



## CARDIO VS STRENGTH TRAINING: WHICH IS BETTER FOR OVERALL HEALTH?

**M. Suresh Kumar\* & K. Vinayakan\*\***

\* Director of Physical Education, Ganesar College of Arts and Science (Affiliated to Bharathidasan University), Melasivapuri, Ponnamaravathy, Pudukkottai, Tamil Nadu, India

\*\* Assistant Professor, Department of Computer Science, Khadir Mohideen College (Affiliated to Bharathidasan University), Adirampattinam, Thanjavur, Tamil Nadu, India

**Cite This Article:** M. Suresh Kumar & K. Vinayakan, "Cardio Vs Strength Training: Which is Better for Overall Health?", *International Journal of Computational Research and Development*, Volume 9, Issue 2, July - December, Page Number 99-105, 2024.

**Copy Right:** © DV Publication, 2024 (All Rights Reserved). This is an Open Access Article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium provided the original work is properly cited.

### **Abstract:**

Physical fitness plays a crucial role in maintaining overall health, yet there is ongoing debate about whether cardio or strength training is more beneficial. This paper explores the distinct benefits of cardiovascular exercises (cardio) and strength training, comparing their effects on physical health, mental well-being, and long-term wellness. Cardio exercises, such as running and cycling, primarily enhance cardiovascular health, endurance, and fat loss, while also improving mood and reducing stress. In contrast, strength training, including weightlifting and resistance exercises, focuses on building muscle mass, increasing bone density, and boosting metabolism. Both forms of exercise offer unique advantages: cardio promotes heart health and fat burning, while strength training contributes to muscle preservation, metabolic efficiency, and injury prevention. Ultimately, the paper argues that a combination of both cardio and strength training yields the most comprehensive benefits for overall health, optimizing physical fitness, mental health, and longevity. The findings emphasize the importance of a balanced workout regimen tailored to individual health goals.

**Key Words:** Cardio, Strength Training, Overall Health, Metabolism, Cardiovascular Health, Muscle Building

### **1. Introduction:**

Physical fitness is a cornerstone of overall health, influencing everything from cardiovascular health to mental well-being. With the growing emphasis on healthy living, individuals are often faced with choosing between different types of exercise regimens. Among the most popular forms are cardiovascular exercise (cardio) and strength training, each offering distinct benefits for the body and mind. This debate has sparked much discussion within fitness communities, healthcare professionals, and individuals seeking to improve their well-being. While cardio exercises, such as running, cycling, or swimming, are widely recognized for their ability to improve heart health and endurance, strength training, which includes weightlifting and bodyweight exercises, is celebrated for its ability to build muscle, enhance metabolism, and prevent injuries.

Despite the clear benefits of each, there is no definitive answer as to which exercise method is superior. Cardio has long been lauded for its effectiveness in promoting cardiovascular health, burning calories, and improving overall stamina. It is particularly favored for those looking to lose weight and improve aerobic capacity. On the other hand, strength training is often viewed as essential for those aiming to build muscle, increase strength, and maintain bone density, particularly as we age. With increasing awareness of the importance of metabolic health, strength training has gained recognition for its ability to boost metabolism, improve posture, and prevent age-related muscle loss.

This paper explores the key benefits of both cardio and strength training, weighing their impact on physical health, mental health, and long-term wellness. It aims to provide a balanced perspective on these two essential components of fitness, ultimately suggesting that a combination of both may be the most effective approach for achieving optimal health. By examining how each type of exercise contributes to overall fitness, this paper will help individuals make more informed choices based on their personal health goals, whether those goals are weight loss, muscle gain, or general well-being.

### **2. What is Cardio?**

Cardiovascular exercise, commonly referred to as cardio, is any physical activity that elevates the heart rate and promotes improved circulation and oxygen flow throughout the body. The primary goal of cardio exercises is to strengthen the heart and lungs, enabling them to pump blood more efficiently. This type of exercise is often characterized by repetitive, rhythmic movements that engage large muscle groups over an extended period. Common examples of cardio exercises include running, cycling, swimming, walking, rowing, and aerobics, all of which aim to maintain an elevated heart rate for a sustained duration.

Cardio exercises can be categorized into two main types: aerobic and anaerobic. Aerobic exercises are performed at moderate intensity for longer periods and require the body to use oxygen to produce energy. Running, cycling, and swimming fall under this category. Anaerobic exercises, on the other hand, involve short bursts of high-intensity activity, such as sprinting or high-intensity interval training (HIIT). These activities push the body to its limits, relying on energy sources that do not require oxygen. While both types of cardio provide cardiovascular benefits, aerobic exercises are typically better for building endurance, while anaerobic exercises improve strength and power.

