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Effect of 6-weeks Eccentric vs Concentric Action During Complex Training Among Female Field Hockey Athletes: A Conceptual Paper

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Abstract | Complex training is a combination of weight training and plyometric, where it alternates biomechanically similar high load weight training activities with plyometric exercises in the same program, for example squats and jump squats. The purpose of this study is to investigate the effects of eccentric barbell hip thrusts during complex training (ECT) and concentric barbell hip thrusts during complex training (CCT) on speed, agility, and power in female field hockey athletes. The other objective is to compare the effects of ECT and CCT on speed, agility, and power in female field hockey athletes. Twenty-seven female university athletes will be involved in a 6-weeks of training program. They will be divided into three groups: eccentric BHT during complex training (ECT, n = 9), concentric BHT during complex training (CCT, n = 9), and control group (CG, n = 9). Before and after the intervention, all athletes will assess for pre- and post-test in 20-m sprint test (speed), slalom sprint and dribble test (agility), and the countermovement jump (power). There are many research studies that have insight in the strength and conditioning field, but most of the studies have focused on male athletes, other types of sports and different types of exercise training. This study will provide the improvement of the athlete's on-field performances while reducing the chance of injury, help coaches and trainers to improve their athletes' growth and performances that lead to team's success, and give additional understanding and knowledge to other coaches and researchers.

Keywords: *Complex training, barbell hip thrust, speed, agility, power, field hockey.*

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I. INTRODUCTION

Field hockey is a high-intensity team sport that requires players to compete with the combination of stick skills, footwork, repeated short sprints, tackle, acceleration, deceleration, and changes of direction during matches [7] [4]. Female field hockey athletes are a devoted and skilled group who require training to maximize their athletic performance [4] [6] [10]. Resistance training (RT) has been proven to enhance maximum and explosive strength, leading to improved sports performance in athletes [5] [14]. Indeed, an earlier study, found that resistance training improved the physical strength and endurance of both male and female hockey athletes. Complex training is also known as one of the RT methods to improve athlete's performances.

Complex training (CT) is a combination of weight training and plyometrics, where it alternates biomechanically similar high load weight training activities with plyometric exercises in the same program, for example, squats and jump squats [3]. A recent study showed that a six-week complex-contrast training (CCT) intervention of male field hockey training enhanced 30 m sprint, countermovement jumps with arm swing (CMJA), modified agility T-test (MAT), and isokinetic strength.

Other than that, barbell hip thrust (BHT) is a lower-body exercise that increases the muscular capacity of the hip extensors. This exercise may be beneficial in improving athletic performance while lowering the risk of knee injury due to the unusual posture and weight displacement during the activity [1] [13]. This strengthening activity is different from traditional exercises like split squats, deadlifts, and front or back barbell squats [8]. Lately, BHT has been proposed to improve speed, horizontal force output, and gluteus maximus hypertrophy [1] [2]. Researcher found a potentiation effect on both 10- and 15-m sprints in handball players following a BHT training exercise with either moderate (50% of 1RM) or heavy (85% of 1RM) loads.

Skeletal muscles, which are linked to bones and move them relative to one another, can contract in two ways when activated, which are concentric (CON) and eccentric (ECC). The muscle attachments are brought closer together in the case of CON, whereas they move away from each other in the case of ECC [9]. Many studies have shown that RT primarily consists of ECC (lengthening) contractions that induce greater muscle adaptation responses than training that primarily consists of isometric (ISO) or CON contractions [11] [12] compared ECC-only and CON-only training of the elbow. flexors twice a week for 5 weeks and discovered that muscle thickness of the biceps brachii and brachialis increased after the ECC-only training (7.1%), whereas MVC torque of the elbow flexors increased similarly after the ECC-only (22.5%) and CON-only (26.0%) training.

Even with numerous developments in sports science research, there is still a considerable gap in our understanding of the effects of ECC and CON during CT on female athletes. Even though there are many research studies that have insight in the strength and conditioning field, most of the studies have focused on male athletes, other types of sports, and different types of exercise training. This shows a gap in targeted research on how this CT method might affect the performances in speed, agility, and power among female field hockey athletes. Thus, this current research seeks to compare the effects of eccentric (ECT) and concentric (CCT) during complex training on speed, agility, and power among female field hockey athletes.

A. Speed

In multiple studies investigating the effects of CT on sprint performance, athletes who participated in CT showed consistent improvements. It also reported significant improvements in 20-meter sprint performance among university soccer players after an 8-week complex training program. The complex group improved from 3.19 ± 0.18 seconds to 3.06 ± 0.13 seconds, while the control group showed modest change. They also found substantial increases in male handball players' 10-meter and 20-meter linear sprints following a 12-week compound strength training program, with both the compound and complex strength training groups exhibiting significant gains, especially in the 10-meter sprint.

B. Agility

Athletes that followed CT programs showed considerable increases in agility. Past study discovered that during an 8-week period, 18 male futsal players' agility performance, as evaluated by the Illinois agility test, remained consistent in the complex group while somewhat improving in the control group. Moreover, past researcher examined the impact of a 12-week strength training program on repeated sprint ability (RSA) and change-of-direction (COD) sprints in 20 male handball players. The compound strength training group demonstrated small RSA increases, while the complex strength training group had more substantial benefits, however, both groups saw slight COD decreases.

