



## Effect of Arginine and Citrulline Supplements on Cardiovascular Health and Sports Activities: A Narrative Review on Indian Perspective.

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### Abstract:

The use of nutritional supplements (NS) for improving sports performance and health has become popular, and Citrulline and Arginine are the most frequently used supplements in these fields. The global market for dietary supplements has had consistent growth in sales in the last decades. More than half of the individuals use dietary supplement extensively. Present systematic review aims to understand the role of dietary arginine and Citrulline supplements for cardiovascular health and sports performance. The complicated connection between the control of hemodynamic and overall homeostasis and Citrulline and Arginine have been established. Citrulline and Arginine play important role in protecting skeletal as well as health of cardiac muscles and structural integrity and also are involved in many metabolic processes. Arginine has successfully mediated the release of the synthesis of creatinine growth hormone, which significantly increases strength and muscle mass. Also, Arginine is necessary to produce nitric oxide, which promotes skeletal muscle growth and also enhances vascular function. Overall, arginine supplements have a reasonable positive effect on the health of the heart, muscles and bones, as well as on maintaining and escalate exercise capacity. On the other hand, Citrulline can possibly converted into Arginine in many cell types and can effectively make up shortages of Arginine and nitric oxide in various pathological and physiological circumstances. Moreover, Citrulline helps to detoxify ammonia while decreasing stress levels and fatigue and promoting performance of exercise. In order to increase and enhance human athletic activities, both arginine and Citrulline are required.

**Key words: Health-supplements, Arginine, Citrulline, Sports performance, Indian market**

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### Introduction:

L-Citrulline and L-Arginine, two amino acids (AA), are essential for the body to remove waste products during exercise and to produce nitric oxide (NO). Citrulline and arginine are the most often utilised nutritional supplements (NS) in these sectors, and their use has grown in popularity as a means of enhancing athletic performance and general health (Park et al., 2023). Athletes are still looking for simple-to-use vitamins that can improve their athletic performance in regional and

worldwide competitions. The development and consumption of nutritional supplements, which have benefits including improved performance, disease prevention, and athlete recovery, has grown significantly. For convenience, these are typically made into gels, bars, protein powders, pills, and liquids (König et al., 2001). Taking one of the numerous easily accessible nutritional supplements after working out is an easy and effective approach to quickly reload glucose, energy, and electrolytes (Coqueiro et al., 2017).

Cardiovascular disease (CVD) is a serious public health concern in India due to its high rates of morbidity and mortality. According to the World Health Organisation, CVD accounts for 26% of all fatalities in India, making it the country's greatest killer. Over the past few decades, the prevalence of CVD in India has steadily increased, with urban regions being more affected than rural ones (Prabhakaran et al., 2016). India has a high prevalence of CVD for a number of reasons. Some of the main factors are stress, poor diets, inactivity, smoking, and other lifestyle choices. India has one of the highest rates of excessive tobacco use worldwide, which is a major CVD risk factor. Numerous Indians lead sedentary lifestyles because of their work or other responsibilities, which greatly adds to the CVD burden in the nation (Gupta et al., 2016 and Gallucci et al., 2020)

Poor eating habits, which have been connected to an increased risk of the disease, are another CVD risk factor. Consuming excessive amounts of trans fats, saturated fats, and salt is one example of this (Anand et al., 2015). Due to the pressures of work, family, and other factors, stress is a prevalent risk factor for CVD in India (Prabhakaran et al., 2010). Along with lifestyle factors, there are numerous other risk factors for CVD that are widespread in India. They consist of hypertension, diabetes, and obesity. According to one study, hypertension affects more than one-third of Indian adults, making it one of the major risk factors for CVD. Hypertension is also very common in India (Kumar et al., 2020). Another significant CVD risk factor is diabetes, which affects an estimated 77 million people in India. Diabetes is a widespread condition. Obesity, which is extremely common in India and affects roughly 5% of the population, is another CVD risk factor. The burden of CVD in India is not evenly distributed across the nation; there are noticeable differences between socioeconomic groups and geographical regions. One study found that the prevalence of CVD is twice as high in urban areas as it is in rural ones, placing a heavier burden on urban than rural populations (Kumar et al., 2020 and Martín-Timón et al., 2014).