The benefits of cardio extend far beyond heart health. One of its most recognized advantages is its ability to aid in weight management. Cardio exercises burn calories, which contributes to fat loss when combined with a proper diet. Regular cardio can also help regulate blood sugar levels, lower blood pressure, and reduce cholesterol, which significantly reduces the risk of chronic conditions such as heart disease, diabetes, and stroke.

In addition to physical benefits, cardio exercises are also known for their positive effects on mental health. Cardiovascular activity stimulates the release of endorphins, often referred to as "feel-good" hormones, which help to alleviate symptoms of stress, anxiety, and depression. Many individuals experience improved mood and cognitive function after engaging in cardio exercises, making it an effective tool for overall well-being.

Cardio also increases stamina and endurance, making everyday activities such as climbing stairs, walking long distances, or carrying groceries easier. Over time, regular cardio activity can enhance the efficiency of the heart and lungs, improving one's ability to perform physical tasks without fatigue. This increased endurance also carries over into other forms of exercise, such as strength training, by allowing individuals to sustain longer workouts and recover faster between sets.

Cardio is a crucial component of any fitness regimen due to its wide-ranging benefits for the heart, body, and mind. It helps to improve cardiovascular health, burn fat, increase endurance, and enhance mental well-being. Whether it is performed for weight loss, improved fitness, or stress relief, incorporating regular cardio exercise into one's routine can significantly contribute to long-term health and longevity.

### **3. What is Strength Training?**

Strength training, also known as resistance training, is a form of physical exercise that focuses on improving muscle strength and endurance through the use of resistance. The resistance can come from various sources, including free weights (such as dumbbells and barbells), resistance machines, bodyweight exercises (such as push-ups and squats), and resistance bands. The goal of strength training is to progressively overload muscles, stimulating growth and improving the body's ability to perform physical tasks with greater force and efficiency.

At its core, strength training involves exerting effort against a resistance, which forces muscles to adapt by becoming stronger and more durable over time. As muscles are pushed to work harder than usual, microscopic tears occur in the muscle fibers. The body then repairs these fibers, making them thicker and stronger—a process known as muscle hypertrophy. This is why strength training is often associated with muscle building and is a key element for individuals looking to increase muscle mass.

Strength training exercises can be divided into two categories: compound exercises and isolation exercises. Compound exercises, such as squats, dead lifts, and bench presses, involve multiple muscle groups and joints, making them highly effective for building overall strength and improving functional movement. Isolation exercises, such as bicep curls or tricep extensions, focus on one specific muscle group, allowing for more targeted development and muscle definition. Both types of exercises have their place in a well-rounded strength training routine, depending on an individual's goals.

The benefits of strength training extend far beyond simply increasing muscle mass. One of the most significant benefits is the enhancement of metabolic health. As individuals build muscle through strength training, their resting metabolic rate (RMR) increases. Muscle tissue requires more energy to maintain than fat tissue, which means individuals with more muscle mass burn more calories even while at rest. This contributes to fat loss and can help in weight management, making strength training a valuable tool for those looking to improve their body composition.

Strength training also plays a critical role in maintaining bone health. When muscles contract during resistance exercises, they place stress on bones, which stimulates bone growth and increases bone density. This is particularly important as people age, as it helps prevent osteoporosis and reduces the risk of fractures. Additionally, strength training improves joint stability, flexibility, and coordination, reducing the risk of injuries in everyday activities or other forms of exercise.

Beyond physical benefits, strength training has positive effects on mental health. Studies have shown that lifting weights can improve mood, reduce symptoms of anxiety and depression, and increase overall feelings of well-being. The focus and discipline required for strength training can also enhance self-esteem and provide a sense of accomplishment as individuals progress in their training.

Strength training is not just for athletes or bodybuilders—it's an essential component of a fitness routine for anyone seeking to improve their overall health. It offers numerous benefits, including increased muscle mass, improved metabolic rate, enhanced bone density, and better mental health. Whether done to increase strength, prevent injury, or improve body composition, incorporating strength training into one's fitness regimen can lead to long-lasting improvements in physical and mental well-being.

