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THE RELATABLE EFFECT OF ENDURANCE, AGILITY, AND VO2 MAX ON BALL GAMES AMONGS DIFFERENT ATHELETS: SYSTEMIC REVIEW

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Abstract

Aim: The relatable effect of endurance, agility, and vo2 max with ball games in various athletes. Due to their accessibility and global appeal, sports are the most culturally inclusive activities. Ball sports have existed for thousands of years in human history. These days, 13 of them—table tennis, tennis, volleyball, water polo, ice hockey, football/soccer, golf, handball, hockey, rugby, and badminton—are included in the Olympic games. Athletes' whole bodies undergo physiological changes as they practice, play, and train: their body mass, height, body fat, type of muscle fibres, and oxygen intake are all impacted and improved.

Methods: We obtained articles that were published or made available on different websites between 2010 and 2022 via PubMed, Google Scholar, and the Cochrane library. inclusion criteria were experimental investigations, literature reviews, systemic and meta-analyses, and randomized control trials. We take into account every research that looked at how different athletes' levels of endurance, vo2max, and agility affected their ball games. The review was restricted to research published in peer-reviewed publications with full texts available in English; studies that attempted to achieve a disadvantage within our chosen parameters were not included. All research reports, irrespective of the study design, were approved. Studies that were only published in abstract or dissertation form, studies that were based on the target population, expert reports, letters from the editor, books, monographs, clinical narratives, and studies with an unclear relationship between sports and selected parameters were all excluded from this analysis.

Results: The search method turned up 200 results. Eighty-five articles were eliminated after duplicate references were removed and titles and abstracts were screened. Ninety of the 115 articles that remained following the full-text screening were read in full. These were then subjected to a final screening that involved looking up additional relevant papers in the reference lists of the included studies and prior reviews. The exclusion criteria based on the complete text included the following: no influence on certain parameters, flawed effects and results, secondary research, improper outcome measurement, and inappropriate study design. As a result, 32 studies (Prisma chart, table no. 1) that were mentioned in the review of literature as well as additional table no. 2 were included in the final review.

Conclusion: In order for ball game athletes to perform better on the field, it is established that there is a substantial relationship between vo2max, agility, and endurance. training protocols also differ depending on the type of sports.

Keywords: sports, endurance, agility, vo2max, hockey, ball games, systemic reviews and metanalysis.

Introduction

Sport can be defined as organized, structured physical activities that are played at both official and informal levels by people of all ages. Are certain sports that you are familiar with, such as basketball, football, rugby, tennis, and hockey, while others are more debate-based, like motor racing? Etc., however, the level of physical exertion required in sports varies. Physical educators have offered an explanation and a protocol for sports and leisure. The basic goals of recreation are rest, exercise, and fun. Athletics, on the other hand, is a sport where a great deal of coaching, training, funding, rules, advertising, and institutional control are all present. [3]Since ancient times, ball sports have been a part of human history. Currently, 13 of them—table tennis, tennis, volleyball, water polo, ice hockey, football/soccer, basketball, beach volley, golf, handball, hockey, and rugby—are included in the Olympic games. Every game has its own launcher, ball, pitch size, and player count. Various ball velocities are caused by these variations. Other than the speeds and how to maximize them, along with their intensities, training methods, and physiological effects. Throughout training, competition, and practice, athletes' bodies undergo physiological changes. In our study, ball games were specifically related to hockey, a long-standing sport that has experienced significant and quick development in the last ten years. All levels of play, but especially top play, now have different technical, tactical, and physiological requirements due to the introduction of synthetic playing surfaces. [5] Football is a complicated dynamic activity that involves a lot of different and varied kinesiology tasks, many of which involve cyclic and acyclic movements. [6][7] Rugby is a worldwide contact sport that is played at amateur, semi-professional, and professional levels. An 80-minute senior rugby league match usually consists of short recuperation intervals amidst vigorous running and tackling sequences. [8] basketball, which considers itself to be among the world's most popular sports. It's a high-intensity, intermittent sport. This indicates that a quick player can occasionally be a slow player in basketball [9] with parameters of endurance, agility, vo2max and also discussed its physiological changes by side. [10][11]

Physiological changes in selected ball games: 1. American football requires highly particular physiological conditions. After reviewing the literature, Hoffman confirmed that the glycolytic energy system supplies the remaining 10% of the energy needed for American football, with the phosphagen energy system providing up to 90% of the energy needed. The time-motion study of American football provided evidence in Favor of this, revealing that standard plays in high school, college, and professional games in the USA last for roughly 5 seconds, with 30 seconds elapsing between plays. [7] 2. In a 40-minute game, basketball players travel in all directions, running, dribbling, shuffling, jumping, and moving at different speeds, covering a distance of roughly 4500–5000 meters. Both the anaerobic and aerobic metabolic systems seem to be engaged during a game in order to carry out such actions during performance. Nonetheless, anaerobic conditioning has been prioritized in practice since it has long been believed that anaerobic metabolism serves as the main energy pathway for basketball players. [9] 3. We still don't fully understand the physiological and metabolic needs of playing rugby. While some argue that oxygen-dependent (aerobic) metabolic pathways are more significant, others believe that oxygen-independent (anaerobic) metabolism accounts for the majority of rugby metabolism. (I discovered that throughout a rugby match, blood lactate levels stayed below while blood-free fatty acid levels increased thrice. [8] 4. According to analysis, playing hockey has a physiological cost and energy expenditure of 2.26 L/min, which puts it in the category of "heavy exercise." An estimated 36 to 50 kJ/min will be spent on energy. [5]

