E-ISSN: 2707-7020
P-ISSN: 2707-7012
JSSN 2022; 3(1): 37-44
Received: 25-11-2021
Accepted: 2-12-2021

Ram Mohan Goud M
Research Scholar (Doctor of Philosophy in the Faculty of Sports), Indira Gandhi TMS University, Ziro, Arunachal Pradesh, India

Dr. Sandeep Bhalla
Director - Sports & Physical Education Department, Indira Gandhi TMS University, Ziro, Arunachal Pradesh, India

Corresponding Author:
Ram Mohan Goud M
Research Scholar (Doctor of Philosophy in the Faculty of Sports), Indira Gandhi TMS University, Ziro, Arunachal Pradesh, India

Netball: Importance of training of players

Ram Mohan Goud M and Dr. Sandeep Bhalla

Abstract
To optimize the development of essential fitness attributes in each sport, training must be specific and stress the internal and external demands engaged during competition. Physical Balance is vital in netball because it impacts the foot movements, which consider as a fault play in this game. Balance Training Program will enhance basic fitness such as agility, quick reaction, and especially the balance component among netball players. The stability while playing netball will reduce foot movement errors among netball players to perform well and enhance their game performance. The objectives of physical preparation for netball, i.e., safeguarding against injury and improving performance, would appear to encompass aspects like, strength training; metabolic conditioning; neuromuscular and movement skills training.

Keywords: Netball, balance training, foot movement, effectiveness, landing, stability

Introduction

Sporting performance is multi-factorial and requires a combination of fitness attributes that are unique to each sport. To optimize the development of essential fitness attributes in each sport, training must be specific and stress the internal and external demands engaged during competition. External demands encompass the physical stimuli encountered during training and match-play, while internal demands represent players' perceptual and physiological reactions to the imposed physical stimuli. In this regard, netball is a high-intensity, intermittent sport that stresses a range of different fitness attributes in players. Consequently, netball strength and conditioning coaches and sports scientists must develop conditioning programs that best develop these fitness attributes and optimally prepare players for the external and internal demands of match-play. Furthering the concept of training specificity in netball, the match-specific demands experienced by each playing position and playing level must be considered in developing netball-specific conditioning programs. In this way, the varied court restrictions and roles specific to each playing position in netball impose unique internal and external match demands across positions. For example, goal positions (goal shooters (GS) and goal keepers (GK)) experience the lowest external demands, centers (C) experience the highest external demands, and the remaining positions (wing attackers [WA],wing defenders (WD), goal attackers (GA), and goal defenders (GD)) experience external demands between these positions during match-play for female netball players. Incontrast, inconsistent variations between playing positions have been observed for internal demand variables (i.e., rating of perceived exertion (RPE) and heart rate (HR) responses) during netball match-play. Furthermore, positional differences in external and internal match demands were shown to vary according to playing level when amateur domestic, under-19 years representative, and over-19 years representative female netball players were directly compared. Indeed, female netball players competing at higher levels undergo greater external match demands than players competing at lower levels. So, the match demands experienced in netball are specific to playing level in addition to playing position. Accordingly, the development of netball conditioning programs with respect to playing position likely needs to be specific to the playing level of the players involved.

Physical Preparation for Netball

The stated objectives of physical preparation for netball– i.e., safeguarding against injury and improving performance – would appear to encompass three major aspects:

a) Strength training – including speed-strength development and plyometrics
b) Metabolic conditioning
c) Neuromuscular and movement skills training

