ARC Journal of Research in Sports Medicine
Volume 3, Issue 1, 2018, PP 6-18
www.arcjournals.org

The Effect of Load Deception on Kinetic Variables during the Second Pull from Blocks of the Power Clean

John D Duggan*, MSc, CSCS, Jeremy Moody, ASCC, PhD

School of Sport and Health Sciences, Cardiff Metropolitan University, Cyncoed Campus, Cyncoed Road, Cardiff, CF23 6XD, UK

Corresponding Author:** ***John David Duggan, *School of Sport and Health Sciences, Cardiff Metropolitan University, Cyncoed Campus, Cyncoed Road, Cardiff, CF23 6XD, UK.*
Email: *johndavidscc@gmail.com*

Abstract: *Strength & conditioning practitioners often seek novel and applied methods to enhance athletic performance. The purpose of this current research was to examine whether 'not knowing the load 'during a mid-thigh pull (MTP) performance led to enhanced performance characteristics across a randomised selection of loads (75%-95% 1RM). Fifteen male collegiate athletes (age 21.8 ± 2.3, height 171.8 ± 7.5 cm, mass 89.3kg ± 9.8kg, MTP 1RM 135.5kg ± 18kg) were selected for the pre 1RM MTP and the 5 post randomised unknown lifts between 75%-95% of individual 1RM. The research demonstrated that unknown loads at 75% 1RM lead to significant changes in average power (AP) (known1062±251 W, unknown1213 ± 289W; $p \leq 0.05$; effect size (ES) = 0.56 small). Unknown loads at 75% 1RM lead to significant changes in average velocity (AV) (known: 0.49±0.1, unknown: 0.66 ± 0.10m/s; $p \leq 0.00$; ES = 1.66 large). There was also a significant change in peak velocity (PV) at 75% 1RM (known: 0.74±0.16, unknown: 0.95 ± 0.26m/s; $p \leq 0.05$; ES = 0.99 moderate). Unknown loads at 80% 1RM lead to significant changes in AV (known: 0.47±0.10 unknown: 0.60 ± 0.10m/s; $p \leq 0.01$; ES = 1.36 large). There was no significant difference in AP, AV, peak power (PP) and PV variables across 85, 90, 95% 1RM ($p \geq 0.05$; ES = trivial to small). It appears that these findings especially at unknown loads between 75% and 80% 1RM could be beneficial in enhancing velocity-based performance variables. Therefore, the applications of unknown loads are of meaningful practical use to enhance performance variables during weightlifting pulling derivatives. Therefore, weightlifting pulling derivatives are potentially a useful training modality to improve desirable ballistic actions in particular triple extension.*

Keywords: *Load Deception, weightlifting pulling derivatives, Athletic Performance, Strength & Conditioning*

1. INTRODUCTION

Strength & conditioning practitioners endeavour to seek novel and practical methods to enhance athletic performance. The use of technology has become an integral part of strength & conditioning practice, kinematic (velocity) and kinetic (power) variables can be measured by commercially available devices.[1,2]Monitoring repetition velocity during strength training provides the practitioner with valuable information regarding the neuromuscular demands and the training effect during that particular movement. [3]The use of instantaneous feedback (knowledge of performance & knowledge of results) can have a significant influence on athletic performance.[4-9] Recent research[10]demonstrated that when athletes were provided with visual kinematic information during a back squat, this led to the maintenance of barbell velocity in subsequent repetitions, enhanced motivation and competitiveness. However, little research has been conducted on the use of load deception to enhance weightlifting performance.

The concept of false feedback has gained traction within the community. For example, informing the athlete that they are lifting a lower weight than they are, the task is perceived as less challenging and leads to increased motivation.[11,12] Siff & Verkhoshansky[13] conceptualized the idea of weightlifting with an unknown load. They theorized that by implementing load deception, it would allow the athletes other senses to super-compensate and enhance performance during a lift. They also proposed that this enabled the athlete to remember joint angles, muscular tension, movement patterns and reproduce them more effectively. This deception has been theorized to enhance proprioceptive sensitivity and makes it possible for the athlete to make more internal visualisations of a technique.[14] One of the first studies on unknown loads was conducted by Ness & Patton[15] on bench press performance.

They found that there was significantly higher strength performance when the resistance was greater than the subject believed. However, the research failed to specify why this enhancement had occurred.

A recent study[16] on handball players established that the use of unknown loads in a bench throw increased power outputs and throwing velocities compared to known loads. The researchers suggest that the unknown load stimulated the central nervous system to overestimate the mass, causing a larger force production than was required to move the real mass. Furthermore, another study established that load deception led to greater adaptations in eccentric phase variables particularly under moderate-high loads in well trained athletes.[17]This type of training stimulus may provide an innovative strategy for stimulating rapid muscle activation and enhanced force production.[18]

Recently, the application of weightlifting exercises and their pulling derivatives have gained popularity amongst practitioners.[19-22]These exercises rely on the application of large impulse over a short period of time during the second pull to create the displacement of the barbell at a rate sufficient to enable the lifter to catch the bar in the rack or overhead position.[23-26]Their derivatives enable athletes to develop their ability to apply large enough impulses across different phases of the lifts. Furthermore, the quest to enhance rate of force development (RFD) remains elusive for practitioners. RFD is an adaptation which enhances muscle activation which results in greater force production in shorter time periods.[27-29] Researchers[30-32] suggests that RFD and PPO during lower body resistance exercises are developed across a range of loads. The capacity to produce maximal voluntary activation in the early phase of explosive contraction (first 50-75ms) seems to be a determining factor in enhanced RFD production.[33] Furthermore, Suchomel et al.,[34] advocates that optimal loads should be between 90-95% of 1RM for weightlifting derivatives. Theoretically, an increase in RFD allows for a higher level of muscular force in early phase of muscular contraction (0-200ms).[35] Conclusively, athletes who possess the ability to produce dynamic explosive strength tend to have superior athletic qualities.[36,37]

The second pull of the clean produces the most force during all the phases.[38-41] The second pull of a sub maximal clean can generate vertical velocity from ranges between 0.88m/s to 1.73m/s in elite weightlifters.[42] Kilduff et al.,[43] Hoffman et al.,[44]advocates the importance of high force, high velocity training program (weightlifting) to develop strength, speed and power for field-based athletes. These improve-ements were based on the higher RFD and improved contractile speeds associated with high force, high velocity movements. Conversely, research[45] discovered that the mid-thigh clean pull resulted in higher PPO compared to a power clean. Kipp et al.,[46] Suchomel et al.,[47]and Hori et al.,[48] suggest these derivatives from mid-thigh simulate joint angles which are performed during the drive phase of both running and jumping during athletic performance. Izquierdo et al.,[49] suggest that greater average and peak velocity, average force and average power output have been demonstrated by using training modalities that reduce the deceleration phase by allowing the load to be projected in a throw or jump.