Endurance and its role in selected ball games: The ability of a person to operate at a high level for safe and efficient operations over the course of a mission, operation, deployment, or expedition is known as endurance. Two crucial components of endurance are safety and performance. [12] The ability to engage in a sort of activity requiring several muscle groups and systems over an extended length

of time is commonly referred to as endurance. [6] Perhaps the most crucial skill for football players is endurance. This talent has a 70–80% rate of heredity. Energy reserves and the functional quality of energy potential are the manifestations of the regulatory mechanisms that determine how well an organism can endure [13] A hockey player's endurance is defined as their capacity to play games and train without tiring and to withstand exhaustion. Aerobic energy mechanisms in the body give overall endurance. [14][15] The basketball player must work on a variety of fitness-related skills. The athlete will therefore engage in a variety of training modalities concurrently after completing a variety of academics. It was determined that sports-specific endurance circuit training is useful for raising aerobic capacity and preserving high school male basketball players' vertical leap performance strength during the competitive stage. [16] Due to the nature of the physical contact, rugby seems to rely a lot on strength, power, speed, and endurance. An examination of retrospective data and a number of experiments were conducted in an attempt to determine the significance of upper body strength, power speed, and endurance for rugby league players. Because endurance is dependent on how well regulatory mechanism's function. [17]

Agility and its role in selected ball games: Agility has historically been defined as the ability to change direction fast, precisely, and just swiftly. Certain authors have broadened the definition of agility to encompass changes in direction that involve the entire body in addition to rapid movements. [18][19][20] Football players can enhance their dynamic athletic performance and explosive muscle power by engaging in complex agility training. [20] Basketball calls for quick reflexes and forceful jumping. For athletes looking to develop new skills, plyometric training is a helpful resource. "Explosive-reactive" power training is the name given to exercises that vigorously and repeatedly stretch and contract muscles to enhance power. [21] Agility plays a significant role in hockey, as the sport involves many quick spins. Agility rose significantly after the required weeks of training. [22] Rugby players require highly developed physiological features due to its physically demanding nature. A great degree of physical power, speed, agility, and aerobic fitness are requirements for players. [19][18]

Vo2max and its role in selected ball games: The amount of oxygen required varies depending on the sport. An athlete's anaerobic capacity is commonly observed to increase when they engage in anaerobic training; however, it is also commonly noted that their aerobic capacity improves following anaerobic exercise. Knowing which training style—aerobic or anaerobic—is best for a certain activity and whether combination training is required is therefore crucial. [23] Football in sports "Athletes' physical prowess is a crucial component of their success in sports." It encompasses an enormous variety of capacities, the main one being aerobic capacity. More VO2 must be consumed since the player must have an effective energy system that can sustain them for the entire 90 minutes at maximum strength. [24][25][26] High-intensity techno-tactical movements including sprinting, dribbling, kicking, jumping, dodging, tackling, rucking, mauling, and scrumming are necessary in rugby. In these types of sports, having a high degree of aerobic capacity helps athletes tolerate a heavy workload and recover quickly in between brief, sporadic bursts of high-intensity activity. One of the most popular markers of aerobic power metabolism, VO2max is regularly used to assess aerobic performance. [27]An intense sport that is played sporadically is basketball. Thus, both quick players and sluggish players can be found in basketball. greatest oxygen consumption, or VO2Max, and the greatest degree of aerobic endurance are related concepts. Athletes' physical fitness level is indicated by VO2Max, one of the metrics and indicators that aids in quick recovery during competition. [24][28] Our research has shown that training increases maximal aerobic capacity, primarily because increased aerobic activity causes muscles to hypertrophy from increased exercise. [24][26]

Review of Literature

1.Duthie. Grant, Pyne. David, et al (2012) in the article "Applied Physiology and Game Analysis of Rugby Union" conclude that anthropometrically and physically, the forwards and backs differed significantly. Backs usually have a lower proportion of body fat and are shorter than forwards, who

are usually heavier. Forwards are becoming more muscular and larger overall, which is a change from their previous traits. Better absolute anaerobic and aerobic power as well as muscular strength are displayed by the forwards. Results vary in body physiology, including endurance, agility, and strength, with the backs benefiting when body mass is included. Vol2max. (8)

2.Reilly. Thomas, Borrie. Andrew, et al (2012) in the article "Physiology Applied to Field Hockey" conclude that depending on their bodies, capacities, and training regimens, hockey players of both sexes have different needs. According to the article, training program designs have an impact on both the male and female bodies in this case; for example, female players' aerobic power has been found to vary between 45 and 59 ml/kg/min. yet, the research reports that men's aerobic power ranges from 48 to 65 ml/kg/min.that distinct needs apply to hockey players of both sexes based on their bodies, abilities, and training schedules. Training program designs in this instance, the article claims, affect both the male and female bodies; female players, for instance, have been found to have aerobic power ranging from 45 to 59 ml/kg/min. Men's aerobic power, however, is said to vary between 48 and 65 ml/kg/min, according to study. (5)