In addition, targeted training interventions appear to be warranted in order to specifically address the types of injuries and associated risk factors characteristically observed in netball. Common sites of injury documented in netball include ankle, knee, lower back and shoulder. It has been highlighted by a study of netball players competing at national level that in order to be effective, physical preparation must not be conducted in isolation. Training should rather be delivered in the context of the sport and the identified needs of each individual player, and undertaken in collaboration with coaching staff and medical support team. The importance of taking a multidimensional approach to physical preparation is also highlighted by the finding that strength training interventions which have been employed in isolation have reported little or no significant effect on measures of lower limb injury risk. Similarly, movement skills instruction and feedback alone had limited effect on certain measures, specifically hip abduction and ground reaction forces. Conversely, employing strength and movement skills training modalities in combination is found to have an additive effect, which was reflected in a much more significant positive impact across a wider range of kinetic and kinematic measures associated with lower limb injury risk. Consistent with the primary objective of physical preparation for netball being guarding against injury, the logical first step when undertaking players' physical preparation is to conduct a musculoskeletal screening and dynamic profile. This process should ideally be conducted jointly by both physiotherapist and strength and conditioning specialist. The initial musculoskeletal assessment will naturally be led by the physiotherapist, and will include standard clinical tests of passive joint integrity and range of motion. The second part – the dynamic profile – might then be led by the strength and conditioning specialist but jointly scored by both practitioners, and should consist of selected movement-based screens from the literature. For example, one such screen that would appear to merit inclusion is the Star Excursion Balance Test. This test requires the athlete to maintain their center of balance within a fixed base of support (the supporting foot) whilst reaching out the opposite leg in various directions, which is reflective of balance demands on court. This dual approach including both clinical musculoskeletal and dynamic assessments will allow the identification of both mechanical factors (e.g., joint laxity, passive joint function) and functional instability under active conditions (e.g., impaired proprioception, balance, postural control) that have been implicated in lower limb injury in particular. Hypermobility has been identified as an intrinsic injury risk factor associated with increased injury rates among junior netball players. This risk factor would be easily identified during players' initial musculoskeletal screening. Players exhibiting hypermobility around these joints would be susceptible to exposing connective tissue structures to joint ranges of motion in which they are placed under excessive strain. Such ligament laxity is also associated with decreased proprioception and kinesthetic sense around the joints affected. The interaction of these two factors readily explains the greater incidence of lower limb injury in particular suffered by netball players with hypermobility. Accordingly, where hypermobility is identified during the player's initial musculoskeletal screening there is a need for added emphasis on development of lower limb strength, postural control, proprioception and dynamic stabilization in order to augment active stability provided to lower limb joints to compensate. Movement skills training will also help the player to avoid particular postures and lower limb biomechanics on court that place excessive stress on lower limb joint structures.

Strength Training in Netball

- **Aims:** Development of general strength for fundamental athletic movements – i.e., variations of squat, lunge movements etc. – is necessary to underpin movement skills instruction with regard to 'safe' posture and lower limb alignment during activities on court. The integral role of strength training with respect to addressing lower limb injury risk has been highlighted by a recent study which identified that the effectiveness of movement instruction and feedback alone was limited in the absence of concurrent strength training. It appears that development of lower limb force generating capabilities via strength training improves the athlete's capacity to make the necessary adjustments in posture and lower limb mechanics during athletic movements as instructed. These findings underline the importance of concurrent strength training to support neuromuscular and movement skills training with regard to addressing lower limb injury risk factors. Following a period of general strength development appropriate to the requirements of the individual player, specific development of eccentric strength and eccentric speed-strength of lower limb kinetic chain would also appear necessary. There are obvious benefits to be derived from training these capacities as a means to develop the player's ability to absorb both impact forces when landing and torques generated during change of direction movements. To this end, speed-strength and plyometric exercises should be progressively introduced once the player reaches an appropriate stage in their physical development. In addition to lower limb strength development for improved lower limb control and biomechanics, the other major objective of strength training for netball players is performance enhancement, which will necessarily include upper-body strength and speed-strength development. In addition to developing strength and speed-strength of agonist muscles involved in the passing and shooting movements that occur in netball, upper body strength development should also address the muscles that stabilize the shoulder girdle during these skill movements.
- **Exercise Selection:** Players might be introduced to variations of the squat movement during their early preparation particularly during off-season/preseason with the objective of developing general strength and postural control. As players' physical preparation progresses consideration must be given to the observation that training responses with respect to lower limb neuromuscular control appear to be movement task specific. Given that players rarely perform movement on court from an equal weight-bearing bilateral stance, it follows that there will therefore be a progression from bilateral strength training exercises to an increasing emphasis on exercises performed from a unilateral base of support. Exercises might include single-leg squat, backward and forward lunge with barbell, including variations with

the barbell racked either across the front or the back of the shoulders. Variations of the step-up exercise offer a means to develop gluteal muscle recruitment; this would appear important in view of the quadriceps/low back dominance often exhibited by female athletes. Finally, to transfer strength development to multi-directional movements performed on court, lunge movements in a variety of directions; likewise, variations of the step-up exercises (e.g., lateral step up) might be considered. From the point of view of developing strength and power for ball skills on court, upper body strength training exercises should include pushing lifts – for example variations of the push up as well as free weight exercises such as dumbbell bench and shoulder press. In addition, pulling movements should also be included in players' upper body strength training. This is important for a variety of purposes including addressing/avoiding muscle imbalances, developing postural control around the shoulder girdle (scapular stabilization) and the role of the mid back muscles in providing tension to the 'corset' of muscles that brace the trunk. Finally, alternate and single-limb exercises (for both upper and lower body) have advantages for concurrent development of postural control, lumbopelvic stability and torsional stability in particular.