A plethora of research has demonstrated that weightlifting pulling derivatives produce similar or greater force, velocity power variables during the second pull compared with full weightlifting movements.[50-52] Suchomel et al.,[53]andComfort et al.,[54] suggests that weightlifting pulling derivatives from blocks may require a greater RFD compared with a dynamic start because the athlete would have to overcome inertia. Furthermore, a more upright position during the pull phase could enhance force production capabilities.[55] The enhanced force production could improve mechanical advantage and stimulate a potentiated stretch-shortening cycle. The derivatives may also enable the practitioner to overload the triple extension movement, enhancing strength and power character-ristics.[56,57] Therefore, the application of these derivatives may enhance the triple extension movement within the athletic population[58-60]Also, from a pragmatic perspective, the teaching of derivatives may enable the athlete to achieve the ability to produce higher velocities and higher force movements without gaining full technical competency of the lift.[46]

The objective of this research is to ascertain whether not knowing the load to be lifted during of a mid-thigh pull (MTP) could enhance kinetic and kinematic variables. The research analysed if an athlete provided a ‘true’ maximal effort when faced with a known load compared to an unknown load. It has been theorized that when the athlete is unaware of the load other senses will super-compensate and enhance performance.[13] The MTP offers a practical application that is easier for less experienced athletes to learn because of the omission of the catch phase.[45] Furthermore, MTP produces the greatest lower body power as compared to other weightlifting derivatives. [61,62] The findings of this project may result in an opportunity for training adaptations for both weightlifters and sports performers who adopt derivative weightlifting movements.[63-65] Consequently, the stimulus of unknown load could provide a novel coaching application.

2. METHODS

2.1. Participants

The study was approved by the Cardiff Metropolitan University Institutional Ethics Committee, conforming to the declaration of Helsinki. All participants provided informed consent prior to participation. Fifteen male collegiate athletes (age 21.8 ± 2.3, height 171.8 ± 7.5cm, mass 89.3kg ± 9.8kg, MTP 1RM 135.5kg ± 18kg) participants were recruited from the Institutions Weightlifting Team and students who were proficient in weightlifting movements (GAA-Gaelic Football & Hurling, Rugby). All participants were engaged in a structured resistance training program for18 months and were participants in the institutions sport science support program. This was to ensure competency of skills involved in the study. The recruitment of participants was on a voluntary basis. Prior to the research, MTP familiarisation sessions were offered to the participants. All testing was completed in the Institutions high performance gym.

The participants were informed of the testing procedures and the risks associated with the protocol. All participants consented to partake in the study. Participants were asked to wear appropriate clothing and footwear. Prior to the test, participants were required to complete a physical activity readiness questionnaire (PAR-Q). Once all participants had consented and were eligible to participate in the study, the testing commenced. Participants were requested to refrain from strenuous exercise 48 hours before testing, maintain normal dietary intake and attend the testing in a hydrated state.

2.2. Testing

Anthropometric data (mass - Seca 875 Class (III)), (height - Seca 213 Height Measure) and 1 repetition maximum (1RM) of MTP was collected during the first test. The second session was for the specific testing of the unknown MTP at apercentage intensity 1RM randomly selected by the researcher. This involved the collection of velocity-based variables for further analysis which was measured by a Tendo Weightlifting Analyzer System (Trencin, Slovak Republic). Acceleration was analysed from variations in velocity over time [*acceleration = velocity (v) / time (t)*].[66]An abundance of research concluded that muscular power can be measured with a high degree of reliability with this unit.[67-70]Furthermore, Garnacho-Castaño et al., [71]demonstrated that Tendo Weightlifting Analyzer System was a reliable system for measuring movement velocity and estimating power in strength based exercises. There was a minimum of 48 hours between the two sessions to ensure optimal recovery after maximal testing in the first session.[72]Both testing sessions were completed at the same time to ensure reliability.

Before both sessions, a dynamicwarm-up protocol was completed involving hip/glute activations, dynamic whole-body movements and potentiation jumping activities. This was followed by a dynamic complex barbell warm-up of the movements involving the MTP.[73] Finally, a 1RM protocol using the MTP as suggested by Baechle et al.,[74]was completed. The same warm up protocol was used prior to the testing of blinded MTP. The only difference was when the warm up was complete, the participants left the testing area while the weight was randomly selected by the researcher. The participant was then double blindfolded outside the gym and guided back into the power rack by the researcher. This was to ensure the participants avoided any trip hazards on returning to the test platform. After the blinded attempt, they were guided back out of the gym and the next load was randomly pre-selected. Participants performed five individual unknown MTP attempts whilst the barbell was connected to the Tendo Weightlifting Analyzer System to allow for analysis of several velocity based variables. The filter within the Tendo Weightlifting Analyzer System was set to 10Hz as recommended by Cronin et al., [75]and McMaster et al.,[76]. The inclusion of body weight was used during testing as recommended by Cormie et al.,.[77] The load was randomised between 75%, 80%, 85% 90% and 95% of MTP 1RM. There was 6 minutes' rest period between each repetition to prevent any potential potentiating or fatiguing effect.

The power rack was modified so the bar (Jordan, Norfolk, UK) was at the athlete's mid-thigh height. Irrespective of stature, the preferred angles of the peak power position are approximately 60-70°, 120-130°, and 140-150° at the ankles, knees, and hip, respectively.[78,79]This was achieved by adapting the safety bars to the desirable height to achieve the angles of the jump position of the clean. The power rack could be adjusted within 5cm deviations. Participants feet were positioned shoulder width apart with the bar positioned at mid-thigh over the midfoot. Participants used the hook grip during MTP attempts. The participant contacted the barbell at a mid-thigh position. Participants adopted their MTP position and maintained tension throughout the upper body and a naturally concave curvature of the thoracic spine to maintain appropriate hip angle to maximise force produced through the floor. The ascending part of the lift was completed forcefully with triple extension through ankles, knees and hips. Participants shrugged shoulders and allowed the barbell to travel up along thighs. Elbows remained 'long and locked'. On the descent phase of the lift, knees were flexed to absorb the load.[80]

2.3. Data Analysis

The kinetic and kinematic variables AV, PV, AP and PP were calculated as follows: velocity ($m{\cdot}s^{1}$) = vertical movement of the bar (m) x time (s^{-1}), acceleration ($m{\cdot}s^{-2}$) = vertical bar velocity ($m{\cdot}s^{-1}$) x time (s^{-1}). force (N) = system mass (kg) x vertical acceleration of the bar ($m{\cdot}s^{-2}$) + acceleration due to gravity ($m{\cdot}s^{-2}$) power (W) = vertical force (N) x vertical bar velocity $m{\cdot}s^{-1}$).[70] Regression equations were used to predict estimated velocity based measures from the 1RM using Excel software (Microsoft: Redmond, WA, USA). [81,82]From the linear regression formula the load when velocity is zero and velocity when load is zero was calculated to estimate the various loads in AV, PV, AP and PP.[81]

2.4. Statistical Analysis

Standard statistical methods were used for the calculation of descriptive statistics (means, standard deviations (SD)). The normality of the data was analysed by using a Shapiro-Wilk Test. A paired sample t-test was used to compare means and ensure the data was normally distributed with no outliers.[83]The alpha level was set at $p \leq 0.05$. Relative reliability between repetitions within each testing session was determined using a 2-way random effects model intra-class correlation coefficients (ICCs) and 95% confidence intervals. The ICC *r* values was interpreted according using the criteria of Cortina[84]where *r* 0.80 is highly reliable.[85,86] Effect Size[87]classification was determined using Hopkins[88] scale which defines <0.2, 0.2-0.6, 0.6-1.2, 1.2-2.0, 2.0-4.0 and >4.0 as trivial, small, moderate, large, very large and extremely large respectively.[89,90]This type of magnitude statistic can enable the reader to infer whether this type of training stimulus has practical application in addition to statistical significance.[91]All statistical procedures were analyzed using SPSS 24 (IBM, New York, NY, USA).