3.Alemdaroğlu. U, (2012) in the article "The Relationship Between Muscle Strength, Anaerobic Performance, Agility, Sprint Ability and Vertical Jump Performance in Professional Basketball Players" conclude that an essential part of basketball technique and conditioning is the development of explosive strength, take-off power, speed, and agility. These skills contribute significantly to effective movement both with and without the ball. Provided are the relationships between isokinetic knee strength and anaerobic performance. Peak power at every contraction velocity was substantially connected with isokinetic concentric knee extension strength. PP, CMJ, SJ, and 10 m sprint performance showed a weak but statistically significant association. (29)

4.Mishra. MK, Pandey. AK, et al (2015) in this article "A comparative study of VO2 max among the basketball, football, volleyball and hockey male players" conclude that when it comes to VO2 Max, football players are higher than those in basketball, volleyball, and hockey. Muscular strength, muscular endurance, and cardio- respiratory endurance are all components of physical fitness, with the latter being the most crucial. Physical fitness is an intricate concept.(24)

5.Cohen. C, Clant. C, et al (2016) in the article "In physics of ball sports" conclude that the force of the throw and the game determine the ball's acceleration, speed, and velocity. The size, shape, and mass of the ball, the launcher, the pitch, and the number of players all vary amongst games. Various ball velocities are caused by these variations. We conclude by discussing ball trajectories and their effect on the scale of sports as well as the history of ball games, in addition to velocities and how to maximize them.(10)

6.Sonchan. W, Moungmee. P, et al (2017) in this article "The Effects of a Circuit Training Program on Muscle Strength, Agility, Anaerobic Performance and Cardiovascular Endurance" conclude that the study participants experienced improvements in their cardiovascular endurance, anaerobic capacity, muscle strength, and agility after completing the circuit training program. To increase physical fitness, you can use this program as a reference when choosing an exercise regimen. (28)

7.Pincivero. DM, Medicine. TO Bompa, et al (2018) in the article "A physiological review of American football" conclude that the game requires a certain level of strength, power, speed, agility, flexibility, and both anaerobic and aerobic endurance. This review's goal is to analyse American football as a sport. Understanding the physiological systems used in football is essential to creating training plans that are ideal for preparation and field position requirements. The player's physiological requirements change after specialized instruction from previously.(6)

8.Girard. J, Feng. B, et al (2018) in this article "The effects of high-intensity interval training on athletic performance measures: a systematic review" conclude that revealed there were positive impacts of HIIT on some metrics of athletic performance. We discovered that HIIT produced gains in the 33-meter on-ice sprint in hockey players. Along with increasing VO2max and endurance, it also increases sprint speed. (30)

9.Ravi. Pramod, et al (2019) in this article "The effect of medicine ball training on shoulder strength and abdominal strength and endurance among Sudan school boy's football players in Qatar" conclude that when it came to SS and ASE, the experimental group had greatly improved because of MBT,

while the control group had not exhibited any discernible change. A random split into two groups was applied to the chosen individuals. (15 people) made up Group I, which is the Experimental Group; (15 people) made up Group II, which was the Control Group. The six-week training session for the Experimental Group (EG) involved Medicine Ball Training (MBT) on three different days per week.[32]

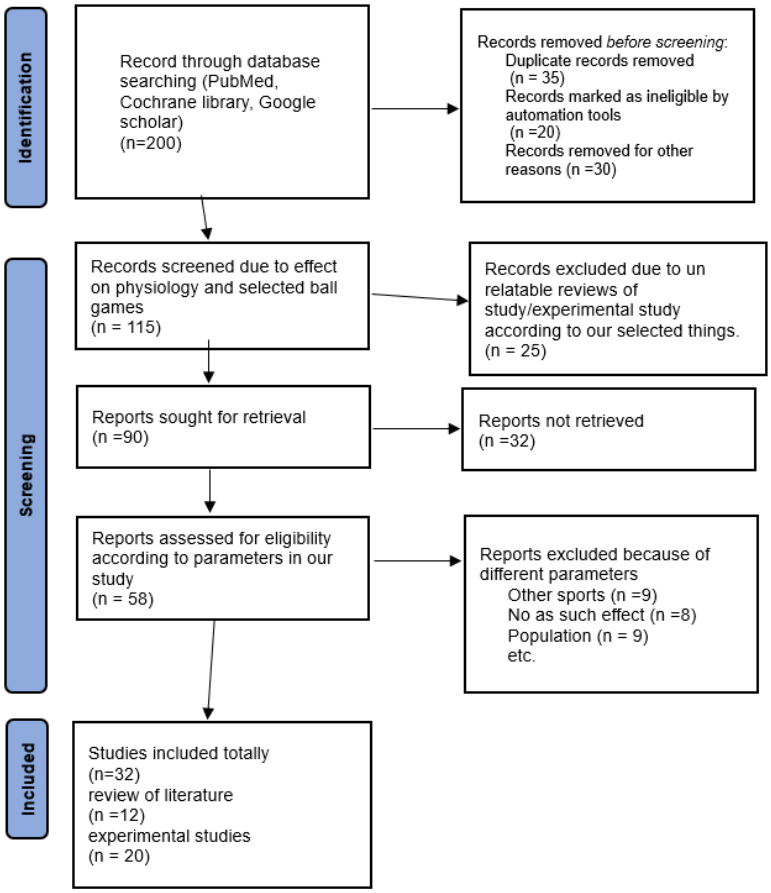
10.Ahsan M, Ali MF, (2023) in this article "Comparison of physiological characteristics and physical performance measures among athletes from random intermittent dynamic type sports" conclude that These results demonstrated that athletes from random intermittent dynamic type sports differed significantly in terms of physiological and physical performance traits. To attain the highest levels of athletic achievement, these methods are in charge of enhancing physiological and physical performance. The nature of the game should be taken into account when designing the training program in terms of both morphological and functional aspects. [55]