### **4. Benefits of Cardio for Overall Health:**

Cardiovascular exercise, or cardio, offers a wide range of health benefits that significantly enhance both physical and mental well-being. By engaging in activities that elevate the heart rate and improve circulation, cardio strengthens the cardiovascular system and provides numerous advantages for overall health. These benefits include improved heart health, enhanced endurance, weight management, mental health improvements, and a longer, healthier life.

#### **Cardiovascular Health:**

One of the most significant benefits of cardio is its positive impact on heart health. Regular cardio exercise helps strengthen the heart muscle, improving its ability to pump blood efficiently throughout the body. This enhances circulation and oxygen delivery to tissues and organs, which lowers the risk of heart disease, high blood pressure, and stroke. Cardio exercise also helps to reduce harmful cholesterol levels (such as LDL) while increasing beneficial cholesterol (HDL), further supporting cardiovascular health. Consistent cardio activity can reduce the strain on the heart, making it less susceptible to chronic conditions like coronary artery disease.

#### **Weight Management and Fat Loss:**

Cardio is one of the most effective ways to manage and reduce body fat. It burns calories during the exercise session, and when combined with a healthy diet, it creates a calorie deficit that leads to weight loss. Cardio helps to burn both fat and carbohydrates, making it an excellent tool for individuals seeking to lose weight or maintain a healthy body weight. Additionally, cardio helps preserve lean muscle mass during weight loss, which is important for long-term weight management and metabolic health. Increased calorie expenditure from regular cardio also boosts the body's ability to burn fat even at rest, aiding in fat loss over time.

#### **Increased Endurance and Stamina:**

Regular cardio improves aerobic capacity, which is the body's ability to use oxygen efficiently during physical activity. As you engage in cardio exercises over time, your lungs and heart become more efficient at delivering oxygen to muscles, allowing you to perform physical tasks for longer periods without feeling fatigued. This enhanced endurance can improve your

performance in daily activities-such as climbing stairs, carrying groceries, or walking long distances-and in other forms of exercise, like strength training, where increased stamina allows for longer or more intense workout sessions.

#### **Mental Health Benefits:**

In addition to its physical benefits, cardio is widely recognized for its positive effects on mental health. Exercise, particularly aerobic activities, stimulates the production of endorphins, often referred to as “feel-good” hormones. These endorphins help alleviate stress, anxiety, and depression, improving mood and promoting a sense of well-being. Regular cardio has been shown to reduce symptoms of anxiety and depression, improve cognitive function, and increase mental clarity. Cardio exercises like running, cycling, or swimming also provide an opportunity for mindfulness and mental relaxation, which can serve as an effective outlet for stress relief.

#### **Longevity and Disease Prevention:**

Regular participation in cardio exercise has been associated with increased life expectancy. By promoting heart health, improving blood circulation, and lowering the risk of chronic diseases such as diabetes, obesity, and certain cancers, cardio contributes to a longer, healthier life. Studies show that individuals who engage in consistent cardiovascular exercise have a lower risk of developing conditions like Type 2 diabetes, hypertension, and metabolic syndrome. Cardio also improves immune system function, making the body better equipped to fight off illnesses and infections.

#### **Enhanced Recovery and Functionality:**

Cardio enhances overall physical fitness and can aid in the recovery process after injury or illness. By increasing blood flow, cardio helps deliver oxygen and nutrients to tissues, promoting faster healing and recovery. It also improves flexibility, joint mobility, and coordination, all of which are essential for functional movement and preventing injury in everyday activities. As a result, regular cardio makes daily tasks easier and less taxing on the body.

### **5. Benefits of Strength Training for Overall Health:**

Strength training, often referred to as resistance training, is a critical component of any well-rounded fitness regimen, offering a range of benefits that enhance overall health. Unlike cardio, which primarily focuses on cardiovascular fitness and endurance, strength training works to increase muscle mass, improve bone density, boost metabolism, and enhance overall physical function. Whether through weightlifting, bodyweight exercises, or using resistance bands, strength training plays a vital role in maintaining long-term physical health and well-being.

#### **Increased Muscle Mass and Strength:**

The most immediate and noticeable benefit of strength training is the development of muscle mass and overall strength. Regular resistance training leads to muscle hypertrophy-the process where muscles grow in size due to the stress placed upon them during exercise. Building muscle not only improves physical appearance and performance but also strengthens the body as a whole, enhancing functional capacity. Improved muscle strength makes everyday tasks, such as lifting groceries, carrying heavy objects, or even climbing stairs, easier and less taxing on the body.