3. RESULTS

The ICC indicated that the dependent variables were reliable (AV; r=0.92, AP; r=0.89, PP; r=.090 and PV; r=0.93). Table 1 shows significant p-values for all known and unknown loads of the MTP. There was a significant difference between pre AV 75 (0.49 ± .11) and post AV75 (0.66 ± .097) conditions; t (14) =-5.66, p = 0.000 (ES = 1.66; large). There was also a significant difference between pre AV 80 (0.47 ± .097) and post AV 80 (0.60 ± .099) conditions; t (14)=-4.23, p = 0.001 (ES = 1.36; large). There was no significant difference between pre-AV 85, 90, 95 and post AV 85, 90, 95 (p-values ranging 0.023 to 0.129; ES ranging from 0.52 to 0.86; small to moderate).

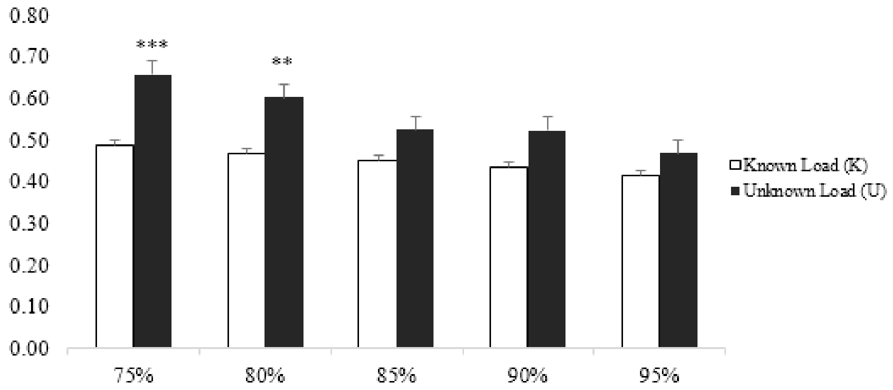

Figure1. *A comparison ofAV of known and unknown mid-thigh pull variables with effect sizes*

There was a significant difference between pre AP 75 (1062 ± 251) and post AP75 (1212 ± 289) conditions; t(14)=-2.073, p = 0.05 (ES = 0.56; small). There was no significant difference between pre-AP 80, 85, 90, 95 and post AP 80, 85, 90, 95 (p-values ranging 0.496 to 0.832; ES ranging from 0.04 to 0.27; trivial)

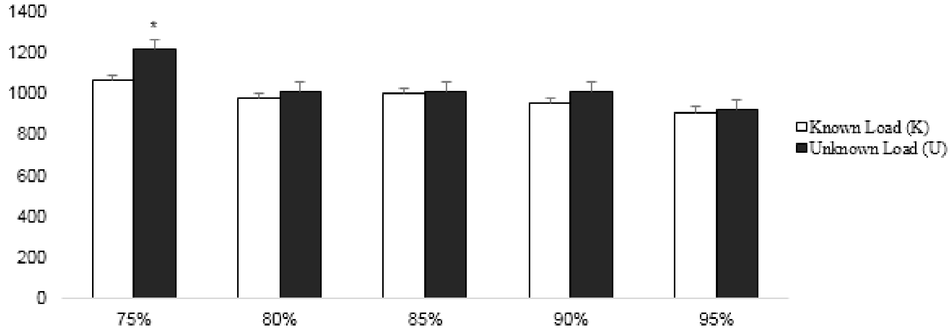

Figure2. *A comparison of AP known and unknown mid-thigh pull variables with effect sizes*

There was a significant difference between pre PV 75 (.74 ± 0.16) and post PV 75 (.095 ± .026) conditions; t(14)=-3.325, p = 0.05 (ES = .99; moderate). There was no significant difference between pre-PV 80, 85, 90, 95 and post PV 80, 85, 90, 95 (p-values ranging 0.007 to 0.651; ES ranging from 0.14 to 0.83; trivial to moderate).

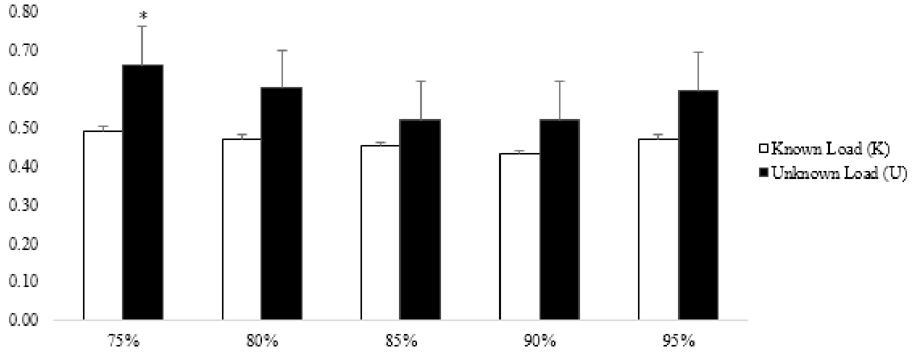

Figure3. *A comparison of PV of known and unknown mid-thigh pull variables with effect sizes*

Table1. *Mean ± SD, Average Power (W), Average Velocity (m/s), Peak Power (W), Peak Velocity (m/s) across various loads of known (K) and unknown loads (U)*

	K 75	U 75	K 80	U 80	K 85	U 85	K 90	U 90	K 95	U 95
AP	1062±251	**1213±289***	976±261	1011±214	998±248	1009±255	952±237	1006±154	909±226	919±173
AV	0.49±0.11	**0.66±0.10*****	0.47±0.10	**0.60±0.10****	0.45±0.09	0.52±0.11	0.43±0.09	0.52±0.12	0.42±0.08	0.47±0.12
PP	1629±412	1816±496	1563±396	1622±311	1506±376	1560±381	1433±363	1472±264	1368±346	1355±272
PV	0.74±0.16	**0.95±0.26***	0.70±0.15	0.83±0.14	0.68±0.14	0.78±0.17	0.65±0.14	0.72±0.15	0.62±0.13	0.64±0.14

Change from Pre-Test Significant At:

*(P ≤ 0.05) **

*(P ≤ 0.01) ***

*(P ≤ 0.00) ****

There was no significant difference between pre - PP 75, 80, 85, 90, 95 and post PP 75, 80, 85, 90, 95 (*p*-values ranging .132 to .893; ES ranging from 0.12 to 0.41; trivial to small).

