

Review Paper

Medicinal Properties of Boron Supplementation on the Prevention and Treatment of Diseases: A Systematic Review



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ABSTRACT

Objective Boron supplement is an essential ingredient for humans approved by the American Food and Drug Administration. Since today, the use of dietary supplements for the treatment of diseases has received much attention, this systematic review study aimed to determine the effect of boron supplement on the treatment and prevention of various diseases.

Methods The search was conducted among papers published until July 2019 and indexed in Web of Science, Scopus, PubMed, Science Direct, Google Scholar, SID, IranMedex and MagIran databases using keywords of "boron supplementation", "boric acid", "calcium fructoborate", "treatment", and "prevention". Articles with a score of 3 or more based on the Jadad Scale were included in the study (n=67).

Results Fifteen preventive therapeutic effects of boron supplement were investigated. All studies confirmed the favorable effect of boron supplementation in the fields of treatment and prevention and no side effects were reported in any of them.

Conclusion Symptoms of boron deficiency such as amnesia, osteoporosis, degenerative diseases, hormonal disorders and decreased libido are prevalent, and this deficiency has many side effects that can be prevented. Hence, the use of boron as a reasonable nutritional intervention and appropriate alternative to conventional chemical drugs is recommended.

Extended Abstract

1. Introduction

Boron supplement is one of the microorganisms approved by the US Food and Drug Administration and plays an important role in people's health. Boric acid and calcium fructoborate are two boron-containing compounds. The main form of boron in body tissues is boric acid and the rest is

found in the form of borate anion. Considering the regulation of plasma boron levels through renal excretion, toxicity caused by boron consumption in humans is rare and usually has no adverse effects on humans. People usually consume boron via drinking water and food intake. The daily intake of boron is about 1-3 mg/day for most adults.

The maximum recommended dose for pregnant and lactating women aged over 19 years and all adults is 20 mg/day. The major sources of this ingredient are nuts, dried

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fruits, grains, fresh vegetables, and fruits. Boron has a positive effect on the growth of bone and central nervous system, hormone regulation, reducing the risk of some types of cancer, improvement of arthritis and associated heart disease symptoms, speeding up the wound healing, pain reduction in gynecological diseases, and kidney stones through reduction of cytokines. Studies show that dietary regimes with low boron intake are common and this deficiency leads to problems in public health and increasing the risk of cancer. In this systematic review, we aimed to investigate the effect of boron supplementation on the prevention and treatment of diseases.

2. Materials and Methods

In this review study, we review all studies related to the preventive and therapeutic effects of boron supplementation published until July 2019 and indexed in Web of Science, Scopus, PubMed, ScienceDirect, Google Scholar, SID, IranMedex, and MagIran databases. For the search, the keywords of “Boron Supplementation”, “Boric Acid”, “Calcium Fructoborate”, “Treatment”, and “Prevention”

were used. Those studies which were related to effectiveness of boron supplementation in the medical field and had a score of 3 or more based on the Jadad Scale were included in the study. Based on initial evaluation, 437 articles were found. of these, 66 papers and 7 books were reviewed. Of 66 papers, only one was in Persian and the rest were in English (Figure 1).

3. Findings

Boron deficiency is harmful to the human body, leading to problems in public health and an increased risk of cancer and even death. The most common symptoms of boron deficiency are arthritis, amnesia, osteoporosis, degenerative and soft cartilage diseases, hormonal disorders, and decreased libido. Studies have shown that the boron intake of less than 1 mg per day creates a context for some problems in the human body and prevents from its benefits to the body.

In this study, of 67 reviewed articles, 15 were related to the preventive and therapeutic effects of boron including its