Methodology

Inclusion and Exclusion Criteria: The review was sticked to those studies with the primary goals of improving/effect of endurance, agility, vo2max on selected games or improve physiology of athletes after any training or exercise, effect on physiology of athletes runs with ball during playing, both male or female practising team sports at elite or competitive level with no acute or chronic disease. Studies that aimed drawback in our selected parameters were excluded. The population of interest was hockey, badminton, rugby, and football players other criteria of population were excluded. we only included those studies that provided individual data or separate data or meaningful data for those. The review was limited to studies published in peer-reviewed journals with full text available in English. All research reports were accepted, regardless of study design. We excluded studies published only in abstract or dissertation form, grey literature studies, studies with undefines relation in between sports and selected parameters, other sports than selected parameters, any kind of disease-based/physically disabled population of sports, studies not based on the target population, expert reports, letters from the editor, books, monographs, clinical narratives were not included in this study. [34]

Search Strategy: Our study conducted a review search to identify all relevant articles. Basically, focused on the parameters of endurance, agility, and vo2 max studies targeting enhancement of different ball games athlete performance as a search protocol. Articles from PubMed, Google scholar, Cochrane library that were published or made accessible on various websites between 2010 to 2022 were retrieved. Each search included phrases such as endurance, agility, vo2max rehabilitation treatment, physiology and physiotherapy. We reviewed many pieces of research before selecting whether to include an article in our study. Reading choices - where applicable, the following keywords were included in articles: hockey, basketball, football, rugby, formal review, systemic review, meta-analysis, endurance, agility, vo2 max, ballgames, sports, training, games. [3]

Table no 1: Prisma Chart



Result

Research become an increasingly popular subject nowadays. It involves using training measures to assess the utility of numerous interventions to enhance athletic performance. [11] The search strategy retrieved 200 records. After removal of duplicate references and screening of titles and abstracts, 85 articles were excluded. Of the remaining 115 articles and after full-text screening, 90 was left after final screening checking according to inclusion criteria was 32 (Prisma chart, table no1) mentions in review of literature and supplementary table no 2 as well. [36]

Effects of selected parameters (endurance, agility, vo2max) on rugby players: Out of eight, three articles were related to endurance, first article mention that in rugby players practice requires high level of muscular strength, endurance, power for success. The forward notions require more endurance and strength than backsThe total work over the duration of a game is lower in the backs compared with the forwards; forwards spend greater time in physical contact with the opposition while the backs spend more time in free running, allowing them to cover greater distances. [8] second article mention that the circuit training program improves the cardiovascular endurance and muscular strength. When we apply particular circuit practice to the rugby players for certain period of time than variation in endurance and strength was seen on high levels. [37] third article mention that due to the nature of the modern game, it requires players to be strong to successfully tackle, agile to quickly evade opposition, have high cardiovascular endurance to sustain performance more than 80 min Utes of activity, and have rapid force production capabilities for accelerating and tackling. [38] Our other two articles were related to agility which also play vital role in physical performance of our sports players. articles mention that after applying particular training programs like plyometric training and sprint training etc; on rugby players were help in improving its agility, standing long jump, strength, 80m sprint, power. findings demonstrated that both line sprinting and plyometric training regimes are effective in improving agility and leg power and that line sprinting performed over 10, 20, 40 and 100 metres is an effective training protocol to improve 40m sprint time. [37] Remaining other articles were related to vo2max which is most essential component in our physiology and physical need of sports person.

when we applied two fitness training programs with long and short sets with the same intensity and volume on physical fitness and performance factors in rugby elite players. 27 rugby players from rugby club of Khorasan Razavi Gas Industrial Cooperative participated voluntarily and were divided randomly into three equal groups: long set group, short set group and control group, program was of 8 weeks for intervention. Results showed a significant increase in both VO2max and anaerobic power in the experimental groups compared with the control group. [35]

Effects of selected parameters (endurance, agility, vo2max) on football players: Eight of the selected articles reported direct results regarding the effect of endurance, agility and vo2max on football game. First three articles were applied different trainings to football players and they show positive effect on improvement of endurance among players, like medicine ball training on shoulder and abdominal strength, after 6-week training program of medicine ball strength and endurance of shoulder and abdominal were increases in experimental group.[32] On other hand , when we applied Concurrent training which actually very popular training strategy, called strength and endurance training in a training unit also show positive impact on endurance of football players.[40] When we applied low, moderate and high intensity of physical exercise for 12 consecutive weeks. The selected physical fitness variables muscular endurance, muscular strength was increases in performance on matches. [41][42]

