**Cardiovascular Adaptation to Athletic Stress**

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**ABSTRACT:**

*Background*

Athletic stress, characterized by high-intensity physical and physiological demands, leads to significant cardiovascular adaptations in athletes. These adaptations are crucial for meeting the increased demands placed on the heart during training and competition. Despite the benefits, there is a notable risk of cardiac events, such as cardiac arrest, particularly among athletes. This underscores the importance of understanding how athletic stress impacts cardiovascular function and the potential long-term implications.

*Objective*

To investigate the effects of athletic stress on cardiovascular function, comparing key cardiovascular parameters between athletes and non-athletes, and to highlight the importance of awareness and monitoring of athletes' cardiovascular health.

*Methods*

A scoping literature review was conducted using PubMed and Google Scholar. Key search terms included "athletic stress," "cardiovascular system," "exercise stress impact on heart," and "cardiovascular assessment in athletes." Inclusion criteria focused on peer-reviewed studies published in English from January 2000 to July 2024, involving human subjects and examining the cardiovascular impact of athletic stress. Exclusion criteria included studies published before 2000, non-human subjects, and articles not in English.

*Results*

Athletes exhibited significant cardiovascular adaptations, including a lower resting heart rate (54 bpm) compared to non-athletes (70 bpm), lower blood pressure (112/68 mmHg vs. 124/76 mmHg), higher cardiac output (6.0 L/min vs. 4.8 L/min), and greater left ventricular mass (150 grams vs. 120 grams). These findings demonstrate enhanced cardiovascular efficiency and structural adaptations in response to athletic stress.

*Discussion*

The results confirm that athletic stress leads to positive cardiovascular adaptations, such as improved myocardial efficiency and greater cardiovascular endurance. However, the magnitude of left ventricular hypertrophy observed was higher than expected, highlighting the need for continued monitoring of athletes' cardiovascular health. The findings suggest that cardiovascular adaptations to athletic stress are beneficial but also emphasize the importance of interdisciplinary approaches, including sports medicine, preventative care, and rehabilitation, to ensure long-term cardiovascular health in both athletes and the general population.

**INTRODUCTION:**

High intensity workouts put strain on an athlete’s body due to physical and physiological stress during training, practice, and games. This stress may be connected to the fact that one in 50,000 athletes experience cardiac arrest [1]. Intense physical activity may also lead to arrhythmias. Currently, the issue is the lack of awareness for athlete’s wellness when it comes to sports. The complexity of these health issues leads to minimal post look out after treatment to these athletes knowing they are stereotyped to be “healthy” all the time. In this paper I aim to provide an understanding of how stress upon athletes relates to cardiovascular function in order to identify how to promote cardiac health among athletes.

**METHODS:**

I searched PubMed and Google Scholar using the key terms: “athletic stress,” “cardiovascular system,” “cardiovascular adaptation to exercise,” “exercise stress impact on heart,” “sports and heart disease,” and “cardiovascular assessment in athletes” combined with Boolean operators to refine the search terms. Articles published before 2000, not published in English, or not conducted in humans were excluded. Other literature reviews were also excluded. Inclusion criteria required that the articles address how athletic stress impacted the cardiovascular system. My search strategy refined the articles from 1,500 to 100 articles.

**RESULTS:**

### *Cardiovascular Responses to Athletic Stress*

The resting heart rate (HR) was found to be lower in athletes compared to non-athletes. The mean resting HR for athletes was 54 bpm (beats per minute), while non-athletes averaged a total of 70 bpm [2].

**Table 1.** Average resting heart rate among athletes compared to non-athletes

| **Study Type** | **Average Resting HR (bpm)** |
| --- | --- |
| **Athletes**  | **54** |
| **Non-Athletes** | **70** |

Blood pressure (BP) is a measurement that shows athletes generally had lower systolic and diastolic numbers when being compared to non-athletes. The average systolic BP for athletes was 112 mmHg, while non-athletes had an average systolic BP of 124 mmHg [2]. The average diastolic BP for athletes was 68 mmHg in comparison to 76 mmHg in non-athletes [2].

**Table 2**. Systolic and diastolic blood pressure of athletes compared to non-athletes

| **Study Type** | **Systolic BP (mmHg)** | **Diastolic BP (mmHg)** |
| --- | --- | --- |
| **Athletes**  | **112** | **68** |
| **Non-Athletes** | **124** | **76** |

Cardiac output (CO) is measured in liters per minute where it can be seen it was higher in athletes. The average cardiac output for athletes was 6.0 L/min, whereas non-athletes averaged 4.8 L/min [2, 3].

**Table 3.** Cardiac output of athletes compared to non-athletes

| **Study Type** | **Cardiac Output (L/min)** |
| --- | --- |
| **Athletes**  | **6.0** |
| **Non-Athletes** | **4.0** |

Left ventricular mass is measured in grams of the left ventricular. Based on prior data it shows an increased left ventricular blood flow with an average LVM of 150 grams compared to 120 grams in non-athletes.

**Table 4.** Left ventricular mass of athletes compared to non-athletes

| **Study Type** | **Left Ventricular Mass (grams)** |
| --- | --- |
| **Athletes**  | **150** |
| **Non-Athletes** | **120** |

Athlete’s cardiovascular adaptations included improved stroke volume (cardiac output), enhanced myocardial efficiency (heart rate), and greater overall cardiovascular endurance (blood pressure) [6].

**DISCUSSION:**

An important correlation that needs to be noted from the results is that “athletic stress” does improve cardiovascular function in order to fulfill the needs of an athlete. This cardiovascular adaptation can be seen by the vital signs between athletes and non-athletes. This is exhibited by the lower resting heart rate of 54 bpm compared to the non-athlete who shows 70 bpm [3,4]. In athletes due to the physical stress it causes more oxygen to be delivered which decreases the amount of pumps needed per minute. Additionally seeing they also have a lower blood pressure both systolically and diastolically for similar reasons. As based on this adaptation it strengthens the myocardium muscles. This strengthening efficiently pumps the blood with less effort on the arteries which can also improve the endothelial function. Upon vitals that increased was the higher cardiac output (6.0 L/min vs. 4.8 L/min), and increased LVM (150 grams vs. 120 grams) [6,7]. This is due to knowing when pumping the amount of blood per beat is lower in athletes, this means the amount of blood being pumped per beat increases. This can be shown for the substantial increase in cardiac output. The Left ventricular mass is a subunit of that in which it only tracks one sector of the heart [4]. By this alone it should show a positive correlation by an increase in cardiac output would show an increase in left ventricular mass. This overall shows the impact of how exercise can provide an impact upon cardiovascular health.

Most of the results were predicted to occur due to prior studies and research that consistently showed that exercise/athletic activity provides an improvement on cardiovascular efficiency and health [2, 5-11]. However, the magnitude of these changes, particularly the increased left ventricular mass, was surprising. When realizing that athletes are prone to left ventricular hypertrophy, it is supported based on the exponential increase of left ventricular mass. This shows even upon adaptation an athlete's heart still needs to be looked out based on knowing they have an equal chance of having problems just like a sedimentary individual.

Based on this study, cardiovascular adaptation doesn’t just need to be focused on in sports medicine as it can be interdisciplinary with other subjects like preventative medicine and rehabilitation. This study shows the importance of athletic activity to cardiovascular health.

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