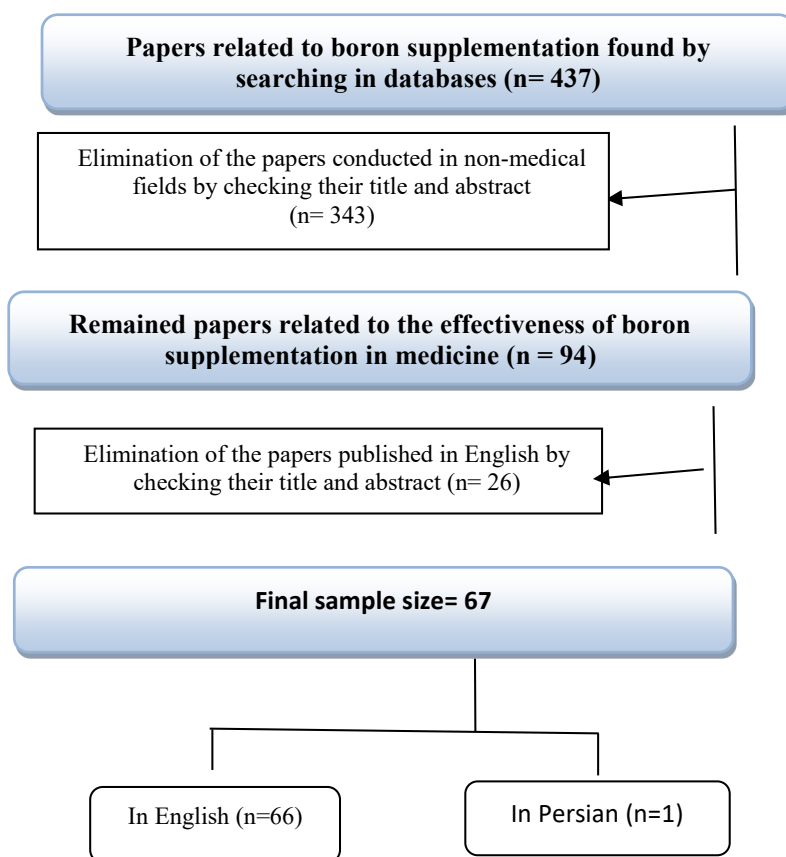


Figure 1. Flowchart of the sampling process

Table 1. Different domains of the medicinal properties of boron supplementation in the prevention and treatment of diseases

Number	Domain	Main Finding
1	Osteoporosis	Significant effect on bone strength
2	Inflammatory biomarkers	Significant reduction in inflammatory biomarkers
3	CRP	Significant decrease in CRP, fibrinogen, and Erythrocyte Sedimentation Rate (ESR)
4	Cardiovascular system	Significant decrease in nitroglycerin consumption, frequency of angina attacks, and pain after the intervention
5	Pain relief	Significant decrease in the mean severity and duration of pain in the boron supplementation group before and after intervention
6	Kidney stones in animals	Significant decrease in calcium crystal deposition in the intervention group compared to the control group
	Kidney stones in humans	Elimination of 9×20 mm stone is associated with significant reduction in pain and reduction of hematuria without hydronephrosis
7	Central nervous system	Significant decrease in brain magnesium and phosphorus concentration in the boron-deprived group and less activity of rats in this group
8	Prostate Cancer	Significant difference in prostate size between the two study groups
9	Cervical Cancer	Significant difference in cervical cytopathology changes between the two groups
10	Lung cancer	Significant reduction of lung cancer incidence between the two study groups
11	Breast cancer	Significant reduction of genotoxic changes in the medium containing boric acid
12	Liver cancer	Significant decrease in Proliferating Cell Nuclear Antigen (PCNA) and as a result, significant decrease in liver cancer
13	Melanoma	Induction of apoptosis in melanoma cells in vitro
14	Hormones	significant increase in mean plasma concentration of free testosterone and a significant decrease in estradiol
15	Infertility	Modification of the abnormal form of sperm in one man and improvement of sperm motility in another person and increasing sperm count in both cases

effect on osteogenesis, inflammatory response, C-Reactive Protein (CRP), cardiovascular system, pain relief, kidney stone, central nervous system, prostate cancer, cervical cancer, lung cancer, breast cancer, liver cancer, melanoma, hormones, and infertility (Table 1). The use of boron in pharmaceuticals is also on the rise.

4. Conclusion

Boron has a positive effect on the growth of bone and central nervous system, hormone regulation, reducing the risk of some types of cancer, improvement of arthritis and associated heart disease symptoms, speeding up the wound healing, pain reduction in gynecological diseases, and kidney stones. Despite the need for boron intake of 1-3 mg per day in adults, symptoms of boron deficiency such as arthritis, amnesia, osteoporosis, degenerative and soft carti-

lage diseases, hormonal disorders, and decreased libido are still common, and this deficiency can have many adverse effects that can be prevented. Therefore, its consumption as a reasonable dietary and a suitable alternative for common chemical drugs is recommended.

Ethical Considerations

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Authors' contributions

Conceptualization, investigation, analysis and resources, writing-review & editing by all authors; initial draft prepara-



tion, visualization, supervision, project administration, funding acquisition: Somaye Nikkhah.

Conflicts of interest

The authors declared no conflict of interest.

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