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Effects of Dynamic Balance Training on Agility and Balance in Young Athletes Participating in Different Sports: A Systematic Review

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ABSTRACT

Background: Athletes are trained for agility according to the requirement of their game. Agility training is the integral part of training protocols in almost all the games in one way or another. The majority of games require acceleration, deceleration and sudden change of direction without losing balance.

Aim: To investigate the effects of dynamic balance training on agility and balance of young athletes participating in different types of sports.

Methods: The authors systematically searched Google Scholar, Pedro, PubMed database for relative literature in accordance with the PRISMA criteria for literature searches. Authors studied many randomized controlled trials of dynamic balance training protocols and their influence on agility in young athletes participating in different sports.

Results: Out of 3500 studies 09 studies met the selection criteria which dealt with the effects of dynamic balance training on agility in young athletes participating in different sports. In all studies agility was influenced positively by dynamic balance training of athletes despite the sports they were indulged in.

Conclusion: This systematic analysis of the relevant literature indicates that dynamic balance training protocols can increase agility significantly in young athletes in just a few weeks despite the game they are indulged in. Some of the interventions also have an effect on static and dynamic postural control.

Introduction

The process in which the body's center of gravity is maintained over provided base of support is termed as balance. A person does so by getting continuous cues in form of visual, audio and somatosensory information from the brain which is coordinated to execute complex tasks. This happens to be the fundamental requirement in athletes for best athletic performance and injury prevention because many studies suggest that control of balance is necessary to prevent chances of injury in high intensity sports. Every sport contain specific motor skills which need the accomplishment of certain body posture and movements [1]. This is required for the efficient athletic performance during the sport activity because in sports field, the sportsman continuously gets into situations that changes their balance when they move, jump and sprint. Literature suggests that

athletes possess better balance than non-athletes and that is mainly due to the repetitive balance practice they perform in the form of balance training. This is due to the improvement in kinetic responses by brain [2]. Balance is usually categorized into two types I-e static balance and dynamic balance. Static balance is the one in which a person tries to keep his center of mass within the base of support in a certain standing position without or with minimal postural sway [3]. Dynamic balance refers to maintaining the equilibrium and stability during movement or if this equilibrium is lost, re-establishing it without allowing the body to fall [4,5]. From neuro-mechanical perspective, a system for postural control is required all the time to maintain the center of gravity within given base of support.

It is a vital component for sportsman during game and even in activities of daily living [6]. Dynamic balance is believed to be more challenging than static balance because it requires the ability to maintain equilibrium during a transition from a moving to a static state. Studies suggest that when the performance of balance is enhanced in a person, it leads to increased level of physical activity and performance of athletes which includes sprinting, jumping in vertical direction, sprinting, and tasks that require rapid change in direction. Furthermore, it is also narrated that superior balance performance in sport-specific conditions is an important prerequisite to become a high-level athlete. For example, in highly dynamic situations during sports like basketball, volleyball and soccer, the important requirement for a high-level performance needs special grip on rapid changes-of direction, vertical and horizontal jumping, and proper dynamic alignment of the center of gravity relative to the base of support [7]. Agility is generally termed as rapid change in direction. It includes the process to recognize specific sports related situations rapidly and react promptly to that condition. In sports when a player sprints in a straight line or deliberately changes his position to achieve the target, it is termed as agility. It is the skill required by the athletes to rapidly decelerate, then change direction and finally accelerate in the direction which is required [8]. Requirements for this rapid change in direction varies from sports to sports but majority of them are structured in such a way that high level of agility is required for high level performance in that game [9].

For example, a soccer player tackling the ball, a basketball player, or a gymnast during his performance. It is a motor skill which can be improved through proper training and practice [10]. Balance training is found to be an effective tool to increase the control in posture of the athletes which helps in enhancing his performance [1]. Evidence suggests that balance training done for the period of four weeks or more helps in improving functional outcome measures, especially control of posture and stability in equilibrium [11]. Over the past decades, the requirement of balance training have been growing increasingly in various sports. It has increased to such extent that balance performance has been recognized as a must inclusion in the standard guidelines for physical fitness by ACSM (American College of Sports Medicine) [12]. Dynamic balance is considered to be an important factor in executing complex technical movements, and preventing chance of injury in future [1,13]. High level athletes must possess special sensorimotor abilities for efficient performance. Dynamic balance training reduces rate of injury during sports. It is accomplished by improving the considerable risk factors for injury during the game. The mechanism through which dynamic balance training results in decreased injury rates is still being studied. Nevertheless, studies have been published that indicate that dynamic balance training has many positive effects on injury prevention and enhancement of athletic performance because it improves sensory and motor coordination, activation of muscles, equilibrium, activation of gamma motor neurons, activation and co-contraction of muscles [14].