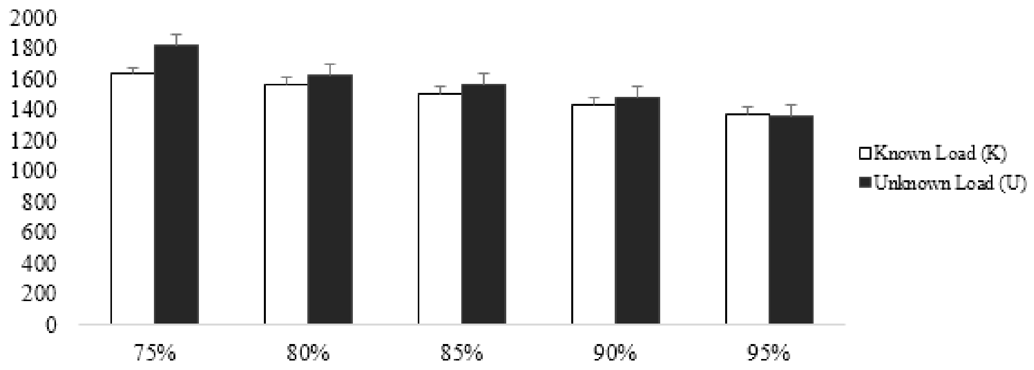

Figure4. *A comparison ofPP of known and unknown MTP variables with effect sizes*

4. DISCUSSION

The objective of this study was to determine whether not knowing the load to be lifted during an MTP performance across a variety of randomised loads led to improvements in kinematic and kinetic variables. The research demonstrated that unknown loads at 75% 1RM led to significant changes in AP with small ES, In AV, there was a large ES and in PV there was a moderate ES. Furthermore, significant change occurred in AV unknown loads at 80% 1RM with large ES. There was no significant difference in AP, AV, PP and PV variables across 85, 90, 95% 1RM (trivial to small ES). It appears that these findings especially at loads between 75% and 80% 1RM lead to improved performance in velocity variables. Specifically, Kipp et al,[92] demonstrated that optimal external mechanical power output during a power clean was between 75% and 85% of 1RM. These findings also coincide with Sabido *et al.,*[16] who found that unknown loads lead to greater power outputs in early time intervals and increased throwing velocity during an unknown bench throw. Comfort *et al.*,[93] demonstrated that individual peak power occurred at ranges between 60% and 80% 1RM. Male collegiate athletes demonstrated significantly greater bar velocities with 40-80% 1RM during a known MTP performance.[94] This was of similar cohort used in this study. Cormie *et al.*,[95] further advocates that weightlifting loads ranging from 50% to 90% of 1RM have a significant effect in improving peak force, velocity and impulse. However, Haff *et al.*,[96] proposes in a known clean pull loads of 80% 1RM or less produces the highest power outputs, which supports the results in this study. Furthermore, this study coincides with Jidovtseff et al.,[97] who advocated that loads between 54 and 84% of 1RM should be used to emphasize power production when using load-velocity relationships. Jandačka and Beremlijski[98] demonstrated that the optimal load for reaching maximum power output for dynamic strength effort was between 50 to 80% of 1RM in athletes. Training with optimal load is important due to the neural factors which could contribute to enhanced motor-unit recruitment, rate-coding and synchronization. The higher threshold Type II muscle motor units are recruited during higher power outputs[99] Conclusively, this can allow practitioners to infer that these loads replicate the strength-speed segment of the force-velocity curve which occurs between 0.75-1.0m/s.[100,101]

To the best of the researcher's knowledge this is the first study which used an weightlifting derivative at unknown loads. The study attempted to demonstrate that, when an athlete is aware of the load, they do not produce maximal effort (kinematic and kinetic variables). Conversely, when faced with an unknown load, they produce increased effort which manifests itself in increased kinematic and kinetic measures. This seemed to be the case in study at 75% 1RM and to a certain extent at 80% 1RM. It has been theorized that mechanism of unknown loads stimulates the central nervous system to overestimate the weight, thus allowing a larger force production to move the actual weight.[102]Hernández-Davó*et al.*,[17,18] hypothesize the potential mechanisms used during an unknown load involve changes in both voluntary activation and reflex-mediated muscular activation. Furthermore, unknown loads have been associated with increased stiffness and greater recoil of the muscular-tendon unit which are associated with concentric performance during SSC activities.[103]

The over-estimation of load may be due to muscle pre-activation which is often used as a mechanism to increase joint stiffness.[104] The mechanisms of pre-activation allow the muscular-tendon unit to produce a higher muscular force at the concentric element and could have enhanced unknown loads at 75% 1RM in AV, AP and PV. Furthermore, the co-activation in the agonist muscle-tendon unit can enable elastic energy to be stored and potentially used in the concentric phase of the movement. This will produce superior rapid force during the primary phases of the unknown MTP.[105]It has also been suggested that co-activations increase joint stability and stiffness.[106]The movement velocity could have led to improvements in the performance characteristics during the unknown MTP loads. This type of stimulus has been proven to enhance the reflex inhibition of the Golgi tendon organs and the facilitation of the muscle spindles. Additionally, this can stimulate synergistic activation of antagonist and agonist motor units.[107,108] The use of unknown loads could elicit enhanced neural contributions which lead to higher-power outputs including motor-unit recruitment, rate coding and synchronization in known loads.[99]

The method of using unknown loads may provide an important stimulus for the increased activation and subsequent movement velocities during weightlifting movements.[109]This type of stimulus can enable practitioners to utilize weightlifting pulling derivatives to stimulate the required adaptation.[110]Additionally, if one can perform repetitions at higher movement velocities, this may stimulate dynamic muscular strength adaptations at loads between 60-79% 1RM.[111]In conjunction with this research, loads between 75%-80% led to significant *p*-values and moderate to large effect sizes in average power and peak velocity. The use of unknown loads could enable practitioners to utilize strength-speed training phase more effectively, which in turn allow further increases in RFD, power and maintenance of strength levels.[112,113]Recent research demonstrated that moderate to heavy loads (65-80% 1RM) optimized power output during weightlifting derivatives[114]The modality of explosive strength training provides an effective stimulus for improving early phase (0-100ms) explosive force.[115]Consequently, the use of unknown loads could have positive implications in physical rehabilitation settings and return to previous performance protocols.[116]