#### **Enhanced Metabolism and Fat Loss:**

One of the key benefits of strength training is its ability to boost metabolism. Muscle tissue is metabolically active, meaning it requires more energy to maintain than fat tissue. As individuals increase their muscle mass through strength training, their resting metabolic rate (RMR) rises, leading to greater calorie expenditure even when not actively exercising. This increase in metabolic rate helps with fat loss, making strength training an effective tool for managing weight. Additionally, strength training helps preserve lean muscle mass during weight loss, ensuring that the body burns fat rather than muscle, which is essential for long-term weight management.

#### **Improved Bone Health:**

Strength training plays a significant role in maintaining and improving bone health, particularly as we age. Weight-bearing resistance exercises place stress on the bones, which stimulates bone-forming cells and increases bone density. This is crucial in preventing osteoporosis and reducing the risk of fractures, especially in older adults. The impact of strength training on bone health has been shown to be as effective, if not more so, than other forms of exercise, such as cardio, when it comes to building stronger, denser bones.

#### **Injury Prevention and Joint Health:**

Strength training helps improve joint stability and reduces the risk of injuries. By strengthening the muscles surrounding joints, it enhances their ability to absorb impact and protect against strain. This is particularly important as individuals age, as strong muscles and ligaments provide additional support to joints that may become weaker or less flexible over time. Additionally, strength training increases flexibility and range of motion, further reducing the risk of injury. Whether preventing common injuries like sprains and strains or more severe ones such as ligament tears, strengthening muscles can provide a protective barrier against physical trauma.

#### **Improved Posture and Functional Fitness:**

Regular strength training contributes to better posture by strengthening the muscles that support the spine, shoulders, and hips. A strong core, in particular, plays a crucial role in maintaining proper alignment and reducing the risk of back pain and discomfort. Improved posture not only enhances physical appearance but also reduces the strain on muscles and joints, preventing long-term musculoskeletal issues. Furthermore, strength training enhances functional fitness-the ability to perform daily activities, such as bending, lifting, or carrying, more efficiently and safely.

#### **Mental Health and Well-Being:**

In addition to the physical benefits, strength training has significant mental health advantages. Resistance exercises have been shown to reduce symptoms of anxiety, depression, and stress, promoting an overall sense of well-being. The discipline required for strength training can improve self-esteem and confidence, especially as individuals track progress and see improvements in strength and muscle tone. Additionally, strength training provides a sense of accomplishment and control, both of which contribute positively to mental health. Many individuals report feeling empowered and energized after completing a strength workout, making it an effective tool for combating negative emotions and enhancing mood.

### **Longevity and Aging:**

Strength training is particularly important as we age, as it helps counteract the natural decline in muscle mass and strength that comes with the aging process. Sarcopenia, the age-related loss of muscle mass, can lead to frailty, mobility issues, and an increased risk of falls. Strength training helps prevent this loss by maintaining muscle mass, improving balance, and enhancing overall mobility. As a result, strength training contributes to healthy aging, promoting independence and quality of life in older adults.

### **6. Comparing the Two for Overall Health:**

When considering which type of exercise is best for overall health, both cardiovascular exercise (cardio) and strength training provide distinct and significant benefits. However, they target different aspects of fitness and health, making it essential to understand how each contributes to well-being. Rather than competing, cardio and strength training complement each other, and a combination of both can optimize long-term health outcomes. In this comparison, we will explore how each form of exercise impacts cardiovascular health, metabolism, weight management, mental well-being, and other important health factors.

#### **Cardio for Heart Health and Endurance:**

Cardio exercises are primarily known for their cardiovascular benefits. Regular cardio, such as running, cycling, or swimming, strengthens the heart and improves circulation. As the heart becomes more efficient at pumping blood, the body's oxygen delivery improves, reducing the risk of heart disease, stroke, and hypertension. Cardio also significantly enhances endurance, allowing individuals to engage in physical activities for longer periods without fatigue. For individuals focused on improving heart health and stamina, cardio is essential, as it increases aerobic capacity and lowers the resting heart rate over time.

Moreover, cardio is the go-to exercise for burning calories and reducing body fat, making it an excellent choice for weight loss and fat management. The increased calorie burn from cardio helps to create a calorie deficit, which is crucial for fat loss when paired with a proper diet. This fat-burning effect makes cardio particularly effective for individuals looking to reduce visceral fat (fat around the organs), which is a major risk factor for heart disease and diabetes.