- **Speed-Strength Training:** Jumping is a key movement for netball particularly for the positions that contest possession in the D area in the vicinity of the posts. Speed-strength exercises such as jump squats and Olympic-style lifts are proven modalities for developing vertical jump height and concentric power output. Versions of plyometric exercises that involve only the concentric part of the movement such as jump and bound movements executed from the floor or using a box without any preceding eccentric action can similarly be used to develop concentric speed-strength for both bilateral and unilateral jump movements. In terms of exercise selection, whilst developing power expression is important to a varying degree depending on the playing position, concentric power and reactive speed-strength are required in a variety of horizontal directions. This will necessitate speed-strength exercises that allow power to be developed in a horizontal as well as a vertical direction. Examples include variations of horizontal (bilateral and unilateral) jumps and bounds from a stationary start. Eccentric speed-strength is another important aspect which can be developed by using drop-and-hold landing movements, progressing drop height and moving from bilateral to unilateral landings in a variety of directions. The latter progressions in particular allow eccentric speed strength and dynamic stabilization to be developed concurrently.
- **Plyometrics:** Plyometrics offer development of both reactive strength (i.e., capacity for rapid transition from eccentric into concentric movement) and mechanical and neural elements of the stretch-shortening cycle (SSC) for both vertical and horizontal jumping and bounding movements on court. Players' plyometric training might follow a progression from slow SSC movements – for example countermovement jump – to fast SSC exercises such as drop jumps or cyclic bounding movements that emphasize short ground contact time. In much the same way as for strength training, plyometric training should also feature a progression from bilateral to unilateral jumping and bounding movements given the specific nature of training effects with respect to inter-muscular coordination.

Metabolic Conditioning in Netball Game

In view of the intermittent nature of activity in netball, it follows that metabolic conditioning for the sport should similarly follow an intermittent or interval framework. Metabolic conditioning for elite netball players might therefore comprise a combination of methods, including aerobic interval training, anaerobic interval training and repeated sprint conditioning. Practically through the course of the training year players' metabolic conditioning will encompass an array of conditioning modes. Cross training modes will feature predominantly during the off-season and early preseason; these sessions will also follow an interval format. However, as the season approaches a combination of interval conditioning, tactical metabolic conditioning, and skill-based conditioning games will be employed to provide metabolic conditioning that is specific to the needs of the sport. Interval conditioning will tend to follow a progression from aerobic interval conditioning to anaerobic intervals and finally repeated sprint conditioning. Incorporating relevant movement skills into metabolic conditioning also provides the opportunity to reinforce correct and safe movement mechanics under conditions of fatigue. Tactical Metabolic Conditioning is another approach that may be used, which involves modelling conditioning upon observed patterns of work-to-rest identified from competitive matches15 – albeit this will require prior investigation given the sparsity of data available for the sport. Finally, skill-based conditioning games not only incorporate relevant movement skills, ball skills and tactical elements but also offer advantages in terms of motivation and compliance. That said, the effectiveness of this training mode is dependent on imposing appropriate constraints. Players should also be monitored during all sessions to objectively evaluate work rate, which requires access to the necessary equipment such as heart rate monitors.

Neuromuscular and Movement Skills Training in Netball

The major objectives of movement skills training for netball are to instill safe movement strategies, improve players' athleticism and develop the change of direction movement abilities that underpin agility. Targeted neuromuscular training interventions are critical in view of the deficits in lower limb control that are characteristically seen among female athletes.

- **Postural Control:** Postural control and balance abilities comprise input from visual, vestibular and somatosensory systems. Postural control also involves the various elements that comprise lumbopelvic stability. A key element that contributes to lumbopelvic stability is the hip musculature of the supporting limb(s) during weight- bearing, which is particularly vital to postural control under both static and dynamic conditions. However, lumbopelvic stability also comprises the 'local' stabilizing system of deep postural muscles and the 'corset' formed by abdominal muscles, low and mid back muscles and thoracolumbar fascia. The critical role played by the trunk muscles with respect to postural control is underlined by the observation that ability to control motion and orientation of the trunk during athletic movement impacts upon joint kinetics and kinematics throughout the lower limb kinetic chain– in particular at the knee joint but also the ankle joint. Postural control and lumbopelvic stability similarly directly impact upon incidence of low back pain and injury. Practically, 'sensorimotor training' to develop postural control or balance will consist of a range of single-limb support tasks that impose appropriate constraints to develop particular components of static balance either independently or in combination. For example, single-limb balance tasks performed on a stable surface with eyes closed or turning the head are designed to specifically develop the vestibular input to postural control. Many practitioners progress the demand of the balance task by moving onto labile surfaces – such as balance disk or wobble board. A variety of single limb balance tasks with different constraints may be employed during athletes' training, however exercise selection should also feature relevant balance tasks on a stable surface similar to that found on court. One such balance task that might be considered is an adaptation of the Star Excursion Balance test. The balance abilities required by this activity was reported to be relatively distinct from other measures of static balance in a study of female athletes, including female college soccer and basketball players.