For this purpose, dynamic balance training helps in maturation of such abilities [13]. A study suggests that such kind of balance exercise program will help in training proprioception pathways more effectively under competitive circumstances. To prevent injuries the receptors in central and peripheral nervous system, mechanoreceptors in muscles and ligaments should be activated. Balance training helps to achieve this goal in rapid and efficient manner. We can say that balance training helps to decrease the timing between nervous stimulus and muscular response to get the high level of performance during the sport activity [3]. Balance training is now an integral part of physical fitness training of the players in almost all sports to enhance performance and to reduce sports related injury risk [15]. A combination of balance, strength, plyometric, agility and sports specific exercises are primarily responsible for training effects [16]. Most investigators studied the influence of balance training on functional performance and neuromuscular control. Research shows that balance training assists in increase in proprioception, kinesthetic awareness, and muscular strength [17]. Dynamic balance is also critical for improving agility, as it allows for a more efficient change in direction [18]. Agility training can improve cognitive ability, power production, and ultimately sports performance [19]. Agility improves flexibility, balance, and control. Additionally, agility drills encourage our body to learn how to maintain correct body placement. With proper training, sensitive areas such as the lower back, shoulders, and ankles are protected while moving quickly [20].

Therefore, this study aims to investigate the effects of dynamic balance training on agility and balance of young athletes participating in sports.

Methods

A systematic review of the literature was carried out according to the stipulations of the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) statements [21].

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria were defined on the basis of PICO model [22]. Other publications and research restrictions were not applied. The PICO scheme for study selection expanded to include study design.

Search Strategy

The literature survey was carried out on August 2020 and covered the database Google Scholar, Pedro and PubMed. The detailed search strategy is shown in Table 1. The reference lists of the publications finally chosen for inclusion were scrutinized.

Table 1: Showing detailed search strategy on the basis of PICO model.

PICO(S) item	Inclusion and exclusion criteria
P– Population collection	The majority of the population must be young athletes of age 18–35 years. Studies having population with balance issues were excluded. If two or more publications with same techniques, only the first publication considered.
I-Intervention	The intervention must have defined balance training protocols. Balance must be measured at baseline.
C-Control intervention	Control groups without training or with alternative training methods will be considered.
O-Outcome	The outcome must influence agility of young athletes and outcomes evaluation must be age specific and not gender specific.
S – Study design	Randomized control studies and quasi experimental studies published in English from 2015-2019 were included. No other study designs were included.

Study Selection and Data Extraction

Initially, potentially relevant publications were selected by two of the authors of this article independently on the basis of title and abstract. Selection by one of the two searchers was deemed sufficient. Full analysis with verification of inclusion and exclusion criteria was carried out with consensus. Study data and study characteristics were recorded and checked according to an expanded PICO strategy. Each publication's risk of bias, i.e., the risk of systemic error, was analyzed with the Cochrane risk of bias tool for RCT [23]. The bias was assessed independently by two authors. If they failed to agree, a third author (supervisor) joined them to achieve consensus by discussion.

Results

Study Selection

A total of 3500 publications were identified. After elimination of duplicates and scrutiny of study titles and abstracts 60 articles remained for full-text analysis. 09 publications fulfilled the selection criteria. The commonest reason for exclusion was age specification and balance training protocols scrutiny. The 09 selected studies have a total of 650 athletes of different sports. No studies including population other than athletes were included.

Risk of Bias

The evaluation of the risk of bias in the studies chosen for inclusion can be found in Table 2. One basic problem in training interventions is blinding the participants and trainers, which is practically impossible with full prior provision of information. These systematic limitations explain the overall high or unclear risk of bias with regard to blinding of study participants and personnel. Only one third of the studies describe how the randomization was performed and how the participants were kept unaware of group assignment (selection bias). In seven studies there were no data on blinding (detection bias).