#### **Strength Training for Muscle Mass and Metabolism:**

While cardio excels in improving heart health and endurance, strength training is essential for building muscle mass, increasing strength, and boosting metabolism. Strength training helps preserve lean muscle, which naturally declines with age. By increasing muscle mass, individuals improve their metabolic rate, as muscles require more energy to maintain than fat tissue. This increase in metabolic rate results in greater calorie expenditure, even while at rest, helping to manage weight more effectively in the long run.

Strength training also plays a critical role in bone health by improving bone density, making it especially beneficial for older adults or those at risk for osteoporosis. Additionally, strength training enhances joint stability, functional movement, and flexibility, reducing the risk of injury and improving overall mobility. For those seeking to build muscle, prevent age-related muscle loss, or improve physical strength, resistance training is a vital component of a fitness routine.

#### **Mental Health Benefits of Both:**

Both cardio and strength training have significant mental health benefits. Cardio exercises have been shown to reduce symptoms of anxiety, depression, and stress by stimulating the release of endorphins, the body's natural "feel-good" hormones. The rhythmic, repetitive nature of cardio exercises like running or swimming also provides a meditative quality, allowing individuals to clear their minds and improve mental clarity. Many people report a sense of emotional well-being and stress relief after a cardio session, which is why it's often recommended for those dealing with mental health challenges.

On the other hand, strength training has its own positive effects on mental health. The focus and discipline required for resistance exercises often lead to improvements in self-esteem, body image, and confidence. Strength training provides a sense of accomplishment as individuals track progress and achieve strength milestones. The mental focus involved in lifting weights can also act as a form of stress relief, with many people experiencing improved mood and mental resilience after their workouts.

#### **Longevity and Disease Prevention:**

Both cardio and strength training contribute to longevity by reducing the risk of chronic diseases such as diabetes, high blood pressure, and heart disease. Cardio is particularly effective in improving heart health and reducing the risk of stroke or cardiovascular events, while strength training enhances muscle and bone health, reducing the risk of falls and fractures, particularly in older adults. Additionally, strength training plays an essential role in preserving muscle mass, which naturally declines with age, helping to maintain functional independence well into the later years of life.

#### **The Best Approach: A Balanced Routine:**

While both cardio and strength training offer essential health benefits, neither is superior to the other. Instead, the most effective approach to overall health is incorporating both types of exercise into a balanced routine. Cardio offers cardiovascular health, fat loss, and endurance, while strength training focuses on muscle growth, metabolism, and bone health. Together, these exercises provide a comprehensive fitness plan that promotes optimal health, improves physical performance, and supports mental well-being.

For overall fitness, a combination of both cardio and strength training is ideal, as they complement each other. For example, someone might include two or three days of strength training per week to build muscle and strength, along with two or three cardio sessions to improve cardiovascular health and burn fat. The balance between both forms of exercise helps avoid the limitations of focusing solely on one, offering a holistic approach to fitness.

Cardio and strength training are both integral to overall health, and their benefits are most effective when combined in a well-rounded fitness routine. By engaging in both, individuals can optimize cardiovascular health, enhance muscle strength, support mental well-being, and achieve long-term fitness goals.

### **7. Which is Better for Overall Health?**

When it comes to overall health, the question of whether cardio or strength training is superior depends largely on an individual's specific goals, but the most comprehensive approach to fitness involves combining both. Each type of exercise provides unique benefits, and neither can be considered inherently better than the other in terms of overall health. Instead,

understanding the distinct advantages of cardio and strength training-and how they complement each other-can guide individuals in creating a balanced and effective fitness regimen.

### **Cardio: Heart Health and Endurance**

Cardiovascular exercise, or cardio, is essential for improving heart health, increasing endurance, and burning calories. Cardio exercises, such as running, cycling, or swimming, strengthen the heart and lungs, improve circulation, and increase oxygen delivery throughout the body. These benefits reduce the risk of cardiovascular diseases, high blood pressure, and stroke, while also enhancing stamina for everyday activities and physical tasks. Additionally, cardio is particularly effective in weight management, as it helps burn calories, reduce body fat, and improve metabolic function.

Furthermore, cardio plays a significant role in mental health by reducing stress, anxiety, and depression. The release of endorphins during cardio activity boosts mood and promotes a sense of well-being, making it a powerful tool for mental clarity and emotional stability. For those looking to improve cardiovascular fitness, endurance, or achieve weight loss, cardio is an essential part of the fitness equation.

### **Strength Training: Muscle Mass and Metabolism**

On the other hand, strength training is indispensable for building muscle mass, improving strength, and boosting metabolism. Through exercises like weightlifting, resistance bands, or bodyweight exercises, strength training increases muscle mass and enhances muscle function. Stronger muscles not only improve physical appearance and performance but also support joint health and reduce the risk of injury.