- **Dynamic Stabilization:** Dynamic stabilization can be defined as the capacity of the athlete to maintain balance during the transition from motion to a static posture– for example, retaining postural control when landing from a hop or jump. This capability has obvious application for netball given that players are required to land and hold a stationary posture from a variety of hop, step, bound and jump movements within one and a half steps every time they take possession of the ball. Dynamic stabilization is identified as a discrete ability that is distinct from static balance or postural control. The aspects of executing a landing and decelerating the athlete's own momentum in order to come to a complete stop impose additional demands, in terms of strength and neuromuscular control, to those required for maintaining the athlete's center of mass within a fixed base of support under static conditions. Developing dynamic stabilization will require dedicated training in order to develop the feed-forward control capacities involved in landing tasks. A study that employed a training intervention focussing on relevant exercises with elite female soccer players reported a significant reduction in a range of lower limb muscle and tendon injuries. Further, this study identified that a dose-response relationship appeared to exist with dynamic stabilization training with respect to injury reduction. That is, the greater the duration of sessions with the training intervention during the study period, the greater the apparent reduction in injury incidence. A first step when training to develop dynamic stabilization should involve instructing players on safe landing mechanics, including optimal lower limb alignment and posture. This has been observed to be an important part of successful interventions to reduce lower limb injury – notably knee injury – in female athletes. Once these movement abilities have been developed under controlled conditions, such as dropping into a single-leg landing from a low box, training exercises can be progressed to incorporate constraints and movements similar to those experienced during game conditions. For example, the same themes in terms of safe landing postures and lower limb alignment can be transferred to drills that feature the variety of landing movements that players are observed to employ on court.
- **Specific Movement Skills Development:** Ultimately, the final progression for the bounding and landing drills described above is to execute these movements on court and incorporate intercepting a ball. This will facilitate best transfer of dynamic stabilization and neuromuscular control to the specific jump-landing activities that feature in netball. Similarly, the evasive and tracking movements that feature in netball should also be developed in an appropriate way. Modifying change of direction movement technique via movement skills instruction has been shown to have the capacity to reduce potentially injurious loading on the knee joint. As the athletes' movement skills advance, the drills employed to develop change of direction movement abilities should progressively incorporate the constraints and context in which these movements are executed on court. Similarly, movement mechanics differ under pre-planned versus unanticipated conditions. Progressions should therefore include withdrawing the ability for players to anticipate movement responses and incorporating the elements of decision making as encountered on court.

Training Interventions to Target Common Netball Injuries

Initial screening will help identify intrinsic injury risk factors for each individual player. This will include the player's injury history, hypermobility or joint laxity, conversely any deficits in mobility and stability, and imbalances in muscle function that may predispose the player to injury. Knowledge of common injuries and associated injury mechanisms will then help identify extrinsic risk factors associated with competing in the sport of netball. Presented here is a summary of investigations involving netball players and data from other female team sports that highlight the injuries that netball players appear most predisposed to sustaining.

- **Ankle:** Given the high incidence of ankle sprain injury– and high incidence of recurrence with this injury – it will be common for netball players at elite level to have a history of previous ankle sprain injury. Taping the lower limb and ankle joint is often employed particularly for players with previous ankle sprain injury as a means to augment proprioception due to the cutaneous stimulation provided. Afferent input from mechanoreceptors within the muscles associated with the ankle joint serve the dominant role in providing the athlete with a sense of joint position and kinesthetic awareness. Development of this afferent pathway is particularly crucial for players with previous ankle injury, which often disrupts sensory input from joint receptors – leading to an increased need for compensatory input. Appropriate strength training and neuromuscular training modes can provide development of proprioception provided by muscle mechanoreceptors. In accordance with this a variety of strength training and neuromuscular training interventions have been shown to improve measures of proprioception and ankle joint position sense specifically. Balance training including various exercises in a single- leg stance should similarly be used to develop the various systems that contribute to postural control and static balance. Exercises incorporating labile surfaces (wobble boards, balance disks etc.) can be employed, however ultimately, exercises on a solid surface similar to that found on court should be used to help facilitate transfer of proprioception and neuromuscular training effects. There is also a need for specific development of dynamic stabilization. Feed-forward control of ankle stabilizers during the preparatory phase prior to touchdown during landing or stopping movements is suggested to be the more important factor in improving active stabilization for those with chronic ankle stability. This would appear to be a learned effect and thus amenable to development via repeated exposure to relevant movements in conjunction with appropriate coaching.

