. All participants in this study underwent all intensities of the weighted vest warming up sessions followed by physical performances test.

2.1 Participants

Twenty power sports male athletes from Universiti Pendidikan Sultan Idris were chosen as participants through random sampling. They were aged between 18-24 years old. Participants with a chronic paediatric disease or an orthopaedic limitation were excluded. Participants were not allowed to increase their intensities, volume, or frequency of their program or training program during the study period if they were regularly participated in strength and conditioning program. Each participant was agreed and signed an informed consent form prior the test.

Table 1.0: Dynamic warming up protocol

Warming Up	Exercise Description
1. Speed skips	While skipping forward, participants emphasized speed of movement and vigorous arm action with both elbows at 90 degree of flexion.
2. Heel kicks	While moving forward, participants rapidly kicked the heels toward the buttocks while emphasizing speed of movement and quick feet.
3Toes in, toes out	While rapidly hopping forward, participants turned the toes inward with the heels turned outward and then turned the toes outward with the heels turned inward. Emphasis was on hip rotation and speed of movement.
4. Trunk twists	Participants placed both hands behind the head and rapidly hopped forward as they twisted their hips to the right and left. They maintained an upright position with the chest forward as they emphasized trunk rotation
5. Skipping straight-leg toe touches	From a standing position with both arms extended in front of the body, participants skipped forward as the left foot was raised toward the left hand and then the right foot was raised toward the right hand. Participants skipped when switching from the left leg to the right leg.
6. Drop squat carioca	From a standing position with feet close together, participants hopped and landed with feet shoulder width apart and knees slightly bent. Then participants rapidly moved laterally while crossing the feet in front of each other. The exercise was repeated in the opposite direction.
7. Push-ups	From a modified push-up position with the knees on a mat and the hands near the chest, participants performed 3 push-ups at a controlled speed followed by 3 explosive push-ups in which they attempted to lift their hands and body off the mat.
8. Sprint series	From a standing position with the feet close together, subjects leaned forward and sprinted.
9. High knee skip	While skipping forward, participants emphasized the height of each skip, high knee lift, and vigorous arm action with both elbows at 90 degree of flexion.

2.2 Procedure

All participants were given consent form and briefing about the study. Height and weight were taken as anthropometric measurements using stadiometer (Seca Corporation, USA). Weight of weighted vest warming up intensities was calculated based in their body weight. Before testing, participants were asked to jog for 5 minutes and then participated in one of the following 10-minute warming up sessions (table 1) in random order on non-consecutive days: (a) wore weighted vest 6% of body mass, (W6), (b) wore weighted vest 12% of body mass (W12) (c) warming up with body weight only or 0% of additional weight in intensities of warming up session (W0). The dependent variables were vertical jump test

score, standing broad jump test score, seated medicine ball toss test score, and 20m sprint test score. Each testing session took place at least 48 hours after a competition or hard practice session. In order to control for the learning effect resulted from repeated testing, we used a crossover technique in which the order of the warming up sessions was randomly assigned.

2.3 Data analysis

Descriptive statistics for all fitness variables were expressed as mean ± SD. All data were calculated using one-way repeated-measure (ANOVA) analysis of variance to analyze differences among criterion measures after the three different intensities of weighted vest warming up sessions. When a significant F value is obtained, post hoc comparisons were conducted via a least significant difference test to identify specific differences between criterion measures or testing sessions. Statistical significance set at $P \leq .05$, and all analysis were carried out using the SPSS statistical package (version 20.0; SPSS Inc, Chicago, IL).

3. Results

	Mean ± Standard Deviation		
Fitness Tests	0%	6%	12%
VJ (cm)	56.65 ± 7.84	60.45 ± 7.64*	61.30 ± 7.18*
SBJ (cm)	91.30 ± 11.21	93.70 ± 10.25*	93.90 ± 10.40*
SMBT (m)	4.10 ± .49	4.30 ± .49*	4.39 ± .46*#
20m S (s)	2.94 ± .17	2.99 ± .12	2.90 ± .13#

*P<.05 from 0% group and # P<.05 from 6% group.
VJ: Vertical jump
SBJ: Standing broad jump
SMBT: Seated Medicine Ball Toss
20m S: 20m Sprint