C. Power

In addition, these studies showed the effect of CT in improving jump performance across several sports. A previous study found significant improvement in lateral cone jump (LCJ) and stationary vertical jump (SVJ) among male university-level cricket players after a 4-week training program, with the plyometric training group (PTG) and complex training group (CTG) showing the most development. Moreover, previous study found that futsal players improved their countermovement jump (CMJ) performance after an 8-week training program. These studies show CT methods suitable to different groups of athletes and efficacy in improving power performance.

II. METHODS

The research design for this study will be true-experimental design, as it will investigate the effect of ECC and CON during CT on speed, agility, and power among female field hockey athletes. This study will involve 27 female hockey athletes aged from 18-25 years old. The inclusion criteria of the athlete are to have at least two years of resistance training and competitive experience in field hockey and must be able to perform a back squat at least 0.8 kg of body weight. The athletes will be randomly assigned with a total of 9 athletes in each group, either eccentric complex training (ECT), concentric complex training (CCT), or control group (CG).

Before starting the intervention, all athletes will undergo a familiarization session. The second week will continue with anthropometry and 1RM sessions. Then, pre-test in the third week. The following weeks will be the 6-week training program, and post-test in the final week. The ECT and CCT groups will be

involved in a 6-week training program, two sessions per week, while CG will be doing normal field hockey training. This study will have pre- and post-tests of speed, agility, and power. Speed will be assessed with a 20-meter sprint test, agility with the Slalom Sprint and Dribble Test (SlalomSDT), and power with the CMJ test. Both speed and agility tests will be measured using timing gates, while power will be recorded using an application, My Jump 2.

III. CONCLUSIONS

Based on the study's objectives, the finding from this study is that it can help athletes improve their on-field performance while reducing their chance of injury. Then, this study may help coaches and trainers to improve their athletes' performances. Last but not least, this study may also give additional information and understanding in the field of sports science, not only for coaches but also researchers.

REFERENCES

[1] B. Contreras, J. Cronin, and B. Schoenfeld, "Barbell hip thrust," Journal of Strength and Conditioning Research, 2011. [Online]. Available: http://journals.lww.com/nsca-scj

[2] B. Contreras, A. D. Vigotsky, B. J. Schoenfeld, C. Beardsley, and J. Cronin, "A comparison of gluteus maximus, biceps femoris, and vastus lateralis electromyography amplitude for the barbell, band, and American hip thrust variations," Journal of Applied Biomechanics, vol. 32, no. 3, pp. 254–260, 2016. Doi: 10.1123/jab.2015-0091.

[3] W. P. Ebben, "Complex training: A brief review," Journal of Sports Science and Medicine, vol. 1, 2002. [Online]. Available: http://www.jssm.org

[4] M. T. Elferink-Gemser, C. Visscher, K. A. P. M. Lemmink, and T. Mulder, "Multidimensional performance characteristics and standard of performance in talented youth field hockey players: A longitudinal study," Journal of Sports Sciences, vol. 25, no. 4, pp. 481–489, 2007. Doi: 10.1080/02640410600719945.

[5] M. Izquierdo-Gabarren, R. González De Txabarri Expósito, J. García-Pallarís, L. Sánchez-Medina, E. S. S. De Villarreal, and M. Izquierdo, "Concurrent endurance and strength training not to failure optimizes performance gains," Medicine and Science in Sports and Exercise, vol. 42, no. 6, pp. 1191–1199, 2010. Doi: 10.1249/MSS.0b013e3181c67eec.

[6] J. Lythe and A. E. Kilding, "Physical demands and physiological responses during elite field hockey," International Journal of Sports Medicine, vol. 32, no. 7, pp. 523–528, 2011. Doi: 10.1055/s-0031-1273710.

[7] B. Mikay and P. Lang, "Why not field hockey?" unpublished paper, 2017.

[8] W. K. Neto and E. Gama, "Barbell hip thrust, muscular activation and performance: A systematic review," Journal of Sports Science and Medicine, 2019. [Online]. Available: http://www.jssm.org

[9] P. Pakosz, M. Konieczny, P. Domaszewski, T. Dybek, M. Gnoiński, and E. Skorupska, "Comparison of concentric and eccentric resistance training in terms of changes in the muscle contractile properties," Journal of Electromyography and Kinesiology, vol. 73, 2023. Doi: 10.1016/j.jelekin.2023.102824.

[10] A. Rathi, D. Sharma, and R. K. Thapa, "Effects of complex-descending versus traditional resistance training on physical fitness abilities of female team sports athletes," Biomedical Human Kinetics, vol. 15, no. 1, pp. 148–158, 2023. Doi: 10.2478/bhk-2023-0018.

[11] S. Sato et al., "Comparison between concentric-only, eccentric-only, and concentric–eccentric resistance training of the elbow flexors for their effects on muscle strength and hypertrophy," European Journal of Applied Physiology, vol. 122, no. 12, pp. 2607–2614, 2022. Doi: 10.1007/s00421-022-05035-w.

[12] S. Sato et al., "Effect of daily 3-s maximum voluntary isometric, concentric, or eccentric contraction on elbow flexor strength," Scandinavian Journal of Medicine & Science in Sports, vol. 32, no. 5, pp. 833–843, 2022. Doi: 10.1111/sms.14138.

[13] R. Snarr and R. Eckert, "Barbell hip thrust," Journal of Sports Human Performance, vol. 2, no. 2, pp. 1–9, 2014. Doi: 10.12922/jshp.v2i2.37.

[14] A. F. Vieira et al., "Effects of resistance training performed to failure or not to failure on muscle strength, hypertrophy, and power output: A systematic review with meta-analysis," National Strength and Conditioning Association. [Online]. Available: www.nsca.com.