- **Knee:** In view of the 'ACL-agonist' role of the hamstring muscles26 and the plateau observed in hamstring strength scores among females following puberty in the absence of corrective strength training, it follows that hamstring strength development should receive appropriate focus in players' strength training. Appropriate (particularly unilateral) strength training is likewise identified as serving an important role in supporting development of lower limb neuromuscular control. Eccentric strength training is often employed for specific development of medial quadriceps (VMO) and patella tendon as part of the rehabilitation for patellar tendinopathy. A range of training modes have been employed, including controlled eccentric knee flexion movements as well as rapid drop squats or drop jump landings. Unilateral single-leg squat protocols have proven efficacy. These exercises typically performed on a decline surface, maintaining an upright posture with minimal forward torso lean and neutral lower limb alignment so that the supporting knee remains in line with the toes. A biomechanical analysis identified that employing a decline surface with a minimum angle of 15-degrees serves to specifically load the patella tendon, which appears to explain the superior effectiveness of decline squats in comparison to eccentric squats performed on a flat surface. There does appear to be an optimal range of motion for the exercise – descending to a knee flexion angle of 60-degrees. Beyond this range forces placed upon the patellofemoral joint increase to a greater extent than patellar tendon forces. In symptomatic athletes, the depth will initially be governed by pain experienced during the movement – it is typically recommended to work just into the range where the movement becomes painful. Within the specific range of motion, progression can be achieved by adding external load, for example using dumbbells held at the sides or supported upon the shoulders. Adding a 10kg load via a backpack was shown to increase knee movement of force by 23%. It is important however that an upright torso posture is maintained when external loading is added, in order that appropriate moments of force through the lower limb joints are maintained during the movement. Developing strength, endurance and neuromuscular control of the muscles that stabilize the trunk appears to be a critical aspect of reducing non-contact knee injury risk for netball players. Capacity to control trunk position and orientation has been implicated in ACL injury mechanism with females athletes61 and a similar association is also reported between reduced lateral trunk strength and patellar tendinopathy. The hip muscles' role in providing lumbopelvic stability and controlling lower limb alignment in single-leg stance and athletic movements and its influence on knee joint loads has been identified as an important aspect in the mechanisms of both knee ligament injury41 and patellar tendinopathy. Much the same approach to training for static balance/postural control and specific development of dynamic stabilization as that suggested for ankle injury prevention can achieve similar benefits for reducing non-contact knee injury risk. This has been shown to be an important aspect of training interventions to reduce rates of ACL injury among female athletes. Similarly, this form of training has also been shown to reduce the incidence of patellar tendinopathy among elite female soccer players. Finally, a key aspect of interventions to reduce lower limb injury is movement skills development, including instruction and reinforcement of 'safe' posture and lower limb alignment during landing and change of direction activities. Appropriate exercises with an emphasis on correct posture and technique can be incorporated into players' practice sessions. A study of female basketball players showed that a 20-minute movement preparation protocol performed prior to players on court practice sessions effected significant improvements in lower limb kinetics and kinematics. The effectiveness of this approach is underscored by a study of female soccer players that employed a movement preparation protocol in a similar way and likewise observed significant reductions in the incidence of non-contact ACL injury.
- **Lower Back:** Deficits identified during players' initial screening in any one of the components that contribute to lumbopelvic stability should be addressed in order to guard against low back pain and injury. For all players there is a need for development of strength, endurance and neuromuscular control of the muscles that stabilize the trunk. Training might include appropriate strength training exercises that emphasize bracing the trunk and controlling lumbopelvic posture in addition to more conventional core stability exercises performed from the floor and also labile surfaces and devices such as balance balls and stability balls. A postural stability and dynamic stabilization training intervention was also associated with significant decreases in (non-contact) lower back injury in a sample of elite female soccer players. It follows that this form of training would appear to be an important component of physical development with respect to protecting against low back pain and injury. One key movement strategy for sparing the spine is to move from the hips in order that the players are better able to maintain a neutral spine position during movements on court. This is of course

contingent on the athlete possessing the necessary hip mobility and strength to be able to move in this way. Accordingly, flexibility training and strength development for these hip muscles incorporating appropriate movements should be an important focus for netball players' training.