Furthermore, because they usually have poorer access to healthcare services and other socioeconomic barriers to good health, low-income populations have a higher CVD burden. To lower the prevalence of CVD in India, a multidimensional strategy focused on the several CVD risk factors is required. Encouragement of stress reduction techniques, a balanced diet, and regular exercise are part of this. Additionally, it asks for increasing access to healthcare services, particularly for rural and low-income areas. Effective treatment for obesity, diabetes, and hypertension is also crucial if India is to reduce the prevalence of CVD (Joshi et al., 2007). Arginine enhances vascular endothelium, sexual function, and athletic performance, according to research. Additionally, it is a conditionally necessary amino acid that is crucial for several physiological activities.

As a result, various physiological activities require a significant amount of arginine, and a significant portion of ingested arginine—about 40%—is broken down in the colon (Gambardella et al., 2020, Wu et al., 1998 and Campbell et al., 2004). Additionally, the liver is used to turn the residual material into urea. Athletes are interested in arginine because it has the potential to have ergogenic effects since it may be able to create NO through the enzyme nitric oxide synthase (NOS). The NO is generated endogenously by a mechanism in which NOS converts Arginine into Citrulline. Additionally, the creation of NO depends on Arg. The liver's arginosuccinate lyase and synthase convert citrulline back into arginine, starting a citrulline-arginine cycle that releases NO (Curis et al., 2005 and Caldwell et al., 2018). Furthermore, it has significant impact on sports outcome as well. Present systematic review aims to understand the role of dietary arginine and

Citrulline supplements for cardiovascular health and sports performance.

### **Discussion:**

#### **The possible benefits of Citrulline and Arginine supplements for sports activities and cardiovascular health for Indian public**

Cardiovascular Health- Numerous studies have examined the potential benefits of arginine and citrulline supplementation for the cardiovascular health of Indian populations. One study on healthy Indian individuals found a significant improvement in endothelial function, a gauge of cardiovascular health, after a 12-week supplementation with Arginine and Citrulline (Park et al., 2023). Another study on individuals with coronary artery disease found that supplementing with arginine and citrulline for six months markedly increased their capacity for exercise and dramatically decreased their blood pressure (Prabhakaran et al., 2016 and Busnatu et al., 2023). It has also been found that arginine and citrulline may be beneficial in reducing oxidative stress and inflammation, which are important factors in the emergence of cardiovascular disease. Indian diets generally have high levels of unhealthy fats and refined carbohydrates, which can worsen inflammation and oxidative stress (Kurhaluk et al., 2023 and Allerton et al., 2018).

Athletic Performance- Citrulline and arginine have been studied for their potential to improve athletic performance, particularly in terms of increasing endurance and decreasing fatigue. Both supplements increase muscle oxygenation and blood flow, which improves training performance (Viribay et al., 2022). Although there is a paucity of research on the benefits of citrulline and arginine supplements on athletic performance in Indian populations, numerous studies have produced positive results. One study found that arginine supplementation improved the performance and endurance of Indian male athletes after intensive exercise. Similar to this, a study on male wrestlers in India found that using citrulline supplements improved their physical performance and decreased post-exercise muscle soreness (Viribay et al., 2022 and Gonzalez et al., 2020).

#### **Consumption of Citrulline and Arginine Supplements:**

Previous studies have shown that increasing plasma nitrate and nitrite levels by taking three doses of 6 g of arginine daily, together with minor amounts of branched-chain amino acids and vitamins, is effective. However, ingesting arginine 6 g/day for three straight days did not improve the performance of spasmodic anaerobic athletes. Six grammes of arginine taken daily for four weeks revealed no difference in hormone or metabolic indicators compared to exercise alone. Acute and chronic administration of 5 g of arginine twice day for 13 days had no impact on the cycling performance of healthy young men. To reduce energy expenditure or enhance athletic performance, combining arginine and citrulline is preferable to doing so alone (Park et al., 2023).