This research also provides further evidence that the weightlifting derivative of the MTP can be used as a method to increase performance variables such as peak force, velocity and impulse.[47,117] Additionally, because the unknown load occurred from a static start (on safety bars in this study) this may require a greater RFD due to the fact that the athlete would have to overcome inertia of the load. The MTP is a ballistic movement that causes vertical thrust with enhanced speed and force production in a minimal timeframe. A practical benefit of using weightlifting pulling derivatives such as the MTP is the reduced technical demand which potentially makes it easier for the athlete to learn. It may also reduce the potential for injury to the wrists and shoulders due to the elimination of the catch phase.[118]Furthermore, during intense periods of training, the catch phase may be eliminated to ensure the athlete is not being over-stressed in terms of training load. By eliminating the catch phase, it can allow the athlete to focus on completion of the triple extension. This can potentially overload the triple extension that is specific to the movement demands of the sport.[23]De Weese et al,[119] suggest that weightlifting derivatives can be programmed during specific training phases to coincide with speed development phases. In particular, the MTP could be used in the strength-speed phase to compliment the maximum velocity sprinting phase. Furthermore, one can overload the second pull phase considerably compared to the full weightlifting movement. [45,120,12]

A major limitation of this study was the use of estimated loads to determine the load of the unknown MTP 1RM. In the future, this could be determined by clean or power clean 1RM and applied to determine the MTP specific loads as used by Comfort et al.,[45]. A further limitation was the relative inexperience of the subjects used. In future studies, it would be appropriate to examine the effect of unknown loads on athletes who have superior training ages and to apply more liberal effect sizes for elite populations. Also, the regression analysis[80,81] used to estimate velocity variables at various 1RM's has recently been questioned by Banyard *et al.*,[122] who reported a large variability in velocity 1RM. However, Carroll et al.,[123] discovered that there was a significantly strong relationship between mean concentric velocity and relative intensity. Future research could determine a load-velocity relationship for the MTP to predict 1RM. Potential research could also be conducted longitudinally to determine the effect of unknown loads across a training cycle. The rest periods used between the randomised loads may not have been sufficient and could have had a fatiguing effect on subsequent repetitions. This is a potential explanation for the insignificant differences at 85%, 90%, 95% unknown 1RM. Additionally, the researchers observed that the participants seemed apprehensive on the first attempt of their blinded MTP effort, which could have affected the performance outcome. However, once the athlete adjusted to being blindfolded, they seemed to become more comfortable to the stimulus. In the future, a pre-trial blinded attempt could be used to overcome this potential anxiety.

5. CONCLUSION

This study demonstrated that when the load was not known participants were able to displace it at significantly greater peak and mean velocities, which resulted in significantly greater mean power. The results of this study suggest when load was not known between 75% and 80% 1RM MTP lead to greater performance in velocity based variables compared with known loads. Furthermore, the use of unknown loads seems to offer a novel stimulus to the central nervous system which leads to improvements in specific performance in a weightlifting pulling derivative. This is important for sports performance where the expression of critical intensity'[124] is an extremely desirable characteristic. This type of training stimulus may allow practitioners to provide an acute strength-speed application to training interventions. Further research is necessary to determine whether further exposure to training with unknown loads would lead to enhanced improvements in velocity variables compared to tradition strength training methods. Secondary, the use of weightlifting pulling derivatives appears to be an important method to train sports specific adaptations. However, practitioners need to be cognizant that unknown load derivatives are another method to include in the spectrum of training modalities and therefore used when deemed appropriate and necessary.

ACKNOWLEDGMENT

This manuscript is original and has not been previously published, nor is it being considered elsewhere until a decision is made on its acceptability by the ARC JRSM Editorial Review Board. The author would also like to thank the participants for their time and efforts during in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

[1] González-Badillo JJ and Sánchez-Medina L. Movement velocity as a measure of loading intensity in resistance training. *Int J Sports Med* 2010*;* 31: 347-352.

[2] Sánchez-Medina L, González-Badillo JJ, Pérez CE and Pallarés JG. Velocity-and power-load relationships of the bench pull vs. bench press exercises. *Int J Sports Med 2014;* 35: 209-216.

[3] González-Badillo, JJ, Marques MC and Sánchez-Medina L. The importance of movement velocity as a measure to control resistance training intensity. *J Hum Kin* 2011*;* Special Issue: 15-19.

[4] Schutts KS, Wu W, Vidal A, Hiegel J and Becker J. Does focus of attention improve snatch lift kinematics?*J Strength Cond* Res 2017; [Epub ahead of print].

[5] Halperin I, Williams KJ, Martin DT and Chapman DW. The effects of attentional focusing instructions on force production during the isometric mid-thigh pull. *J Strength Cond Res*2016*;* 30(4): 919-923.

[6] Sakadjian A, Panchuk D, and Pearce AJ. Kinematic and kinetic improvements associated with action observation facilitated learning of the power clean in Australian footballers. *J Strength Cond* Res 2014*;* 28(6): 1613-1625.

[7] Randell AD, Cronin JB, Keogh JWL, Gill ND and Pedersen MC Effect of instantaneous performance feedback during 6 weeks of velocity-based resistance training on sport-specific performance tests. *J Strength Cond* Res*2011*, 25(1): 87-93.

[8] Winchester JB, Porter JM and McBride JM. Changes in bar path kinematics and kinetics through use of summary feedback in power snatch training. *J Strength Cond* Res2009; 23(2): 444-454.

[9] Kilduski NC and Rice MS. Qualitative and quantitative knowledge of results: Effects on motor learning. *Amer J Occup Ther* 2003; 57; 329-336.

[10] Weakley JS, Wilson KM, Till K, Read DB, Darrall-Jones J, Roe, GAB, Phibbs PJ and Jones B. Visual feedback attenuates mean concentric barbell velocity loss, and improves motivation, competitiveness, and perceived workload in male adolescent athletes. *J Strength Cond* Res 2017; [Epub ahead of print].

[11] Radcliffe JN, Comfort P and Fawcett T. Psychological strategies included by strength and conditioning coaches in applied strength and conditioning. *J Strength Cond* Res 2015*;* 29(9): 2641-2654.

[12] Wulf G and Lewthwaite R. Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning. *Psychon Bull Rev 2016;* 23(5): 1382-1414.

[13] Siff M. and Verkohoskansky Y. *Supertraining:* (6th Ed): Rome: Verhoshansky SSTM, 2009.

[14] Fairbrother JT. *Fundamentals of Motor Behaviour*. Leeds: Human Kinetics, 2010.

[15] Ness RG and Patton RW. The effect of beliefs on maximum weight-lifting performance. *Cog Ther Research* 1979*;* 3(2): 205-211.

[16] Sabido R, Hernández-Davó JL, Botella J and Moya M. Effects of 4-week training intervention with unknown loads on power output performance and throwing velocity in junior team handball players. *PLoS ONE* 2016; 11(6): 1-12.

[17] Hernández-Davó JL, Sabido R, Behm DG and Blazevich AJ. Effects of resistance training using known vs. unknown loads on eccentric phase adaptations and concentric velocity. *Scan J Med Sci Sports* 2017, [Epub ahead of print].

[18] Hernández-Davó JL, Sabido R, Moya-RamónM and Blazevich AJ. Load knowledge reduces rapid force production and muscle activation during maximal-effort concentric lifts. *Euro J App Physio* 2015; 11(5): 2571-2581.

[19] Comfort P, Williams R, Suchomel TJ and Lake JP. A comparison of catch phase force-time characteristics during clean derivative from the knee. *J Strength Cond Res*2016*; [Epub, Published Ahead of Print]*.