Our other three articles mentions that agility also play vital role in physical parameters of our sports players show positive effect toward the enhancement of agility after certain exercise program or redeveloping of training ability. the physical demands of the football game include strength, speed, power, agility, flexibility, as well as aerobic and anaerobic endurance. [6][20] SAQ (speed, agility, and quickness) with resistance training produced significant improvement over agility, dribbling ability, mass of muscles and strength among tribal football players, training was of 60 mins a day for a session, 3 days in week for 12 weeks. It consists of warmups, respective trainings, warm down and after each two week 5% of load was increases from 50% to 80%.[34], another training which was called resistance tube exercises training also applied to our football players, after two-week resistance tube exercise program was found a good impact. [43] Remaining articles talked about the Vo2max, When our study uses touch of small sided game to enhance the Vo2max of our players so it was successfully improved. The subjects of this study were 32 amateur football players. MFT was used to measure VO2max in data collecting technique. result shows the exercise of small side games 4v4 two touches affected to VO2max (sig value = 0.000), training of small side games 4v4 free touch affected to VO2max (sig value = 0,016) and there are some differences between two touches and free touch training. [24]

Effects of selected parameters (endurance, agility, vo2max) on hockey players: Eight of the selected articles reported positive results regarding the effect of endurance, agility and vo2max on hockey game. endurance play vital role in athlete training program. Its variation depends upon type of training/exercise applied by coach. the requirements of both male and female hockey players vary according to their body, capacity and exercise protocols.in that article the design of training programs affect female and male body both, in females Aerobic power amongst female players has been shown to range from 45 to 59 ml/kg/min. on other hand males aerobic power reported in the literature is 48 to 65 ml/kg/min.[44] on other hand when isokinetic resistance training, combined with eccentric overload, improved drop jump performance and induced greater muscle hypertrophy, muscle strength (endurance) than traditional training.[45]In our next two studies articles, the study, 48 intercollegiate male field hockey players were randomly selected and they were divided into three groups consisting of sixteen each (N = 16). Group was HALAN, LAHAN and control. both Combination-1 HALAN and Combination-2 LAHAN programmes were best protocols but the Combination-2 LAHAN programme shows better improvement. [46] The effects of high-intensity interval training on athletic performance conclude that the HIIT was beneficial effects on certain athletic performance measures. In hockey players we found that HIIT-induced improvements in the on ice 33-m sprint. [47] Other three articles related to vo2max conclude the demand of oxygen differs from one sport to other sports. It's a common observation that whenever athlete go for anaerobic type of training his/her anaerobic

capacity is enhanced but along with this it is also observed that after anaerobic type of training the aerobic capacity of the athlete is also improves its vo2max. [24] another article mentions eight weeks of HIIT significantly increases muscle mass, jump performance, and VO2max and significantly reduces adipose mass and time in pushing speed in Chilean female field hockey players. [48] One study also shows specific improvement in Vo2max. effect of anaerobic interval training, they selected 40 intercollegiate level Hockey players who were randomly divided into two groups. The experimental group was given anaerobic interval training for six weeks, consisting of speed endurance exercises, fartlek exercises, sprint intervals and stair stepper exercises and the control group was not provided with any investigational treatment. [49]

Effects of selected parameters (endurance, agility, vo2max) on basketball players: They had specific types of movements, physiological requirements and energy Sources. the activity of basketball players is based on a combination of horizontal movements and, vertical movements, and movements that combine the two movement planes.[9] the explosive strength, take-off power, speed, and agility are abilities that make an important contribution to efficient movement with and without the ball, thus play an important role in basketball technique and training.[29] eight weeks of aquatic and land plyometric training on leg muscle strength, sprint times, and dynamic balance test in young male basketball players. Eighteen young male basketball players volunteered in this study and divided to three groups; aquatic plyometric training (APT), land plyometric training (LPT) and control group (CON). APT improved better than LPT in strength and sprint. Whereas, the LPT group indicated better improvement than APT group in dynamic balance. In this study, maximal strength as measured by 1RM leg press was improved more by APT than by LPT; however, there was no significant difference between APT and LPT groups. [50] Our other articles shows that sport specific training program will be employed which will incorporate skills and movements specific to the sport, at intensities sufficient to promote aerobic and anaerobic adaptations, 39 participants were recruited according to the selection criteria. After 6 weeks training, the experimental group has demonstrated significant improvement in Anaerobic power and anaerobic capacity, agility and vertical jump height has also shown improvement with a p value >0.05.[51] on other hand, 8-week aquatic-based plyometric training program provided the same or more benefits for jumping and agility ability of young basketball players than the land-based plyometric training program of the same duration.[52]Series of our next articles studies clear the concept of Vo2max in basketball players.it is very essential physiological component of sport person which enhance with the enhancement of training protocols/programs. the physiological demands imposed on basketball players is provided by the aerobic and anaerobic energy systems. It was conventionally assumed that anaerobic training improved the strength and conditioning of basketball players. study included 24 participants, they concluded that the VO2 max or the aerobic endurance is a key point in every sport, and yet there are no research papers on the aerobic endurance (VO2 max) of elite Indian basketball players. [35]