Strength training also contributes significantly to metabolic health. As muscle mass increases, so does the body's resting metabolic rate (RMR), which means individuals burn more calories even at rest. This effect is beneficial for long-term weight management and fat loss. Additionally, strength training is vital for maintaining bone density, preventing osteoporosis, and improving balance and posture, particularly in older adults. It is also crucial for functional fitness, making everyday tasks such as lifting, bending, or carrying easier and safer.

### **The Holistic Approach: A Combination of Both**

While both cardio and strength training offer unique and valuable health benefits, the most effective way to achieve overall health is through a combination of both. Cardio provides cardiovascular health, fat loss, and endurance, while strength training supports muscle building, metabolic efficiency, and bone health. Together, they form a well-rounded fitness routine that maximizes overall well-being, combining the heart-healthy benefits of cardio with the muscle-strengthening effects of resistance training.

In practice, incorporating both forms of exercise can prevent the drawbacks of focusing solely on one. For example, too much cardio without strength training can lead to muscle loss and a slower metabolism, while exclusively lifting weights without cardio can neglect cardiovascular health and endurance. A balanced regimen that includes both types of exercise supports a more functional and sustainable approach to fitness, reducing the risk of injury, enhancing mental health, and promoting longevity.

Ultimately, there is no clear-cut answer to which is better for overall health-cardio or strength training. Each plays a crucial role in different aspects of physical and mental health. However, for optimal well-being, a combination of both cardio and strength training is recommended. This balanced approach allows individuals to reap the benefits of enhanced cardiovascular fitness, increased muscle strength, better metabolism, improved mental health, and greater longevity. Whether the goal is weight loss, improved heart health, increased muscle mass, or mental well-being, integrating both cardio and strength training into a fitness routine provides the most comprehensive approach to overall health.

### **8. Conclusion:**

In conclusion, both cardio and strength training are essential components of a well-rounded fitness regimen, each offering unique benefits that contribute to overall health. Cardio is unparalleled in improving heart health, endurance, and fat loss, while strength training excels in building muscle, boosting metabolism, enhancing bone density, and promoting long-term functional fitness. While each form of exercise targets different aspects of health, neither is inherently better than the other. Instead, they complement each other, and together they provide a comprehensive approach to improving physical, mental, and emotional well-being.

For individuals seeking to optimize their health, a balanced combination of both cardio and strength training is the most effective strategy. This integrated approach helps to maximize cardiovascular health, maintain muscle mass, reduce the risk of chronic diseases, improve mental health, and enhance overall performance. Whether the goal is to increase stamina, build strength, manage weight, or improve mood, combining cardio with strength training offers a holistic solution that supports long-term health and fitness.

Ultimately, the key to achieving and maintaining overall health lies in understanding how both types of exercise contribute to wellness and incorporating them into a sustainable, individualized fitness routine. By doing so, individuals can experience the full range of benefits, leading to a healthier, more balanced lifestyle.

### **References:**

1. Schoenfeld, B.J., Ogborn, D., & Krieger, J.W. (2016). Resistance Exercise and Muscle Protein Synthesis: A Review of the Literature. *Journal of Strength and Conditioning Research*, 30(3), 939-947.
2. American College of Sports Medicine (ACSM). (2014). ACSM's Position Stand: Exercise and Physical Activity for Older Adults. *Medicine and Science in Sports and Exercise*, 46(4), 798-808.
3. Jakicic, J.M., et al. (2009). Effect of Exercise Duration and Intensity on Weight Loss in Overweight, Sedentary Women: A Randomized Trial. *JAMA*, 301(1), 1-8.
4. Thyfault, J.P., & Booth, F.W. (2011). Lack of Exercise Is a Major Cause of Chronic Diseases. *Comprehensive Physiology*, 1(4), 1877-1897.
5. KI Jabakumar, MS Kumar, R Kalidasan, Influence of E-Content Based Coaching on Selected Fundamental Skills in Field Hockey, *Recent Research in Science and Technology*, Vol 3, No. 1, 2010, 59-62