[20] Suchomel TJ, Beckham, GK and Wright GA. The impact of load on lower body performance variables during the hang power clean. *Sports Biomech* 2014; 13(1): 87-95.

[21] Cormie P, McGuigan MR and Newton RU. Adaptations in athletic performance after ballistic power versus strength training. *Med Sci Sport Exer* 2010; *1582-1598.*

[22] Pennington J, Laubach L, De Marco G and Linderman J. Determining the optimal load for maximal power output for the power clean and snatch in collegiate male football players. *J of Exer Phys Online* 2010; 13(2): 10-19.

[23] Suchomel TJ, Nimphius S and Stone MH. The importance of Muscular Strength in Athletic Performance. *Sports Med* 2016;46: 1419-1450.

[24] Haff, GG, Carlock JM, Hartman, MJ, Kilgore JL, Kawamori N, Jackson JR, Morris, RT, Sands WA and Stone, MH. Force-time curve characteristics of dynamic and isometric muscle actions of elite women Olympic weightlifters. *J Strength Cond Res*2005; 19(4): 741-748.

[25] Haff GG, Whitley A and Potteiger JA. A Brief Review: Explosive Exercises and Sports Performance. *Strength Cond J* 1997; 23(3): 13-20.

[26] Newton RU and Kraemer WJ. Developing explosive muscular power: Implications for a mixed methods training strategy. *Strength Cond J* 1994; 20-31.

[27] DeWeese BH, Hornsby G, Stone M and Stone MH. The training process: Planning for strength-power training in track and field. Part 1: Theoretical aspects. *J Sport Health Sci* 2015; 4: 308-317.

[28] DeWeese BH, Hornsby G, Stone M and Stone MH. The training process: Planning for strength-power training in track and field. Part 2: Practical and applied aspects. *J Sport Health Sci;* 2015: 4: 318-324.

[29] Stone MH, Sanborn K, O'Bryant HS, Hartman M, Stone ME, Proulx C, Ward B and Hruby J. Maximum strength-power-performance relationships in collegiate throwers. *J Strength Cond* Res 2003; 17(4): 739-745.

[30] Soriano MA, Jimenez-Reyes P, Rhea MR and Marin PJ. The optimal load for maximal power production during lower-body resistance exercises: A meta-analysis. *Sports Med* 2015; 45: 1191-1205.

[31] Haff GG and Nimphius S. Training Principles for Power. *Strength Cond J* 2012; 34(6): 2-12.

[32] Andersen LL and Aagaard P. Influence of maximal muscle strength and intrinsic muscle contractile properties on contractile rate of force development. *Euro J Appl Phy,* 2006; 96, 46-52.

[33] Maffiuletti NA, Aagaard P, Blazevich AJ, Folland J, Tillin N and Duchateau J. Rate of force development: physiological and methodological considerations. *Euro J Appl Phy Online 2016*.

[34] Suchomel TJ, Comfort P and Lake JP. Load absorption force-time characteristics following the second pull of weightlifting derivatives. *J Strength Cond* Res2016; [Epub ahead of print].

[35] Aagaard P, Simonsen EB, Andersen JL Magnusson P and Dyhre-Poulsen, P. Increased rate of force development and neural drive of human skeletal muscle following resistance training. *J Appl Phy* 2002; 93: 1318-1326.

[36] McGuigan MR and Winchester JB. The relationship between isometric and dynamic strength in college football players. *J Sports Sci Med* 2008; 7: 101-105.

[37] Kawamori N, Rossi SJ, Justice BD, Haff EE, Pistilli EE, O'Bryant HS, Stone MH and

[38] Haff GG. Peak force and rate of force development during isometric and dynamic mid-thigh clean pulls performed at various intensities. *J Strength Cond* Res 2006; 20(3): 483-491.

[39] Kipp K, Redden J, Sabick M and Harris C. Kinematic and kinetic synergies of the lower extremities during the pull in Olympic weightlifting. *J App Biomech* 2012; 28: 271-278.

[40] Souza AL and Shimada SD. Biomechanical analysis of the knee during the power clean. *J Strength Cond* Res 2002; 16(2): 290-297.

[41] Garhammer J. Power production by Olympic weightlifters. *Med Sci Sports Exer* 1980; 12: 54-60.

[42] Enoka R. The pull in Olympic weightlifting. *Med Sci Sport 1979*; 11: 131-137.

[43] Storey A and Smith HK. Unique aspects of competitive weightlifting: Performance, training and physiology. *Sports Med* 2012;42 (9): 769-790.

[44] Kilduff, L, Bevan H, Owen N, Kingsley MIC, Bunce P, Bennett M and Cunningham D. Optimal loading for peak power output during the hang power clean in professional rugby players. *Int J Sports Phys per* 2008; 2: 260-269.

[45] Hoffman JR, Cooper J, Wendell M, and Kang J. Comparison of Olympic versus traditional power lifting training programs in football players. *J Strength Cond* Res 2004; 18(1): 129-135.

[46] Comfort P, Allen M and Graham-Smith P. Comparisons of peak ground reaction force and rate of force development during variations of the power clean. *J Strength Cond Res,* 2011; 25(5): 1235-1239.

[47] Kipp K, Malloy PJ, Smith J, Giordanelli, MD, Kiely MT, Geiser CF and Suchomel TJ. Mechanical demands of the hang power clean and jump shrug: A Joint-level Perspective. *J Strength Cond* Res2016; [Epub ahead of print].

[48] Suchomel TJ, Comfort P and Stone MH. Weightlifting pulling derivatives: Rationale for implementation and application. *Sports Med* 2015; 45: 823-839.

[49] Hori N, Newton RU, Nosaka K and Stone MH. Weightlifting exercises enhance athletic performance that requires high-load speed strength. *Strength Cond J 2005;* 27(4): 50-55.

[50] Izquierdo M, González-Badillo JJ, Häkkinen K, Ibáñez J, Kraemer WJ, Altadill A, Eslava J and Gorostiaga, A. Effect of loading on unintentional lifting velocity declines during single sets of repetitions to failure during upper and lower extremity muscle actions. *Int J Sports Med* 2006*;* 27: 718-724.

[51] Suchomel TJ, Comfort P and Lake JP. Enhancing the force-velocity profile of athletes using weightlifting derivatives. *Strength Cond J* 2017; [Epub ahead of print].

[52] Winchester JB, Erickson TM, Blaak JB and McBride JM. Changes in bar-path kinematics and kinetics after power-clean training. *J Strength Cond* Res2005; 19(1): 177-183.

[53] Haff GG, Whitley, LB, McCoy HS. O'Bryant JL Kilgore EE, Pierce, K and Stone MH. Effects of different set configurations on barbell velocity and displacement during a clean pull. *J Strength Cond Res* 2003;17(1): 95-103.

[54] Suchomel TJ, Wright, GA, Kernozek TW and Kline, DE. Kinetic comparison of the power development between power clean variations. *J Strength & Cond* Res2014b*;* 28(2): 350-360.

