

Effect of Complex Training on Salivary Cortisol Level, BOMB Test and Balance Performance in Shot-put Throwers: A Review

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Abstract

Performance in track and field throwing events depends to a large extent, on muscle power production. Combination of plyometric training and weight training are thought to be useful for developing athletic power. Training is an important component for achieving the goal. Both novice and elite throwers spend a large part of time preparing for conventional strength or various forms of power training in order to increase their power and strength, and ultimately aim to improve their throwing performance. However, there is a dearth of evidence of such training programs on shot put throwing performance. Steroid hormones play a key role in modulating the training response of the neuromuscular system. **Conclusion:** Literature on shot put players is very limited. BOMB may be a useful performance testing tool for throwers in the sports of athletics this review highlights the acute effect of complex training on salivary cortisol level, throwing performance and dynamic balance by measuring on SEBT in shot put elite athlete.

Keywords: Complex training; BOMB; Cortisol level; SEBT.

Concept of complex training

Ebben *et al*[21] reviewed that the combining plyometric training and weight training may be helpful in developing athletic power. Importantly, complex training alternates similar high load weight training exercises with plyometric exercises, set for set, in the same workout Performance in track and field throwing events depends to a large extent, on muscle power production.[75] Training is an important component for achieving the goal. Zara *et al*[74] stated that both novice and elite throwers spend a large fraction of their preparation using either conventional strength training or various forms of power training in order to increase their power and strength, and ultimately aim to improve their throwing performance. However, there is a dearth of evidence of such training programs

on shot put throwing performance. As salivary cortisol act as a biomarker for the resistance training. Nunes *et al*[50] stated that Steroid hormones play a key role in modulating the training response of the neuromuscular system. For example, the anabolic effects of testosterone (T) and the catabolic effects of cortisol (C) help to control muscle growth and performance.[17] However, little is known about the T and C responses of elite female athletes and the influence of different workouts.[40,44] Nunes *et al*[50] said that such an analysis is important because resistance training is now widely employed by female athletes to improve neuromuscular performance. Ekstrand[22] suggested that BOMB may be a useful performance testing tool for throwers in the sports of athletics. Salehzadeh *et al*[56] reported that Balance is inseparable part of the daily activities and it is an important index in the evaluation of athletes' performances and in this research he reported that combination of strength(resistance training) and plyometric training had a positive result in increasing the balance although they worked on handball players. Although there is lack of knowledge in literature on these

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important variables in shot putting athlete. This review examines the literature evidence of acute effect of complex training on salivary cortisol level, throwing performance and dynamic balance by measuring on SEBT in shot put elite athlete.

Shot putting is one of the most ancient forms of athletic competition. Considerable research has been performed on the event. But there is no research on the training aspect in the shot put athlete especially female athlete. Shot put is a game of immense power required for a short period of time. The goal of shot putting is throwing a heavy ball as far as possible. The researches done in the field of techniques, analysis etc. G terzis[66] states that neuromuscular training is the most important for the shot put athlete. Mont Hubbard[37] describes the importance of release variables in shotput. Gerasimos terzis[67] said that muscle strength correlates better than LBM with rotational shotput performance in elite shot putters. From a practical standpoint, there is a question arise, the question of whether training should be more focused towards the development of maximal strength or maximal power output. Schmidtbleicher[59] suggested that maximum strength is the primary influencing factor on power output. Results from a study by Stone and colleagues[62] confirmed the relationship between maximum strength and power and also provided insight to their effect on shot put performance. This study examined the relationship between strength and power indicators for 11 well-trained collegiate shot putters and found that maximum strength was strongly associated with peak power output, even with lighter loads such as the shot. Another study by Reis and Ferreira[55] evaluated the validity of several strength and power tests to predict performance in the shot put. The research gave equivocal results as some tests of power (such as a variety of jumping tests) did not correlate with performance while throwing tests (power) and weight lifting tests (strength) showed a significant association with performance As might be surmised, it is difficult to precisely determine the extent to which a thrower's anthropometry (especially

body mass) and muscle physiology characteristics are due to genetics and which are due to training. Ultimately it may be safe to say that the physical characteristics of elite level shot putters are likely affected by both training and genetics. In 2012, Gerasimos terzis[67] stated that 3 maximal bouts of shot put followed by 3 consecutive counter movement jumps or a bout of 20 m sprinting induce an acute increase in shot put performance in experienced shot putters. But there is no literature regarding any training based study along with the salivary cortisol level.

