Impact of high-performance sport on serum potassium values in athletes: A systematic review

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Introduction

Potassium (K+) is a critical alkali metal and the most abundant cation in the body, primarily found inside cells. It's measurable in serum, plasma, whole blood, and urine. During intense exercise, potassium is released from muscles into the bloodstream, with levels related to exercise intensity.

Potassium is essential for cell polarization and transmitting electrical impulses in the heart, so fluctuations in serum potassium (hypokalemia or hyperkalemia) can lead to life-threatening arrhythmias and myocardial issues in athletes (Francielle, 2012; Santos, 2012).

Hypokalemia, or low potassium, can cause muscle issues and, in severe cases, cardiorespiratory arrest due to losses through urine, sweat, or the gastrointestinal tract. Hyperkalemia, or high potassium, may result from excessive intake or kidney problems, causing muscle cramps and reduced excitability, affecting athletic performance (Bompa & Buzzichelli, 2019).

Athletes balance fatigue and recovery, with potassium fluctuations being crucial to their limits. The line between beneficial and harmful effects is fine, and maintaining a diet rich in potassium-regulating foods is vital to prevent imbalances (Manderico, 2016).

Understanding potassium's role in intense physical activity helps optimize performance and avoid health risks.

The main goal of this systematic review is to compare the blood potassium levels obtained before and after training in athletes.

Method

Search Strategy:

According to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Page et al., 2021).

Electronic databases:

- Pubmed, Scopus and Web of Science;
- April 21 and June 15, 2022;
- Boolean operators "AND" and "OR" were used for the search and, whenever possible, Medical Subject Headings (MeSH) descriptors were employed.

Eligibility Criteria and Article Selection:

- Primary research articles;
- Articles published in portuguese, spanish, and English;
- Articles obtained through the search terms used;
- Articles within a 10-year timeframe, from 2012 to 2022;
- Exclusion criteria: studies in which the population did not include athletes, or the population consumed potassium supplements.

Data extraction and Quality Assessment

- Extracted and recorded in Microsoft Excel;
- The methodological quality of the studies was assessed using the assessment tool developed by the Effective Public Health Practice Project (EPHPP);
- Assessed the risk of bias for each study, rated in six specific domains as "strong," "moderate," or "weak," according to the EPHPP algorithm, and also received an overall rating.