Table no 2: Experimental /Observational studies to show effect of endurance, agility and vo2 max among selected ball games (hockey, basketball, football, rugby)

Aim	Year	Population	Training / tool used	Physiological changes	Conclusion
A. Football					
1.Investigation of The Effect of Concurrent Training Strength and Endurance Training on Physical, Physiological and Psychological Parameters in Young Football Players	2021	U19 age group players were included in the research group, 24 male football players who played professionally licensed football for at least 5 years	Concurrent training is a popular training strategy, called strength and endurance training in a training unit	Concurrent training program show effect on agility, endurance strength, power of the players	The application of strength training before endurance training in 'concurrent' training model applications in players; on performance

		and trained for an average of 2 hours a day, 5 days a week			values It concludes that endurance training has more effect than applying it before strength training
2. EFFECT OF SELECTED PHYSICAL EXERCISE ON MUSCULAR FITNESS AND AGILITY FOR U-17 MALE FOOTBALL TRAINEES OF BURAYU TOWN, OROMIYA REGIONAL STATE, ETHIOPIA	2020	U-17 male football Trainees of Burau Town. 30 trainees were selected as study subjects out of 150	low, moderate and high intensity of physical exercise for 12 consecutive weeks. The selected physical fitness variables are muscular endurance, muscular strength and Agility.	there was significant improvement due to exercise program on endurance, agility, strength, power, aerobic capacity	low, moderate and high intensity physical exercise have positive effects on enhancement of muscular endurance, strength and Agility
3.The effect of medicine ball training on shoulder strength and abdominal strength and endurance among Sudan school boy's football players in Qatar	2019	Thirty (30) inter school football boy's player of Sudan nationalities randomly were selected from Indian school Doha-Qatar	Warner Test of Soccer Skill (in M) and Abdominal Strength and Endurance was assessed by AAHPER Youth Fitness Test. Medicine Ball Training (MBT)also used. Group I was Experimental (N=15) and Group II was Control (N=15).	After 6-week training program of medicine ball strength and endurance of shoulder and abdominal were increases in experimental group	It concludes that experimental group has shown improvement in SS and ASE due to MBT and control group has not shown any significant improvement in SS and ASE.
4.The Effect of Touch of The Ball in Small Side Games on The Improvement Vo2max Amateur Football Players	2018	experimental research with a modified pre-test – post-test group design. The sub-jects of this research were32amateur football players	MFT was used to measure VO2max in data collecting technique	number of ball touches in small side games affects the increase in VO2max of amateur soccer players	football coaches and football extracurricular coaches can implement the exercise to increase the VO2max of their players.

5.Effect of resistance tube exercises on kicking accuracy, vertical jump and 40-yard technical test in competitive football players – an experimental study	2014	The study involved 23 competitive football players (11 males, 12 females) aged from 18–20 years recruited from three different universities in Belgaum, Karnataka, India for resistance tube exercise program	Back heel kick accuracy, vertical jump height and 40-yard technical test time were evaluated by using before and after 2-week tube exercise program	After 2-week tube resistance exercise program the agility was enhance in our football players	2-week resistance tube exercise program was effective on selected parameters in competitive football players. It can be included as a component of a regular strength, agility training program for athletes
B. Rugby					
1.Comparative study of the effects of sprint and plyometric training on the speed, agility and power output in intermediate rugby players	2020	22 rugby players participating at club level. players were randomly placed in either the line sprinting group or the plyometric training group (	Sprinting and polymetric training were used for 8 weeks. For agility, the T-test was used, and for power, the standing long jump.	Improvement in agility and speed occur in both groups with certain limits of sprint	sprinting group improved in performances but only measure that was not improve was 80m sprint. The plyometric group showed improvements in two categories only - agility and the standing long jump – while no significant improvements were found in any of the sprint distances.
2.Effects of individualised training programmes based on the force-velocity imbalance on physical performance in rugby players	2020	Thirty-four senior rugby players were divided into four groups according to their Fvimb:	force-velocity imbalance program	Fvimb program improves the endurance, strength, aerobic capacity and power of rugby players	RT programs based on Fvimb was improve sprint performance. Also improved SQ strength, jump height or maximum power.
3.Training Unloading During Winter Break Improves Fitness in Male Rugby Players	2017	Fourteen male club rugby players for instructed exercise testing	Unstructured training program for 4 weeks	Physiological parameters like vo2max, power, strength, speed was increases	Four weeks of unstructured training increases in physiological function despite

					increases in body fat.
4.Effect of 8 Days of a Hyper gravity Condition on the Sprinting Speed and Lower-Body Power of Elite Rugby Players	2015	15 players from a training squad of a national team academy were recruited to participate. experimental group (n = 8) and a control group (n = 7)	It includes wearing of weighted vest at all times during the day for an extended period of time.	They improve our physiological parameters of body like power, strength but not for Sprinting speed in players, physiological effects vary according to players capacity	experimental group had both negative and positive speed and power responses. hyper gravity for 8 days is likely ineffective at improving sprinting speed while undergoing standard rugby training.
5.The Effect of Two Fitness Training Programs with Short and Long Sets on Physical Fitness and Performance Factors in Rugby Elite Players	2013	27 rugby players from rugby club of Khorasan Razavi Gas Industrial Cooperative were participated voluntarily and were divided randomly into three equal groups: long set group, short set group and control group	Long and short sets training for 8 weeks	Vo2max and aerobic power increases,	rugby players can follow interval trainings with long and short sets to improve their aerobic and anaerobic power.
C. Hockey					
1.Effects of a High-Intensity Interval Training Program on Body Composition and Physical Fitness in Female Field Hockey Players	2021	Random sampling was done and divided into 2 groups one was control other was experimental	HIIT for eight weeks in the form of a 14-min workout, distributed between seven exercises of one-min of work and one-min of rest at the end of each session	HIIT increases muscle mass, jump performance, and VO2max, strength	eight weeks of HIIT significantly increases muscle mass, jump, VO2max and reduces the adipose mass and time in pushing speed.