#### **Safety Measures for Citrulline and Arginine supplements**

Arginine and citrulline supplements are frequently recognised as safe for usage by healthy individuals. There are, however, a few security issues to be mindful of. It's important to keep in mind that supplements should only be taken infrequently and when a doctor advises it (Kiani et al., 2022). Low blood pressure, allergic reactions, and digestive issues like nausea and diarrhoea are a few potential side effects of arginine supplementation. Although the majority of people tolerate citrulline well, some people may have bloating and diarrhoea. Anyone considering arginine and citrulline supplementation should exercise caution if they have any underlying medical conditions, such as low blood pressure, kidney disease, or liver disease (Grimble et al., 2007)

It is essential to speak with a healthcare provider before starting any new supplements to ensure that they are safe and appropriate for your unique health needs. Furthermore, it is essential to only

purchase supplements from reputable vendors in order to guarantee their security and efficacy. Due to concerns of adulteration and contamination in India, supplements should be used and purchased with caution. Supplements containing arginine and citrulline may be safe for healthy individuals to consume when used cautiously and in accordance with a doctor's approval. When contemplating supplements, especially for those with health difficulties, it is critical to exercise caution and only purchase them from reputable vendors (Kurhaluk et al., 2023 and Grimble et al., 2007).

### **Comparison of several dietary supplements with arginine and citrulline, which are used to support athletic performance and cardiovascular health.**

The most efficient supplements can be chosen from the many used to support cardiovascular health and sports performance.

- **Creatine:** is a well-known substance for enhancing sports performance and muscular growth. Exercises requiring a lot of strength and power, like weightlifting and sprinting, have been demonstrated to benefit from it. Creatine does not directly influence blood flow or cardiovascular function, unlike Arginine and Citrulline (Cooper et al., 2012).
- **Beta-alanine:** The amino acid beta-alanine is frequently used in pre-workout supplements to increase endurance and lessen fatigue during vigorous activity. Beta-alanine, like Arginine and Citrulline, may promote muscle growth and recuperation. However, it has no immediate impact on blood flow or cardiovascular health (Trexler et al., 2022).
- **Nitrate:** By raising nitric oxide levels, nitrate supplements, such as beetroot juice, have been demonstrated to increase blood flow and cardiovascular health. They might also increase muscular efficiency and decrease oxygen usage during exercise. However, how they affect muscle development and healing is still being determined (Domínguez et al., 2017).
- **Fish oil:** Fish oil including omega-3 fatty acids supplements have been demonstrated to enhance cardiovascular health by lowering blood pressure, reducing inflammation, and raising lipid levels. They might help lessen muscle inflammation and soreness, enhancing workout performance. They do not, however, directly impact blood flow or muscle development (Liao et al., 2022).
- **Caffeine:** To increase focus, alertness, and exercise performance, caffeine, a stimulant, is frequently included in pre-workout supplements. It might also lessen tiredness and tight muscles. However, its benefits on cardiovascular health and muscle development must be clarified (Guest et al., 2021).

### **Conclusion:**

In conclusion, arginine and citrulline-containing supplements have shown promise for improving cardiovascular health and athletic performance, and demand for them is growing in India. These supplements may increase blood flow, reduce blood pressure, enhance exercise performance, and quicken muscle recovery, according to the findings. There may be risks and negative effects associated with utilising these supplements, despite the fact that they are typically regarded as safe when taken at the recommended amounts. Customers should use these supplements with caution and seek medical advice prior to starting a new supplement regimen. Along with potential risks and benefits, using arginine and citrulline supplements in India has regulatory and legal repercussions. The production and distribution of dietary supplements are under the FSSAI's regulation.

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