Plyometric training

The combination of weight training and plyometric training has also been investigated.[1,9, 12,26] Complex training combine biomechanically comparable high-load resistance training followed by Plyometric exercises on a set-for-set basis and has been proposed as a way to improve the quality of the plyometric training stimulus.[20] Ebben and Watts[20] upon literature study have come forward with recommendations for program design. Due to limited data, affirmative guidelines regarding the optimal amount of rest between sets of resistance training and subsequent plyometrics in the complex cannot be given. Evans *et al*[23] examined a complex of bench press and medicine ball put and found increase in medicine ball put when performed after the 5 repetitions maximum (5RM) bench press. This study suggests that efficacy of upper-body complex training and 4 minutes of intra complex rest may give better result.

Previous research has indicated that the overwhelming majority of shot put research that has been conducted largely on male athletes may not be applicable to female athletes.[2,3]

More specifically, the flight phase of the glide or spin may serve as a means of plyometrically loading the rear leg at touch-down. This would be expected to create greater force output owing to the stretch reflex effect

on the knee extensors. Likewise, it might be beneficial to perform plyometric exercises with loads similar to those of experienced in shot putting to mimic the load placed on the rear leg at rear foot touch-down, so that athletes can learn how to use the strengthened muscles.[73]

Biomarkers

Salivary biomarkers are used in stress research as it has proven superior to testing biomarkers in blood. It is well known that acute and chronic exercise elicits changes in levels of hormones and immunological compound.[8,10,28] With recent advances in the field of immune logical and molecular biology, scientists have found more promising ways of analyzing salivary biomarkers and apply them to stress research.[46] More recently, several studies have utilized saliva measures as to assess the levels of these compounds in response to exercise and training.[15,16,49,24, 34,19] Saliva offers a non-invasive and stress-free alternative to serum. In the last few years, saliva analysis has been a useful method of choice for hormone analyses.[27] Saliva collection and analysis is rapidly developing as a tool for the assessment of physiological bio- markers of sports training and Saliva can provide a useful, non-invasive alternative to the collection of serum and plasma, because it can be collected rapidly, frequently and without stress.[10] Papacosta & Nassis *et al*[52] stated that the use of saliva for monitoring steroid, peptide, and immune markers in sport and exercise has made saliva sampling and analysis very attractive to several researchers and clinicians. Cortisol the core glucocorticoid in humans, is known for its important role in metabolism and immune function.[53,31]. Increased cortisol levels are associated with anxiety[41], depression states[29] and intensive physical exercise.[51,63] It is considered catabolic in nature because of its effect on protein and carbohydrate metabolism.[69,72] Stimulation of gluconeogenesis by cortisol spares blood glucose and reduces protein stores. Such diminution of stored protein

may lead to a wasting of skeletal muscle.[69]

Salivary cortisol is a well known biomarker used for assessing resistance training. Salivary hormonal responses to resistance exercise between long-term strength-training and untrained middle-aged men have been investigated.[45] Training that combines both power and strength stimulus has been reported to be superior to more conventional weight training bouts in actualizing strength and power gains.[1,6,13,24] In 2007 article, Cormie *et al*[13] concluded that combining strength and power produced greater improvements in jump height or related power output compared with a power workout that was matched for work performed. Indeed, the use of a combination of high force and high power seems to be superior to classical exercise prescriptions in terms of functional benefits.[30,33,54] Crewther *et al*[14] examined the salivary free cortisol response to resistance exercise with respect to the different training variables, equated by the workout duration and load volume. Hormones with anabolic or catabolic properties, such as testosterone and cortisol, respectively, show quantitative changes, signaling a catabolic state, in relation to the intensity and duration of a preceding physical load.[27] Psychological stressors of competition may be the prime regulator of C and performance.[18] The non-invasive nature of saliva collection also eliminates stress responses associated with blood collection techniques (e.g. Venipuncture).[14] Chronically elevated cortisol levels have been linked to various stressors (eg. Depression, trauma, over training); hence this glucocorticoid is also considered to be one of the primary stress hormones.[17]