Table 2: Showing risk of bias.

Study First Author. Year	Random sequence generation	Allocation concealment	Blinding of participant	Blinding of personnel	Blinding of outcome assessment	In complete outcome data	Selective reporting
(Gadre, et al. [28])	+	?	?	?	?	+	?
(Kubal S, et al. [26])	+	+	-	-	+	+	+
(Saraswat, et al. [37])	+	+	+	-	?	?	+
(Acar, et al. [38])	+	+	+	-	-	?	+
(Guler, et al. [27])	?	+	?	?	-	?	+
(Joshi, et al. [39])	+	+	-	-	-	?	-
(Barber, et al. [40])	+	+	?	?	-	?	+
(Majeed, et al. [41])	?	+	+	-	+	-	+
(Spasic M, et al. [42])	+	+	+	-	-	-	+

Note: – High risk of bias; + low risk of bias; ?: Unclear risk of bias. Because blinding participants is not feasible in the type of study reviewed here. The domain "Blinding of participants and personnel" was split and the two parts assessed separately.

Study Characteristics

Tables 3 provides an aggregated overview of the most important findings. Details of each study—participants, interventions, outcomes, measurement methods, and principal effects on physical performance capacity, agility, and risk of injury—can be found. With regard to evaluation of the results, it should be noted that the studies varied considerably both in the composition of their collectives and in the interventions used. The intervention periods ranged from 6 weeks to 10 weeks, and the training sessions differed widely not only in content but also in intensity, scale, duration, and frequency. In almost all studies the intervention comprised elements of static and dynamic postural control and agility training (Table 4).

Table 3: Aggregated overview of the principal intervention outcomes.

Study First author. Year	Main Interventions	Physical performance capacity	Agility	Risk of injury
(Gadre, et al. [28])	Tandem stance, single leg stance, wobble board (unidirectional)	+	+	+
(Kubal S, et al. [26])	Tandem stance, single leg stance, wobble board (multidirectional)	+	+	+
(Saraswat, et al. [37])	Walking on bricks, Wobble board, tandem stance with close eyes.	-	+	-
(Acar, et al. [38])	Walking on bricks, Wobble board, single leg stance closed eyes	+	+	+
(Guler, et al. [27])	Tandem stance and pass the ball, brick walking, wobble board	+	+	-
(Joshi, et al. [39])	Walking on bricks, Wobble board, tandem stance with close eyes.	+	+	+
(Barber, et al. [40])	Tandem stance, single leg stance, wobble board (unidirectional)	+	+	+
(Majeed, et al. [41])	Single leg stance and tandom stance with eyes closed wobble board	+	+	-
(Spasic M, et al. [42])	Balance ball wobble board single leg stance	+	+	+

Note: + Positive effects found; - No effects found.

Table 4: Details of study characteristics interventions, outcome, agility and performance.

Study First author. Year	Intervention and population	Outcome and measurement methods	Agility	Physical performance capacity
(Gadre, et al. [28])	n= 30, Intervention period 4 weeks, young volleyball players.	Agility: T test Hexagon agility test, single leg stance test	Significant results($p<0.05$) for agility tests	Significant results($p<0.05$) for balance test (24)
(Kubal S, et al. [26])	n= 66 Intervention period -6 weeks, young cricket players	Agility: T test Hexagon agility test, Multi direction reach test	Significant results($p<0.05$) for T agility tests and hexagon agility tests	Significant results($p<0.05$) for multi direction reach test (25)
(Saraswat, et al. [37])	n=60 Intervention period 8 weeks, young baseball players	Agility T test static postural control TTB, Dynamic postural control SEBT	Significant results($p<0.05$) for agility T test	Significant results($p<0.05$) for static and dynamic postural control (26)
(Acar, et al. [38])	n= 38 Intervention period 8 weeks, young cricket players	Single stance test, multi direction reach test, TTB, SEBT		Significant results($p<0.05$) for balance and TTB, SEBT (27)
(Guler, et al. [27])	n= 32 Intervention period 6weeks, Young soccer players	Agility T test multi direction reach test, static posture control test TTB, SEBT	Significant results($p<0.05$) for T test	Significant results($p<0.05$) for static and dynamic balance (28)
(Joshi, et al. [39])	n= 60 Intervention period 8 weeks, young athletes	Agility T test Illinois test multi direction reach test	Significant results($p<0.05$) for T test and Illinois test	Significant results($p<0.05$) for multi direction reach test (29)
(Barber, et al. [40])	n= 42 Intervention period 8 weeks, young athletes	Agility t test single hexagon agility test TTB, SEBT	Significant results($p<0.05$) for T test and hexagon test	Significant results($p<0.05$) for TTB and SEBT (30)
(Majeed, et al. [41])	n= 32 Intervention period 6weeks, High school going students	Single limb stance test, multi direction reach test, TTB, SEBT		Significant results($p<0.05$) for balance, static and dynamic postural control (31)
(Spasic M, et al. [42])	n= 48 intervention period 8 weeks, young cricket players	5m sprint test, reactive agility test, change of direction speed test	Significant results($p<0.05$) for T test and Illinois test	Significant results($p<0.05$) for static and dynamic balance (32).