6. MS Kumar, Impact of Sport Vision Training for Enhancing Selected Visual Skills and Performance Factors of Novice Hockey Players, *Journal of Movement Education and Exercises Sciences*, Vol 1, No. 1, 2011, 1-5
7. V Vallimurugan, MS Kumar, AS Kumar, Effect of Complex Training on Selected Physiological Variables of Women Participants, *Academic Sports Scholar*, Vol 1, No. 5, 2012, 1-14
8. CA Vijayarani, V Vallimurugan, MS Kumar, Influence of Yogic Practices on Selected Physiological and Psychological Variables of Adolescent Boys, *Recent Research in Science and Technology*, Vol 3, No. 1, 2012, 42-44
9. K Kamalakkannan, MS Kumar, R Mohanakrishnan, Influence of Health Related Physical Fitness on Mental Health of Rural School Students, *International Journal of Applied Engineering Research*, Vol 9, No. 15, 2014, 2917-2924
10. MS Kumar, Influence of Circuit Training on Selected Physical Fitness Variables among Men Hockey Players, *International Journal of Recent Research and Applied Studies*, Vol. 1, No. 7, 2014, 16-19
11. MS Kumar, Influence of Health Related Physical Fitness on Mental Health of Rural School Students. *International Journal of Applied Engineering Research*, Vol 9, No. 15, 2014, 2917-2924
12. MS Kumar, R Kalidasan, Skill Tests in Field Hockey - Past, Present & Future, *International Journal of Recent Research and Applied Studies*, Vol 1, No. 2, 2014, 34-36
13. MS Kumar, Influence of Yoga Practices on Blood Pressure Among Rural College Girls, *Star International Research Journal*, Vol. 5, No. 1, 2017, 6-9
14. MS Kumar, AD Kumar, Effect of Mental Training on Self Confidence among Professional College Students, *International Journal of Recent Research and Applied Studies*, Vol 4, No. 12, 2017, 51-53
15. P Raja, S Udhayashankar, MS Kumar, Impact of Varied Frequencies of Aerobic Dance Training on Lipid Profiles for the Students at College Level, *International Journal of Computational Research and Development*, Vol 3, No. 1, 2018, 210-212
16. MS Kumar, Comparative Analysis of Core Strength among Football Hockey and Kabaddi Players, *Think India Journal*, Vol 22, No. 14, 2019, 1261-1264
17. MS Kumar, Position Wise Assessment of Body Weight Among Novice and Experienced Basketball Players, *International Journal of Analytical and Experimental Modal Analysis*, Vol 11, No. 11, 2019, 526-531
18. MS Kumar, Effect of Yogic Practices on Selected Lung Volumes Among Asthmatic Men, *International Journal of Analytical and Experimental Modal Analysis*, Vol 11, No. 7, 2019, 1286-1290
19. A Eswaramoorthy, MS Kumar, Effect of Yogic Practices and Aerobic Training on Flexibility Among Physical Education Students, *Purakala*, Vol 31, No. 8, 2020, 417-420
20. MS Kumar, Investigation of the Changes on Selected Physical Fitness Parameters in Response to SAQ Training among College Women Students, *Alochana Chakra Journal*, Vol 9, No. 4, 2020, 5121-5124
21. S Vishali, S Selvalakshmi, MS Kumar, Studies on the Effect of Yogic Practices on a Psychological and Academic-Related Variable of the Tobacco Smoking Male Students, *Journal of Xidian University*, Vol 16, No. 6, 2020, 2519-2535
22. PV Sujitha, MS Kumar, Effect of Progressive Muscular Relaxation Training on Selected Psychomotor Variables among Hockey Players, *Alochana Chakra Journal*, Vol 9, No. 5, 2020, 2439-2443
23. M Karuppaiah, MS Kumar, Examination of the Changes on Selected Performance Parameters in Response to Circuit Training among Kabaddi Players, *Asian Pacific Journal of Health Sciences*, Vol 9, No. 3, 2022, 25-26
24. M Karuppaiah, MS Kumar, Interval Training's Influence on Changes in Selected Strength Parameters among College Kabaddi Players, *Asian Pacific Journal of Health Sciences*, Vol 9, No. 3, 2022, 143-144
25. MS Kumar, Ekambaram, Rameshkumar, P Duraisami, R Jayachandran, Effect of Yogic Practices Therapeutic Exercise and Combined Practices on Resting Pulse Rate Among Low Backache Men, *Journal of Data Acquisition and Processing*, Vol 38, No. 4, 2023, 816-820.
26. MS Kumar, A Quantitative Analysis of the Impact of Yoga and Aerobic Exercise on the Vital Capacity of School Boys, *International Journal of Applied and Advanced Scientific Research*, Vol 9, No. 1, 2024, 23-28
27. MS Kumar, Characteristics of U-19 Soccer Players in Various Roles, *International Journal of Computational Research and Development*, Vol 9, No. 1, 2024, 13-19
28. MS Kumar, A Relationship Between Unilateral and Bilateral Power Training and Improved Upbody, *International Journal of Interdisciplinary Research in Arts and Humanities*, Vol 9, No. 1, 2024, 22-26
29. L Ajithkumar, P Kumar, B Chittibabu, J Bhukar, MS Ram, MS Suresh, PK Thilagam, Analyzing Optimal Muscle Dynamics During Handstands: A Comprehensive Investigation of Skilled Gymnasts, *Journal of Physical Education and Sport*, Vol 24, No. 4, 2024, 855-863
30. MS Kumar, Resting Heart Rate Effects of Yogic Practices Involving Resistance and Plyometric Training on Teenage Volleyball Players, *International Journal of Advanced Trends in Engineering and Technology*, Vol 9, No. 1, 2024, 15-19
31. Laukkanen, J.A., et al. (2016). Cardiorespiratory Fitness and Cardiovascular Risk Factors in Men: A 30-Year Follow-up Study. *European Heart Journal*, 37(2), 159-166.
32. K Vinayakan, M V Srinath, A Secured On-Demand Routing Protocol for Mobile Ad-Hoc Network, A Literature Survey, Vol 6, No 6, 2015, 598-604
33. K Vinayakan, M V Srinath, Reinforcing Secure on-Demand Routing Protocol in Mobile AD-Hoc Network Using Dual Cipher based Cryptography, *International Journal of Control Theory and Applications*, Vol. 10, No 23, 2017, 103-109
34. K Vinayakan, M V Srinath, Security Mandated Analytics based Route Processing with Digital Signature [SMARPDS] - Pseudonymous Mobile Ad Hoc Routing Protocol, *Indonesian Journal of Electrical Engineering and Computer Science*, Vol 10, No 2, 2018, 763-769
35. K Vinayakan, M V Srinath, A Adhiselvam, Security for Multipath Routing Protocol using Trust based AOMDV in MANETs, Vol. 2 No. 43, 2022, 1640-1654