[55] Comfort P, Allen M, and Graham-Smith P. Kinetic comparisons during variations of the power clean. *J Strength Cond Res* 2011; 25: 3269-3273.

[56] Beckham GK, Sato K, Mizuguchi S, Haff, GG and Stone, MH. Effect Body Position on Force Production During the Isometric Mid-Thigh Pull. *J Strength Cond Res*, 2017 *[Epub, Published Ahead of Print]*.

[57] Hendrick A and Wada H. Weightlifting Movements: Do the benefits outweigh the risks? *Strength Cond J* 2008, 30(6), 26-35.

[58] Malyszek KK, Harmon RA, Dunnick DD, Costa PB, Coburn JW and Brown LE. Comparison of Olympic and hexagonal barbells with mid-thigh pull, deadlift, and countermovement jump. *J Strength Cond* Res 2017; 31(1): 140-145.

[59] Suchomel TJ, Taber CB and Wright GA Jump shrug height and landing forces across various loads. *International J Sports Phys Per* 2015; 28: 1-17.

[60] Kraska JM, Ramsey MW, Haff GG, Fethke N, Sands WA, Stone ME and Stone MH. Relationship between strength characteristics and unweighted and weighted vertical jump height. *Int J Sports Phys Per* 2009;4(4): 461-473.

[61] Channell BT and Barfield, JP. Effect of Olympic and traditional resistance training on vertical jump improvement in high school boys. *J Strength Cond Res* 2008;22(5): 1522-1527.

[62] Suchomel TJ and Kato S. Baseball resistance training: Should power clean variations be incorporated? *J Ath Enhan* 2013;2(2): 1-4.

[63] Brewer C and Favre M. Weightlifting for Sports Performance, in I Jeffreys and J Moody (eds.), *Strength & Conditioning for Sports Performance*. London: Routledge, 2016, pp.261-304.

[64] McBride JM, Triplett-McBride T, Davie A and Newton RU. A comparison of strength and power characteristics between power lifters, Olympic lifters, and sprinters. *J Strength Cond* Res 1999; 13(1): 58-66.

[65] Young WB. Transfer of Strength and Power Training to Sports Performance. *Int J Sports Phys Per* 2006; 1: 74-83.

[66] Helland C, Hole E, Iversen E, Olsson MC, Seyennes O, Solberg PA and Paulsen G. Training Strategies to Improve Muscle Power: Is Olympic-style Weightlifting Relevant? *Med Sci Sports Exerc* 2017; 49(4): 736-745.

[67] Harris NK, Cronin JK, Taylor KL and Jidovtseff B. Understanding position transducer technology for strength and conditioning practitioners. *Strength Cond J* 2010;32(4): 66-79.

[68] Jennings CL, Viljoen W, Durandt J and Lambert MI. The reliability of the FitroDyne as a measure of muscle power. *J Strength Cond* Res 2005*;* 19(4): 859-863.

[69] Bosquet L, Porta-Benache J and Blais, J. (2010) Validity of a commercial linear encoder to estimate bench press 1RM from the force-velocity relationship. *J Sports Sci Med* 2010; 9: 459-463.

[70] Hansen KT Cronin JB and Newton MJ. The reliability of linear position transducer and force plate measurement of explosive force-time variables during a loaded jump squat in elite athletes. *J Strength Cond* Res 2011;25(5): 1447-1456.

[71] Conceição F, Fernandes J, Lewis M, Gonzaléz-Badillo JJ and Jimenéz-Reyes P. Movement velocity as a measure of exercise intensity in three lower limb exercises. *J Sports Sci* 2016; 34(12): 1099-1106.

[72] Garnacho-Castaño MV, López-Lastra S and Maté-Muñoz JL. Reliability and validity assessment of a Linear Position Transducer. *J Sports Sci Med* 2015;14: 128-136.

[73] McGuigan MR, Cormack SJ and Gill ND. Strength and power profiling of athletes: Selecting tests and how to use the information for program design. *Strength Cond J* 2013; 35(8): 7-14.

[74] Jeffreys I. Warm up revisited the 'RAMP' method of optimising performance preparation. *Prof Strength Cond* 2007; 6: 15-19.

[75] Baechle TR, Earle RW and Wathen, D. 'Resistance training', in TR Baechle and RW Earle (eds.), *NSCA Essentials of Strength Training and Conditioning,* Champaign, IL: Human Kinetics, 2008, pp.381-412.

[76] Cronin J, Hing R, and McNair PJ. Reliability and validity of a linear position transducer for measuring jump performance. *J Strength Cond Res* 2004; 18: 590-593.

[77] McMaster DT, Gill, N, Cronin J and McGuigan M. A brief review of strength and ballistic assessment methodologies in sport. *Sport Med* 2014; 44(5): 603-623.

[78] Cormie P, McBride JM and McCaulley GO. The influence of body mass on calculation of power during lower-body resistance exercises. *J Strength Cond Res* 2007*;* 21(4): 1042-1049.

[79] Stone MH, Pierce KC, Sands WA and Stone ME. Weightlifting: A brief overview. *Strength Cond J* 2003*;* 28(1): 50-66.

[80] Marcora S and Miller MK. The effect of knee angle on the external validity of isometric measures of lower body neuromuscular function. *J Sports Sci* 2000, 18, 313-319.

[81] DeWeese BH, Serrano AJ, Scruggs SK and Burton JD. The mid-thigh pull: Proper applicationand progressions of a weightlifting movement derivative. *Strength Cond J* 2013*;* 35(6): 54-58.

[82] Jovanovic M and Flanagan E. (2014) Researched applications of velocity based strength training. *J Aust Strength Cond* 2014; 22: 58-68.

[83] Jidovtseff B, Harris, NK, Crielaard, JM and Cronin JB. Using the load-velocity relationship for 1RM prediction. *J Strength Cond* Res 2011; 25(1); 267-270.

[84] Weissgerber TL, Milic N, Winham SJ. and Garovic VD. Beyond bar and line graphs: Time for a new data presentation paradigm. *Plos Bio* 2015; 13(4): 1-10.

[85] Cortina J. What is coefficient alpha? An examination of theory and applications. *J App Psych* 1993*;* 38: 98-104.

[86] Hopkins WG. Measurement reliability in sports medicine and science. *Sports Med* 2000; 30(1): 1-15.

[87] McGuigan MR. *Monitoring Training & Performance in Athletes.* Leeds, UK: Human Kinetics, 2017.

[88] Dinsdale A and Myers T. Interpreting statistical tests for training interventions. *Prof Strength Cond J* 2016*;* 41: 7-16.

[89] Hopkins W, Marshall S, Batterham A and Hanin J. Progressive Statistics for studies in sports medicine and exercise science. *Med Sci Sports Exer* 2009; 41: 3-13.

[90] Turner A, Brazier J, Bishop C, Chavda S, Cree J and Read P. Data analysis for strength and conditioning coaches: Using excel to analyse reliability, Differences, and relationships. *Strength Cond J* 2015*;* 37(1): 76-83.