Effects of Intervention on Agility

Despite the pronounced heterogeneity, agility is improved in all studies. The training led not only to improved agility but also the enhancement of physical performance capacity (static and dynamic posture control) [24]. Combination of dynamic balance training and agility drills also brought about significant increase in physical performance capacity [25]. Swati Kubal et al worked on dynamic balance of young cricket players (experimental and control group) [26]. The experimental group showed significant improvement in performance on T agility test, difference in the meantime in the experimental group was 0.86 seconds which was statistically significant ($p < 0.05$), (unpaired T test 16.625). The experimental group also showed improvement in performance on hexagonal agility Test the difference in the meantime in the experimental group was 2.74 seconds, which was statistically significant ($p < 0.05$) [26].

Effects of Intervention on Postural Control

Ozkan Guler. et al found that 6 weeks of balance training improved static and dynamic postural control as detected by TTB and SEBT [27]. Difference in static balance 20.7 seconds, 95% confidence interval (CI) 10.8 to 30.6 seconds; difference in dynamic balance 2.3 seconds, 95% CI 0.7 to 4.0 seconds). There was evidence of a protective effect of balance training over 6 months (relative risk of injury 0.2, 95% CI 0.05 to 0.88) [27]. Gadre and Harsha et.al in his 4 weeks study with young volleyball players in groups of experimental and controlled found significant improvement in dynamic balance [28]. Results showed mean improvement in stance time in the experimental group was 22.17secs and the difference in the mean stance time in control group was 3.53secs, which was statistically significant ($p < 0.05$) [28].

Discussion

Agility is a complex ability which depends on coordination, mobility of the joint system, dynamic balance, strength and speed [29]. Since static and dynamic balances are vital for agility, the improvement in agility can be attributed to improvement in balance [30]. However, it is surprising that our systematic study of medical literature found only 10 publications. These studies report results of training intervention but do not indicate the extent to which balance training influence agility [31]. In addition to the small number of publications, a number of other limitations are apparent. The studies selected for inclusion differed, in some cases widely, with regard to the collective investigated and the interventions carried out [32]. The intervention period varied in duration from 4 weeks to 10 weeks. The training programs also differed substantially in terms of normative standards, i.e., intensity of training, frequency of sessions, and amount of training [33]. Moreover, hardly any of the studies report effect sizes or test statistics to permit assessment of the practical relevance of individual findings [34]. Detailed examination of bias clearly shows variation in study quality, to the extent that the internal validity of some particular findings is questionable [35]. Despite the considerable differences among the studies, it is astonishing that in all of them the balance training interventions led to significant increases in agility and physical performance capacity [36-42].

Summary

The interventions used for dynamic balance training in these studies had a positive effect on agility in young athletes performing in different sports. That is why in many sports trainings protocols dynamic balance training is now an integral part of athletes training. Sport specific agility training incorporated with dynamic balance training seems to be more effective in enhancing performance. All the famous games foremost of which are soccer, cricket, tennis, football, basketball, baseball there is a sudden change of direction with maximum acceleration, with a power of quick decision making which requires a very healthy balance to fulfill the requirement of that sport. If balance training is a part of their daily training program it will enhance their performance.

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