A rise in C levels has been observed in many sporting competitions, and these hormonal changes often enhanced the performance and behavioral outcomes. For example, judoists displaying higher Sal-C levels also had higher motivation to perform and obtained the better outcome[57] and higher C levels were found in judo winners when compared with losers.[64] These data confirm suggestions

that C may be essential for working capacity and performance.[70] Thus, acute elevations in C may actually benefit athlete performance during competition.[18] Resting circulating cortisol and testosterone concentrations have been examined in athletes as possible biological markers of overreaching and the overtraining syndrome.[69] Training strain is recognized as a potent stimulator for stress hormone (e.g., glucocorticoids and catecholamines) secretion.[35,43] Nunes *et al* [50] reported that that high volume resistance exercise schemes can stimulate greater C secretion because of higher metabolic demand in elite female athletes. Crewther *et al*[18] stated on effect of training volumes on salivary cortisol level with higher in values when relate to the 1 RM lift during stimulated competition in weightlifters. Complex training and salivary cortisol level is not addressed simultaneously together but in a recent research by Beaven *et al*[7] showed a trivial increase in the cortisol level and this study was mostly focused on salivary testosterone level rather than cortisol level.

Star Excursion Balance Test (SEBT)

The Star Excursion Balance Test (SEBT) is a dynamic test that has prerequisites for strength, flexibility, and proprioception. The goal of the SEBT is to maintain single leg stance on one leg while reaching as far as possible with the contra lateral leg.[39] The SEBT is used to assess physical performance, balance ability among different sports. Researchers have suggested using the SEBT as a screening tool for sport participation and as a post-rehabilitation test to ensure dynamic functional symmetry.[42] Further, researchers have shown that SEBT performance improves after training.[32,36,42] Dynamic balance is defined and measure as the ability of a person to keep balance from dynamic condition to static condition.[71]. Some training that athletes use to improve different performances is strength and plyometric training. In most of the researches, it is reported that a combination of plyometric trainings and strength trainings in comparisons with using

these trainings alone and separately, cause to achieve the highest performances.[1,60] Asadi *et al*[5] reported increased score in dynamic balance by using SEBT test in basket players after in season plyometric training. although there is a little research on dynamic balance when both strength and plyometric training combined as complex training. In a research by Salehzadeh, Karim, *et al*[56] reported an increase in SEBT score in teenage handball players during 8 week of complex training.

Backward overhead medicine ball throw test is a reliable test used to assess the strength in upper body. Medicine ball throws integrate, multidimensional training in that they permit multiplanar movement, greater ranges of motion, and amalgamate a variety of muscle contraction sequences and velocities.[11] The dynamic nature of standing medicine ball throws is increasingly being used as a training tool because they integrate the whole body into each movement task. In pursuit to develop training programs that are more sport specific, coaches are trying to find new methods of using medicine ball throws to train the specific performance characteristics. Physically it requires proprioception and coordination, with multi planar movement.[11] To assess athletic ability during this type of activity, testing may also need to involve integrated, multidimensional movement that simulates as closely as possible the activities required for success in a particular sport.[11]

There is short of study in this area of salivary cortisol level in track n field event especially in female shot put athlete as it is a explosive event as described above. So our purpose of study to see the acute effect of complex training on cortisol level, throwing performance, functional ability and balance in young female shot put athlete.

Current Level of Evidence

As the previous review indicates much has been written on the action of shot putting. Despite this, much still remains to be known about the movement and the training aspect. As we all know the training is an important

component for any sport performance. Now a day's an emerging focus of research is on salivary cortisol which is an important biomarker for any resistance and plyometric training together defined as the complex training. There is a lack of knowledge on to the measurement of power and balance performance together in shotput female athlete after and complex training. Special circumstances unique to the event and the advancement of research methodology make the training ideal for further research.

Research on Current Elite Athletes is Limited

In addition to the effect of doping, the techniques used, the skill level of Participants, and athlete genders are all issues that leave room for further study. The large majority of current research on the shot put has examined sub-elite athletes ranging from the novice to collegiate level throwers.[37] Only a small number of studies have quantitatively examined elite athletes.[4,48,73]. Previous research on shot putting[47,65] and other activities[68] has indicated that the movement kinematics for performers of different skill levels is significantly different even in relatively homogenous subject pools. This may indicate that research findings from one skill level are not applicable to others, especially when the objective is performance enhancement.

Conclusion

By reviewing the literature, there seems to be dearth of evidence on the research on salivary cortisol efficacy on complex training. The research is needed so as to understand the effect of complex training as this training is done by female shot put thrower. This research could give us a light on the consideration of salivary cortisol as a biomarker in the field of sports training.

The gender variability of salivary cortisol, SEBT is also poorly understood. Hence, it would be highly important parameter to analyze the by means of research.

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