[91] Flanagan EP. The effect size statistic-applications for the strength and conditioning coach. *Strength Cond J* 2013; 35(5): 37-40.

[92] Buchheit M. The Numbers Will Love You Back in Return-I Promise. *Int J Sports Phys per* 2016; 11: 551-554.

[93] Kipp K, Harris, C, and Sabick, MB. Correlations between internal and external power outputs during weightlifting exercise. *J Strength Cond Res* 2013; 27(4): 1025-1030.

[94] Comfort P, Jones PA and Udall R. The effect of load and sex on kinematic and kinetic variables during the mid-thigh clean pull. *Sports Bio* 2015; 14(2): 139-156.

[95] Comfort P, Fletcher, C, and McMahon, JJ. Determination of optimal loading during the power clean, in collegiate athletes. *J Strength Cond Res* 2012; 26(11): 2970-2974.

[96] Cormie P, McGuigan MR and Newton RU. Developing Maximal Neuromuscular Power. Part 2-Training Considerations for Improving Maximal Power Production. *Sports Med* 2011*;* 41(2): 125-146.

[97] Haff GG, Stone M, O'Bryant HS, Harman E, Dinan C, Johnson R and Han KH. Force-Time dependent characteristics of dynamic and isometric muscle actions. *J Strength Cond Res* 1997;11(4): 269-272.

[98] Jidovtseff B, Quièvre, J. Hanon, C and CrielaardJM. Inertial muscular profiles allow a more accurate training loads definition. *Science Sports* 2009; 24: 91-94.

[99] Jandačka D and Beremlijski P. Determination of Strength Exercise Intensities Based on the Load- Power-Velocity Relationship. *J Hum Kin* 2011; 28: 33-44.

[100] Kawamori N and Haff GG. The optimal training load for the development of muscular power. *J Strength Cond* Res 2004*;* 18(3): 675-684.

[101] Cronin J, McNair P and Marshall R Force-velocity analysis of strength-training techniques and load: implications for training strategies and load. *J Strength Cond Res* 2003; 17: 148-155.

[102] Mann JB, Ivey PA, Sayers SP. Velocity-Based Training in Football. *Strength Cond J*2015;*37*: 52-57.

[103] De Looze M, Boeken-Kruger M, Steenhuizen S, Baten C, Kingma I and Van Dieen J. Trunk muscle activation and low back loading in lifting in the absence of load knowledge. *Ergonomics* 2000*;* 3: 333-344.

[104] Cormie P, McGuigan MR and Newton RU. Developing Maximal Neuromuscular Power. Part 1-Biological Basis of Maximal Power Production. *Sports Med* 2011*;* 41(1): 17-38.

[105] Wilson, JM and Flanagan, EP. The role of elastic energy in activities with high force and power requirements: A brief review. J Strength Cond Res 2008; 22(5): 1705-1715.

[106] Waugh CM, Korff T, Fath F and Blazevich AJ. Effects of resistance training on tendon mechanical properties and rapid force production in pre-pubertal children. *Eur J Appl Physiol* 2014; 117: 257-266.

[107] Duchateau J Semmler JG and Enoka RM**.** Training adaptations in the behaviour of human motor units. *J App Physio* 2006;101, 1766-1775.

[108] Crewther B, Cronin J and Keogh J. Possible Stimuli for strength and power adaptation: Acute mechanical responses**.** *Sports Med* 2005;35(11): 967-989.

[109] Cormie P, McGuigan MR Newton RU. Changes in the eccentric phase contribute to improved stretch-shorten cycle performance after training. *Med Sci Sports Exerc* 2010; 42(9): 1731-1744.

[110] Chiu LZF and Schilling BK. A Primer on Weightlifting: From Sport to Sports Training. *Strength Cond J* 2005; 27(1): 42-48.

[111] Cronin J, McNair PJ and Marshall RN. Developing explosive power: A comparison of technique and training. *J Sci Med Sport* 2001;4(1): 59-70.

[112] Davies TB, Kuang K, Orr R, Halaki M and Hackett D. Effect of movement velocity during resistance training on dynamic muscular strength: A systematic review and meta-analysis. *Sports Med* 2017*;* 47(8): 1603-1617.

[113] Baker D. A series of studies on the training of high-intensity muscle power in rugby league football players. *J Strength Cond Res* 2001;15: 198-209.

[114] Suchomel TJ, Beckham GK, and Wright GA. Effect of various loads on the force-time characteristics of the hang high pull. *J Strength Cond Res* 2015; 29(5): 1295-1301.

[115] Suchomel TJ and Sole CJ. Power curve comparison between weightlifting derivatives. *J Sports Sci & Med* 2017; 16: 407-413.

[116] Tillin NA and Folland JP. Maximal and explosive strength training elicit distinct neuromuscular adaptations, specific to the training stimulus. *Eur J Appl Physiol* 2014; 114:365-374.

[117] Killebrew SS, Petrella JK, Jung AP and Hensarling RW. The effect of loss of visual input on muscle power in resistance trained and untrained young men and women. *J Strength Cond Res* 2013; 27(2): 495-500.

[118]Comfort, P. Within and between-session reliability of power, force, and rate of force development during the power clean. *J Strength & Cond Res* 2012b; 27(5): 1210-1214.

[119]Stone MH, Pierce KC, Sands WA and Stone ME. Weightlifting: Program design. *Strength Cond J* 2006*;* 28: 10-17.

[120]DeWeese BH, Bellon CR, Magrum E, Taber CB and Suchomel TJ. Strengthening the springs. *Techniques*2016; 9: 8-20.

[121]Comfort P, Udall R and Jones, PA. The effect of loading on kinematic and kinetic variables during the mid-thigh clean pull. *J Strength Cond Res* 2012*;* 26(5): 1208-1214.

[122]Stone MH, Sands WA, Pierce KC, Carlock J, Cardinale M, Newton RU. Relationship of maximum strength to weightlifting performance. *Med Sci Sports Exerc* 2005; 37(6): 1037-43.

[123]Banyard, HG, Nosaka K and Haff, GG. Reliability and validity of the load-velocity relationship to predict the 1RM back squat. *J Strength Cond Res* 2017; *31*(7): 1897-1904.

[124]Carroll KM, Sato K, Bazyler CD, Travis-Triplett N and Stone M. (2017) Increases in Variation of Barbell Kinematics Are Observed with Increasing Intensity in a Graded Back Squat Test. *Sports Med* 2017; *5*(3): 1-7.

[125]Winter EM, Abt G, Brookes FBC, Challis JH, Fowler NE, Knudson DV, Knuttgen HG, Kraemer WJ, Lane AM, Mechelen Wv, Morton RH, Newton RU, Williams C, and Yeadon MR. Misuse of “Power” and other mechanical terms in sport and exercise science research. *J Strength Cond Res* 2016; 30(1): 292-300.

Citation: *John D.Duggan, Jeremy Moody, The Effect of Load Deception on Kinetic Variables during the Second Pull from Blocks of the Power Clean. ARC Journal of Research in Sports Medicine 2018; 3(1):6-18.*