Descriptive data showed means for vertical jump test scores in power sports athletes increased from warming up using 0% of body weight (56.65 ± 7.84) cm, to 6% of body weight (60.45 ± 7.64) cm, and 12% of body weight (61.30 ± 7.18) cm. Standing broad jump test score also increased from warming up using 0% of body weight (91.30 ± 11.21) cm, to 6% of body weight (93.70 ± 10.25) cm, and 12% of body weight (93.90 ± 10.40) cm. Mean score for seated medicine ball toss also increased from warming up using 0% of body weight (4.10 ± 0.49) m, to 6% of body weight (4.30 ± .49) m, and 12% of body weight (4.39 ± 0.46) m. In contrast from the others test, mean score for 20 meter sprint test showed weighted vest warming up using 12% of body weight was the best time taken (2.90 ± 0.13) s followed by 0% of body weight (2.94 ± 0.17) s and 6% of body weight (2.99 ± 0.12) s.

Power sports athletes were tested using all intensities and the mean score for vertical jump test showed statistically significant different ($F(1.545, 29.346) = 26.459$, $p < 0.05$) . Pairwise comparison showed that there were significant difference in vertical jump test score between 0% and 6% of body weight on their weighted vest intensities ($p = 0.001$), and between 0% and 12% of body weight ($p = 0.000$), but no significant differences were observed between 6% and 12% of body weight ($p = 0.283$).

Second parameter measured was standing broad jump test and the mean score showed statistically significant different ($F(1.825, 34.684) = 6.850$, $p < 0.05$). Pairwise comparison showed that there were significant difference in standing broad jump score between 0% and 6% of body weight on their weighted vest intensities ($p = 0.033$), and between 0% and 12% of body weight ($p = 0.016$), but no significant differences observed between 6% and 12% of body weight ($p = 1.0$).

Next parameter was seated medicine ball toss and the mean score showed statistically significantly different ($F(1.282, 24.359) = 13.823$, $p < 0.05$). Pairwise comparison showed that there were significant differences in seated medicine ball toss score between 0% and 6% of body weight respectively ($p = 0.027$), between 0% and 12% of body weight ($p = 0.001$), and also between 6% and 12% of body weight ($p = 0.029$).

For 20m meter sprint test, it showed that the mean score was statistically significantly different ($F(1.378, 26.189) = 4.490$, $p < 0.05$) . Pairwise comparison showed that only score of 20 meter sprint test between 6% and 12% of percentage body weight ($p = 0.010$) have significant different, while score between 0% and 6% ($p = 0.808$), and 0% and 12% of percentage body weight ($p = 0.156$) showed no significant different comparison.

4. Discussions

The main purpose of this study was to investigate the effects effect of different intensities weighted vest warming up session on physical performances. Based on the findings, vertical jump test, standing broad jump test, seated medicine ball toss test, and 20m sprint test showed that there were significantly different between the intensities. This result similar with Thompsen et al. (10) where result of loaded weighted vest in warming up session produced significant different with unloaded weighted vest even though they used 10% of intensity of weighted vest. It was also supported in study from Kim et al. (26) where stated that loaded weighted vest warming up gave significant effect on vertical jump performance.

This finding could be resulted due to the fact that additional weight in weighted vest warming up session promotes a PAP effect. This theory stated that the high loading of activities before performing can increase performance of main activities. This is because of the high loading before main activities play role as enhancer of neuromuscular state (12). Usage of 6% and 12% in this study showed the effect of PAP that makes the result different statistically. Improvement in performance following suitable additional weight in warm up session also gives positive effects in leg stiffness and running economy. Study by Barnes et al. (27) that used 20% of additional body weight on weighted vest warming up session showed increased in peak running speed, leg stiffness and running economy. It also showed in Needham et al. (28) study where 20% additional body weight loaded in warm up session on football player increased significantly compared with unloaded warm up. In conclusion, additional intensities to warming up session like weighted vest can improve physical performances because of the contractile history in muscle that related on PAP theory.

5. Recommendations

Future studies could utilize motion analysis with motion capture technology to evaluate either there is any change in technique of

the physical performance after using weighted vest in warming up session.

Acknowledgement

This study was part of research funded by the Sultan Idris Education University (Code: GPU 2017-0021-102-01).

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