- **Shoulder:** Regardless of whether there is a previous history of shoulder issues it seems prudent that a dedicated shoulder maintenance session is included in the training week for all players throughout the training year. Players' initial musculoskeletal and movement screening can be used to identify any risk factors to be addressed. In those with current or previous shoulder pain and instability the player's history and ongoing assessment can help guide their corrective training and shoulder development work. Exercise selection will in general address the scapula stabilizer muscles and the rotator cuff. Specifically, middle and lower trapezius, rhomboids and serratus anterior are key muscles to be developed. Exercises should similarly focus on developing kinesthetic sense of scapula position. As for rotator cuff development, exercise selection should address all rotator cuff muscles; however, the external rotators (predominantly infraspinatus and teres minor) appear to require special attention as these muscles are subjected to particular stress in throwing sports. Evidence of specific atrophy of the infraspinatus muscle accompanied by reduced external rotation strength scores in overhead striking athletes (beach volleyball players) 39 further suggests a need for specific development. This is likely to be the case particularly for those playing positions that contest for possession of the ball overhead, and execute one-handed over-arm passes, on a frequent basis.

Conclusion

There are a number of different exercises reported to successfully elicit significant activation of each of the four rotator cuff muscles either alone or in combination. Once isolated exercises for specific development of rotator cuff muscles have been introduced, more complex exercises can be included in players' training which allows greater force development. Resistance in the form of either free weights (e.g., dumbbells) or cable machines are generally preferable for these exercises as they avoid the adverse length-tension relationship associated with resistance bands or tubing as well as providing greater ease of progressing load. Exercises for the scapula stabilizers should include rowing and pulling exercises that focus on retracting and adducting the scapula– for example cable and dumbbell rows, cable lath pull-down exercise, and both standard and supine variations of the pull up– as well as exercises that focus on controlled scapular protraction, such as the 'push up plus' and dumbbell pull over exercises. Conditioning training practices, indeed, elicit adequate external intensities but inadequate internal intensities relative to match-play across positions in semi-professional and development netball players.

References

1. Agel J, Arendt EA, Bershadsky B. Anterior Cruciate Ligament Injury in National Collegiate Athletic Association FF Basketball and Soccer: A 13-Year Review. American Journal of Sports Medicine. 2005;33(4):524-531,
2. Barber-Westin SD, Noyes FR, Galloway M. Jump-Land Characteristics and Muscle Strength Development in Young Athletes. American Journal of Sports Medicine. 2006;34(3):375-384,
3. Barr KP, Griggs M, Cadby T. Lumbar Stabilization: Core Concepts and Current Literature, Part One, American Journal of Physical Medicine and Rehabilitation. 2005;84:473-480.
4. Besier TF, Lloyd DG, Ackland TR, Cochrane JL. Anticipatory Effects on Knee Joint Loading during Running and Cutting Maneuvers. Medicine & Science in Sports & Exercise. 2001;33(7):1176-1181.
5. Boling MC, Padua DA, Creighton RA. Concentric and Eccentric Torque of the Hip Musculature in Individuals with and Without Patellofemoral Pain. Journal of Athletic Training. 2009;44(1):7-13.
6. Bressel E, Yonker JC, Kras J, Heath EM. Comparison of Static and Dynamic Balance in Female Collegiate Soccer, Basketball, and Gymnastics Athletes. Journal of Athletic Training. 2007;42(1):42-46.
7. Brown CN, Mynark R. Balance Deficits in Recreational Athletes with Chronic Ankle Instability. Journal of Athletic Training. 2007;42(3):367-373.
8. Cools AM, Cambier D, Witvrouw EE. Screening the Athlete's Shoulder for Impingement Symptoms: A Clinical Reasoning Algorithm for Early Detection of Shoulder Pathology. British Journal of Sports Medicine. 2008;42:628-635.
9. Cowan SM, Crossley KM, Bennell KL. Altered Hip and Trunk Muscle Function in Individuals with Patellofemoral Pain. British Journal of Sports Medicine. 2009;43:584-588.
10. Dempsey AR, Lloyd DG, Elliott BC, Steele JR, Munro BJ. Changing Sidestep Cutting Technique Reduces Knee Valgus Loading. American Journal of Sports Medicine. 2009;37(11):2194-2200.
11. Elphinston J, Hardman SL. Effect of an Integrated Functional Stability Program on Injury Rates in an International Netball Squad. Journal of Science and Medicine in Sport. 2006;9:169-176.
12. Escamilla, RF, Yamashiro K, Paulos L, Andrews JR. Shoulder Muscle Activity and Function in Common Shoulder Rehabilitation Exercises. Sports Medicine, 2009;39(8):663-685.
13. Fabrocini B, Mercaldo N. A Comparison between the Rotator Cuffs of the Shoulder and Hip. Strength & Conditioning Journal. 2003;25(4):63-68
14. Ford KR, Myer GD, Hewett TE. Valgus Knee Motion during Landing in High School Female and Male Basketball Players. Medicine & Science in Sports & Exercise. 2003;35(10):1745-1750.
15. Gamble P. Metabolic Conditioning for Team Sports. In: Strength and Conditioning for Team Sports – Sport-Specific Physical Preparation for High Performance. Routledge, United Kingdom. 2009a, pp.60-77.
16. Gamble P. Training for Injury Prevention. In: Strength andConditioning for Team Sports – Sport-Specific Physical Preparation for High Performance. Routledge, United Kingdom. 2009b, pp.158-196.
17. Gamble P. Athleticism and Movement Skills Development. In: Training for Sports Speed and Agility – An Evidence-Based Approach. In Press.