2.Isokinetic resistance training combined with eccentric overload improves athletic performance and induces muscle hypertrophy in young ice hockey players	2019	Twenty-two healthy, male ice hockey players from Swedish and Norwegian junior hockey leagues volunteered to participate in this study	Group 1 was isokinetic with eccentric training and other was group 2 traditional training for 8 weeks program	Improvement in muscle power, strength (endurance), aerobic capacity(vo2max)	the combination of isokinetic RT and eccentric overload induced greater muscle hypertrophy compared to traditional RT. it also show that type of training improves drop jump performance, gain in maximal strength and power output were similar across training modalities.
3.Effect of varied combinations of aerobic and anaerobic training with game specific drills on selected motor fitness variables of field hockey players	2019	48 intercollegiate male field hockey players were randomly selected from SRMV, RKMV Vivekananda Educational and Research Institute and SRKV Arts College, Coimbatore, Tamil Nadu	There were two experimental groups and one control group. Combination of halan and lahan with game specific drills in both were taken as tool	That study effects cardiovascular endurance, speed, agility	LAHAN programme produced better improvement than the HALAN programme
4.Effect of anaerobic interval training on selected bio motor and skill performance variables among hockey players	2016	40intercollegiate level Hockey players who were randomly divided into two groups. One was investigational group and the other group was control group.	anaerobic interval training for six weeks, consisting of speed endurance exercises, fartlek exercises, sprint intervals and stair stepper exercises	There was improvement occur on selected body bio motor and physiological parameters like vo2max, speed, Endurance, agility	that anaerobic interval training can be imparted to intercollegiate level Hockey players to improve its physiology

5.EFFECT OF RESISTANCE AND PLYOMETRIC TRAINING ON SELECTED PHYSICAL, PHYSIOLOGICAL AND SKILL PERFORMANCE VARIABLES AMONG FEMALE HOCKEY PLAYERS	2014	45 female hockey players were randomly selected from PKR College of Arts and Science for Women and Gobi Arts and Science College, Erode district, Tamil Nādu, India	Group I was treated with resistance training group II with plyometric training, Group III was kept under control. duration of training period was 12 weeks.	According to results there was significant changes occur in agility, strength, vital capacity, blood pressure Endurance, speed in both training group as compared to control group	Resistance training and plyometric group shows effect on physiological variables
D. Basketball					
1.Effectiveness of basket-ball sports specific training program on selective fitness variables in basket-ball players	2022	39 participants were selected according to criteria of random control and were randomly allocated to experimental group (n=19) and control group (n=19	Experimental group included warm-up, running exercise, strength, plyometrics and balance followed by cool down. On other hand control group regular warm-up, stretching, joint range of motion, running, squatting and dribbling exercises.	Improves agility, anaerobic power, speed, muscle strength	It significantly improved anaerobic power and capacity and has shown beneficial effect on agility and vertical jump height.

2.Aerobic endurance (VO2 max) in elite Indian basketball players: A cross sectional study	2021	This cross-sectional study was conducted in Bengaluru, wherein 24 males from Vijaya bank basketball team, residential sports schools and various other academies were included by random sampling.	Distance of 25 meters was marked using measuring tape for running test and audio tape was used to give description to the players on how to follow the test. three marking cones A, B and C were placed in the basketball court (The distances between A to B was 5 meters and B to C was 20 meters. Calculation done by yo yo intermittent recovery test	Improve the vo2max /aerobic capacity of basketball players	study concluded that the VO2 max or the aerobic endurance is a key point in every sport
3.Increase the Performance Level of Young Basketball Players through the Use of High Intensity Interval Training	2021	Twenty-two (n=22) young amateur basketball players participated in this study	12-week HIIT and Tabata training methodology was used	It increases the aerobic and anaerobic performance of basketball players	12-week training based on the High Intensity Interval Training's principles, was give positive result to physical and physiological development of our players for giving their highest level of performance in the game of basketball
4.Comparative effect of land- and aquatic-based plyometric training on jumping ability and agility of young basketball players	2012	Eighteen young male, semi-professional basketball players were randomly assigned to aquatic	8-week land- and aquatic-based plyometric training on jumping ability and agility of	Agility, jumping ability(strength) were improve in aquatic more than land and con.	aquatic-based plyometric training program show same or more benefits for jumping and

		plyometric training (AP), land plyometric training (LP) or a control group (CON)	young basketball players was determined		agility ability of young basketball players than the land-based plyometric training program
5.The effect of aquatic and land plyometric training on strength, sprint, and balance in young basketball players	2011	Eighteen young semi-professional male basketball players from a Rasht area participated in this study.	three groups were assigned group 1 was aquatic plyometric training(n=6), group 2 was landing plyometric training(n=6), and group 3 was control group (n=6)	It changes or improving the strength (endurance), Sprint (muscle mass) of players. apt>lpt in above parameters	APT improved better than LPT in strength and sprint. On other side, the LPT group indicated better improvement than APT group in dynamic balance.