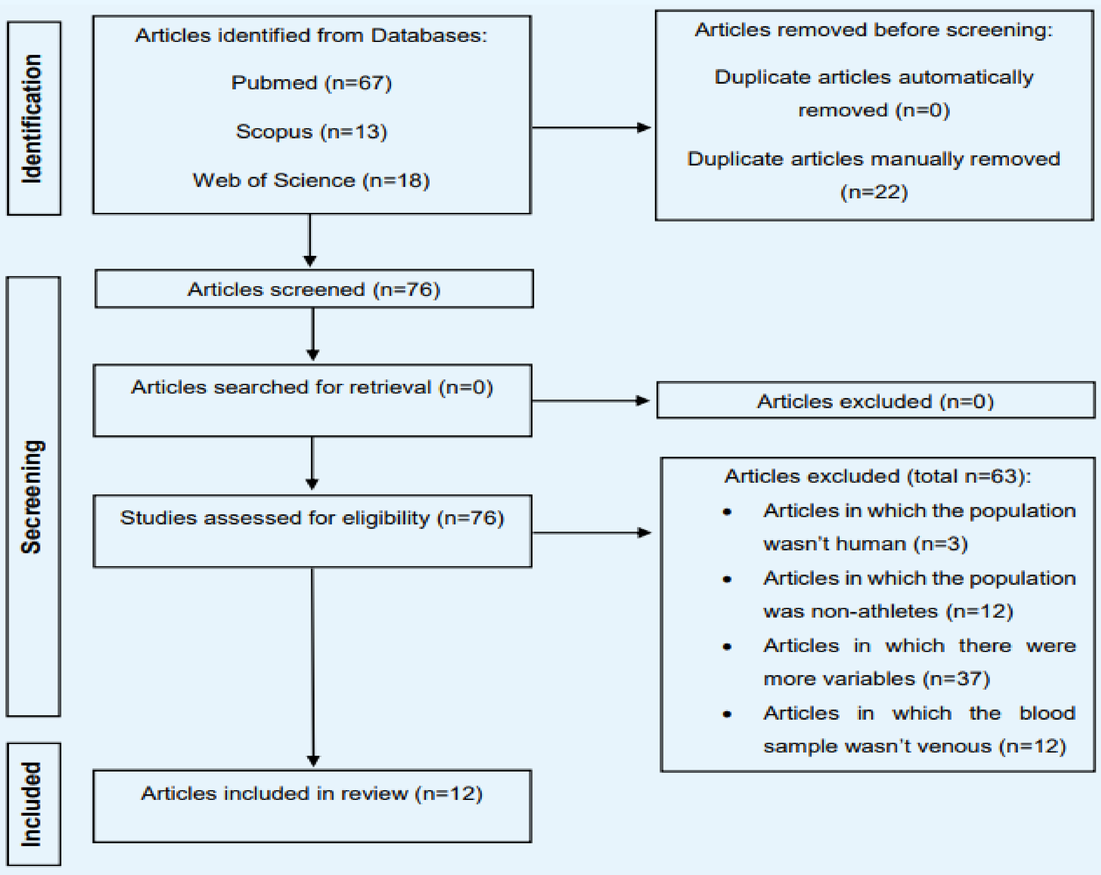

Figure 1: PRISMA Diagram for the selection of articles included in the systematic review

Results and Discussion

Table 1. Summary of the articles included in the Present Systematic Review

Authors	Year	Methodology	Sports	Main findings
Hajdo *et al*	2019	Potassium dosage before and after high intensity training in workouts of 45 minutes, 3 times per week	Bodybuilding	High intensity training has no impact on the studied parameter
Suleyman *et al*	2014	Potassium dosage during night before exercise and after exercise	Running	Night training until exhaustion presents a significant rise on potassium levels compared to the pre-training values
Sumi *et al*	2018	Potassium dosage before, during and after exercise in several moments, also comparing normal conditions and hypoxia	Cycling	Under normal conditions, the increase of potassium after the exercise is more significant than in hypoxia
Boone *et al*	2016	Potassium dosage in individuals with experience of resistance training pre-exercise, immediately after exercise, 30-minute post-exercise and 1 hour after exercise	Bodybuilding	Depending on the intensity of training, potassium values fluctuate not following a linear trend
Doker *et al*	2013	Participants were grouped according to their swimming experience and potassium levels were measure in 3 moments (pre-exercise, immediately after exercise and 1 hour after exercise)	Swimming	In professional athletes, there is an higher decrease in potassium levels after training
Varamenti *et al*	2018	Potassium dosage was carried out in 3 groups, according to ages, in 4 moments during the season (pre-season, start of training, competitive period and post season)	Track and field, fencing, gymnastics, squash, table tennis and target practice	The age of participants did not interfere in the obtained results
Kaminska *et al*	2020	Potassium dosage in urine and blood, in game simulations, before and after exercise	Handball	The location of the match influences the potassium levels
Atanasovska et al	2014	Potassium dosage in several moments (2 minutes after starting the exercise, every 30 seconds during the exercise and several moments after exercise)	Rowing	There was an increase in the serum value of potassium after exercise
Bielec *et al*	2012	Potassium dosage at rest, at the warm-up and 3 minutes after exercise	Swimming	Exercise caused the value of potassium to decrease
Nam *et al*	2020	Potassium dosage in different moments (fasting in normoxia, with slight hypoxia and with severe hypoxia)	Cycling	Hypoxia does not influence the value of seric potassium, unlike the practice of exercise
Casuso *et al*	2017	Potassium levels were measure in 3 moments (pre-exercise, 3 minutes after exercise and 2 hours after exercise)	Swimming and running	The type of sport practiced has influence on the value of potassium after exercise
Wang *et al*	2012	Potassium dosage in different moments (fasting in their 1º, 8º and 15º day of resumed training and before and after 2 hours after high intensity training)	Basketball	There were no significant changes in the value of potassium related to the training intensity

In 7 out of the 12 articles, an increase in potassium levels during exercise and a decrease after exercise were noted. However, these changes in potassium values are not as linear as previously believed. In studies in which the same was not observed, it may be due to the presence of variables that include the type of sport practiced, the environment in which the sport is practiced, the presence of hypoxic conditions, age, training plan, blood collection timing for potassium measurement, pre-analytical variables, and the sampling of each study. Therefore, for better association, all studies should have undergone the same conditions and been subject to the same variables to achieve a general association.

Conclusion

This study aimed to assess the existence of changes in potassium levels in order to gain a better understanding of this topic, so as to improve athletes' life quality and prevent cardiac pathologies. By analyzing the 12 selected articles, it can be concluded that the type of sport practiced and the environment in which it is performed influence the results obtained, not just the physical activity.

Therefore, it was proven that there are changes in blood potassium levels obtained before and after athletes' training, which indicates that part of the objective was achieved. Thus, no definitive conclusion can be drawn, and it is necessary to further explore this topic more individually to later make a better comparison between sports.

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