18. Gamble P. Speed-Strength Development and Plyometric Training. In: Training for Sports Speed and Agility – An Evidence-Based Approach. In Press.
19. Gamble P. Developing Change of Direction Capabilities and Expression of Sports Agility. In: Training for Sports Speed and Agility – An Evidence-Based Approach. In Press.
20. Giannakopoulos K, Beneka A, Malliou P, Godolias G. Isolated vs. Complex Exercise in Strengthening the Rotator Cuff Muscle Group. Journal of Strength and Conditioning Research. 2004;18(1):144-148.
21. Gilchrist J, Mandelbaum BR, Melancon H, Ryan GW, Silvers HJ, Griffin LY, *et al*. A Randomized Controlled Trial to Prevent Noncontact Anterior Cruciate Ligament Injury in Female Collegiate Soccer Players. American Journal of Sports Medicine. 2008;36(8):1476-1483.
22. Hanson AM, DA Padua, Blackburn JT, Prentice WE, Hirth CJ. Muscle Activation during Side-Step Cutting Maneuvers in Male and Female Soccer Athletes. Journal of Athletic Training. 2008;43(2):133-143.
23. Harris GR, Stone MH, O'Bryant HS, Proulx CM, Johnson RL. Short-term Performance Effects of High Power, High Force, or Combined Weight Training Methods. Journal of Strength & Conditioning Research. 2000;14(1):14-20.
24. Herman DC, Onate JA, Weinhold PS, Guskiewicz KM, Garrett WE, Yu B, Padua DA. The Effect of Feedback with and Without Strength Training on Lower Extremity Biomechanics. American Journal of Sports Medicine. 2009;37(7):1301-1308.
25. Herman DC, Weinhold PS, Guskiewicz KM, Garrett WE, Yu B, Padua DA. The Effects of Strength Training on the Lower Extremity Biomechanics of Female Recreational Athletes during a Stop-Jump Task. American Journal of Sports Medicine. 2008;36(4):733-740.
26. Hewett TE, Lindenfield TN, Riccobene JV, Noyes FR. The Effect of Neuromuscular Training on the Incidence of Knee Injury in Female Athletes: A Prospective Study. American Journal of Sports Medicine. 1999;27(6):699-706.
27. Hewett TE, Myer GD, Ford KR, Heidt RS, Colosimo AJ, McLean SG, *et al*. Succop. Biomechanical Measures of Neuromuscular Control and Valgus Loading of the Knee Predict Anterior Cruciate Ligament Injury Risk in Female Athletes: A Prospective Study. American Journal of Sports Medicine. 2005;33(4):492-501.
28. Hewett TE, Ford KR, Myer GD. Anterior Cruciate Injuries in female Athletes, Part 2: A Meta-analysis of Neuromuscular Interventions Aimed at Injury Prevention. American Journal of Sports Medicine. 2006;34(3):490-498.
29. Hewett TE, Tong JS, Boden BP. Video Analysis of Trunk and Knee Motion during Non-Contact Anterior Cruciate Ligament Injury in Female Athletes: Lateral Trunk and Knee Abduction Motion are Combined Components of the Injury Mechanism. British Journal of Sports Medicine. 2009;43:417-422.
30. Holmes A, Delahunt E. Treatment of Common Deficits Associated with Chronic Ankle Instability. Sports Medicine. 2009;39(3):207-224,
31. Hopper DM. Somatotype in High Performance FemaleNetball Players May Influence Players Position and the Incidence of Lower Limb and Back Injuries. British Journal of Sports Medicine. 1997;31:197-199.
32. Hopper DM, Lo SK, Kirkham C, Elliott B. Landing Patterns in Netball: Analysis of an International Game. British Journal of Sports Medicine. 1992;26(2):101-106.
33. Hopper DM, McNair P, Elliott BC. Landing in Netball: Effects of Taping and Bracing the Ankle. British Journal of Sports Medicine. 1999;33:409-413,
34. Hubbard TJ, Kramer LC, Deneger CR, Hertel J. Correlations Among Multiple Measures of Functional and Mechanical Instability in Subjects with Chronic Ankle Instability. Journal of Athletic Training. 2007;42(3):361-366,
35. Hume PA, Steele JR. A Preliminary Investigation of Injury Prevention Strategies in Netball: Are Players Heeding the Advice? Journal of Science & Medicine in Sport. 2000;3(4):406-413.
36. Kettunen JA, Kvist M, Alanen E, Kujala UM. Long-Term Prognosis for Jumper's Knee in Male Athletes: A Prospective Follow-up Study. American Journal of Sports Medicine. 2002;30(5):689-692.
37. Kofotolis N, Kellis E. Ankle Sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players. Journal of Athletic Training. 2007;42(3):388-394.
38. Kraemer R, Knobloch K. A Soccer-Specific Balance Training Program for Hamstring Muscle and Patellar and Achilles Tendon Injuries: An Intervention Study in Premier League Female Soccer. American Journal of Sports Medicine. 2009;37(7):1382-1393.
39. Lajtai G, Pfirrmann CWA, Aitzetmuller G, Pirkl C, Gerber C, Jost B. The Shoulders of Professional Beach Volleyball Players: High Prevalence of Infraspinatus Muscle Atrophy. American Journal of Sports Medicine. 2009;37(7):1375-1383.
40. Landry SC, McKean KA, Hubley-Kozey CL, Stanish WD, Deluzio KJ. Neuromuscular and Lower Limb Biomechanical Differences Exist Between Male and Female Elite Adolescent Soccer Players During an Unanticipated Run and Crosscut Maneuver. American Journal of Sports Medicine. 2007;35(11):1901-1911.
41. Leetun DT, Ireland ML, Willson JD, Ballantyne BT, Davis IM. Core Stability Measures as Risk Factors for Lower Extremity Injury in Athletes. Medicine & Science in Sports & Exercise. 2004;36(6):926-934.
42. Lim BO, Lee YS, Kim JG, An KO, Yoo J, Kwon YH. Effects of Sports Injury Prevention Training on the Biomechanical Risk Factors of Anterior Cruciate Ligament Injury in High School Female Basketball Players. American Journal of Sports Medicine. 3 2009;7(9):1728-1734.
43. McGill SM. Helpful Facts; Anatomy, Injury Mechanisms and Effective Training, In: Ultimate Back Fitness and Performance (3rd Edition). Wabuno, Ontario Canada, 2006a, pp. 61-86.
44. McGill SM. Stage 4: Developing Ultimate Strength, In: Ultimate Back Fitness and Performance (3rd Edition). Wabuno, Ontario Canada, 2006b, pp. 239-273.
45. McManus A, Stevenson MR, Finch CF. Incidence and Risk Factors for Injury in Non-Elite Netball. Journal of Science and Medicine in Sport. 2006;9:119-124.
46. Murphy DF, Connolly DAJ, Beynnon BD. Risk Factors for Lower Extremity Injury: A Review of the