Discussion

The focus of this paper was to review published research to highlight the relatable scope of effect of endurance, agility, vo2max on ball games among different athletes and to summarize the physiological changes in selected parameters of athlete. Overall, this line of research has provided a substantial contribution to effect of endurance, agility, vo2max on ball games among different athletes.

According to D AHMED, et.al; states that young athletes frequently experience burnout and that several factors have an impact on their psychological health. It underlines how crucial it is to recognize and deal with burnout in young athletes in order to support their overall development. The study examined the degrees of burnout experienced by young athletes who played volleyball, basketball, and football. The research findings indicated notable variations in the burnout sub-factor of "Emotional and Physical Exhaustion" between the three groups. This emphasizes the importance of paying attention to factors that can lead to young athletes experiencing burnout, such as an increasing training load, insufficient rest time, and intense competition pressure. The study also discussed how inadequate athlete support systems and selection procedures exist in India, which might impede the growth of athletes and create false beliefs about sports participation. (2)

According to Linaza M, et.al; states that research into 3D digitalization technology and the creation of affordable, customized solutions is crucial to the preservation of traditional sports and games (TSG). Technology may boost interaction with cultural heritage and encourage participation in traditional sports by capturing the looks of professional athletes and local heroes. Via gaming and learning opportunities, the suggested platform lets users engage with virtual versions of their country's heroes. Efficient motion capture and analysis can be achieved by utilizing pre-existing technological components such as accelerometers and Kinect-based sensing. All things considered, the paper emphasizes how crucial technology is to preserving and advancing many cultural practices in athletics. (1)

According to Hammami, et.al; concludes the comparing small-sided games (SSG) in team sports to interval or agility training, the results of the study showed that SSG training can produce modest to significant gains in physical fitness related to team sports and specific skill tasks. The benefits of SSG training were noticeable at all skill levels in team sports like rugby, handball, and soccer, despite certain study limitations like variability in outcomes and sample sizes. The impact of SSG training was evaluated using standardized mean differences and 95% confidence intervals in a meta-analysis that revealed significant increases in a number of physical fitness metrics and particular team sports-

related skills. Overall, the results point to SSG as a potential useful tactic for improving players' abilities both physically and technically in team sports. (56)

According to Y Setiakarnawijaya, et.al; states that study, futsal participants' performance was enhanced by exercising with the Naz app, especially in terms of raising Vo2max. The average Vo2max of futsal athletes differed significantly between before and after the adjustment of small side game training, according to the research. This implies that aerobic capacity and running performance can be enhanced by implementing little side game modification training. The study concludes by highlighting the advantages of improving futsal athletes' performance with the use of the Naz application and slight side game modifications. (57)

According to T Satheeskuma, et.al; states that significant gains were seen in bio motor traits like agility and cardiovascular endurance as well as skill performance traits like striking and dribbling ability in the study on the impact of anaerobic interval training on hockey players. These gains were ascribed to the experimental group's anaerobic interval training regimen, underscoring the advantages of this type of training in improving sports performance (). The results are consistent with earlier studies that highlighted the beneficial effects of functional training regimens on speed and fitness components (). Overall, the findings imply that anaerobic interval training can be a beneficial addition to collegiate hockey players' training plans, producing appreciable improvements in skill- and physical-related areas that are essential for performance. (49)

According to F D'Elia, et.al; concludes that young basketball players' aerobic power and anaerobic capacity were shown to increase upon the implementation of a particular High-Intensity Interval Training (HIIT) program. Significant gains in VO2 max and SAN values were noted after a twelve-week training program based on HIIT principles. According to this, basketball players' physical and physiological development may be positively impacted by HIIT training, which will improve their performance. (54)

According to AH Haghighi, et.al; concludes that field-selected fitness program comprising speed, endurance, and plyometric protocols with long and short sets lasting 45 minutes each session was incorporated in the 8-week training program, which consisted of three sessions per week. The control group spent 60–70 minutes throughout this time engaging in standard team technical and tactical exercises. Comparing the experimental groups to the control group, the results revealed a substantial increase in both VO2max and anaerobic power ($P<0.05$). But when it came to the groups' performance on rugby skill tests (shot accuracy, shoot distance, pass accuracy, and pass distance), there was no discernible difference in terms of muscle power or agility ($P>0.05$). To enhance their aerobic and anaerobic power, rugby players can generally benefit from interval training that alternate between long and short sets. (58)

Conclusion

It has been shown that vo2max, agility, and endurance have a significant association that helps ball game athletes perform better on the field. The type of sport also affects the training regimens.

Limitations of the study

This review contains limited games and parameters.

Future scope of the study

In future we can include other games rather than ball and also consider other socio and non socio parameters along with physiological parameters.

Conflict of the study

There is no conflict in the study.

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