36. K Vinayakan, M V Srinath, A Adhiselvam, Reinforced Securing of Data Leakage in Mobile Ad hoc Network (MANET) by Hybrid Mechanism of Identity Based Encryption (IBE), *International Journal of Health Sciences*, Volume 6. No S8, 2022, 3622-3635
37. S Sujatha, K Vinayakan, The Role of Collaborative Learning in Mathematics Education: A Review of Research and Practice, *Indo American Journal of Multidisciplinary Research and Review*, Vol 6, No. 2, 2022, 200-206
38. S Sujatha, K Vinayakan, Mathematical Literacy for the Future: A Review of Emerging Curriculum and Instructional Trends, *International Journal of Applied and Advanced Scientific Research*, Vol 7, No. 2, 2022, 65-71
39. S Sujatha, K Vinayakan, Assessing the Impact of Math Competitions and Challenges on Student Learning: A Review, *International Journal of Advanced Trends in Engineering and Technology*, Vol 8, No 2, 2023, 62-67
40. S Sujatha, K Vinayakan, Integrating Math and Real-World Applications: A Review of Practical Approaches to Teaching, *International Journal of Computational Research and Development*, Vol 8, No. 2, 2023, 55-60
41. S Sujatha, K Vinayakan, Engaging Students with Mathematics: A Review of Motivation and Engagement Strategies, *International Journal of Interdisciplinary Research in Arts and Humanities*, Vol 8, No. 2, 2023, 55-60
42. K Vinayakan, VA Mangayarkarasi, Review: Data Analytics Problems, Unanswered Research Challenges and Big Data Technologies, *International Journal of Computational Research and Development*, Vol 8, No. 2, 2023, 61-69
43. K Vinayakan, VA Mangayarkarasi, An Analysis of the Distinctions among IoT Network Cloud, Edge, and Fog Computing, *International Journal of Applied and Advanced Scientific Research*, Vol 9, No. 2, 2024, 130-134
44. Bamman, M.M., & Stec, M.J. (2013). Resistance Exercise and Bone Health. *Sports Medicine, Arthroscopy, Rehabilitation, Therapy & Technology*, 5(1), 11.
45. Keogh, J.W.L., & Kilding, A.E. (2014). Physical Benefits of Strength Training for the Elderly: A Review of the Literature. *Journal of Aging and Physical Activity*, 22(1), 24-45.