Literature. British Journal of Sports Medicine. 2003;37:13-29.
47. Fox AS, Spittle M, Otago L, Saunders N. Descriptive analysis of landings during international netball competition: Enhancing ecological validity of laboratory testing environments. International Journal of Performance Analysis in Sport. 2013;13(3):690-702.
48. Haddera AT. Examine the Relationship Between Team Cohesion, Comparative Anxiety and Self-Confidence Among Ethiopian Basketball Teams. Journals of Tourism, Hospitality and Sports. 2015;13:30-35.
49. Humphries B, Stanton R, Hayman M, Borgelt H, Humphries B, Stanton R, *et al*. A novel approach to standardizing landing and balancing tasks in netball using single-leg horizontal jumps single-leg horizontal jumps. Measurement in Physical Education and Exercise Science. 2018;10:1-9.
50. Kementerian Pendidikan Malaysia, Buku Panduan Pelaksanaan Dasar Satu Murid Satu Sukan (1M1S). Bahagian Sukan. Malaysia, Perpustakaan Negara, 2011.
51. Mccartney, Kieran N, Forsyth J. The efficacy of core stability assessment as a determiner of performance in dynamic balance and agility tests. Journal of Human Sport and Exercise. 2017;12(3):640-650.
52. Mothersole G, Cronin JB, Harris NK. Jump-Landing Program for Females: Development of a Systematic Progression Model. European Journal of Applied Physiology. 2014;36(4):52-64.
53. Pearce AJ, Kidgell DJ, Latella C, Carlson JS. Effects of secondary warm up following stretching. European Journal of Applied Physiology. 2012;105:175-183.
54. Stuelcken M, Greene A, Smith R, Vanwanseele B. Knee loading patterns in a simulated netball landing task. European Journal of Sport Science. 2013;13(5):475-482.
55. Miller Ronald. Vygotsky in perspective. (R. Miller, ed.) United Kingdom: Cambridge, 2011.