

Essentiality of Boron for Healthy Bones and Joints

Rex E. Newnham

Rex Newnham and Associates, North Yorkshire, England

Since 1963, evidence has accumulated that suggests boron is a safe and effective treatment for some forms of arthritis. The initial evidence was that boron supplementation alleviated arthritic pain and discomfort of the author. This was followed by findings from numerous other observations epidemiologic and controlled animal and human experiments. These findings included *a*) analytical evidence of lower boron concentrations in femur heads, bones, and synovial fluid from people with arthritis than from those without this disorder; *b*) observation evidence that bones of patients using boron supplements are much harder to cut than those of patients not using supplements; *c*) epidemiologic evidence that in areas of the world where boron intakes usually are 1.0 mg or less/day the estimated incidence of arthritis ranges from 20 to 70%, whereas in areas of the world where boron intakes are usually 3 to 10 mg, the estimated incidence of arthritis ranges from 0 to 10%; *d*) experimental evidence that rats with induced arthritis benefit from orally or intraperitoneally administered boron; *e*) experimental evidence from a double-blind placebo-boron supplementation trial with 20 subjects with osteoarthritis. A significant favorable response to a 6 mg boron/day supplement was obtained; 50% of subjects receiving the supplement improved compared to only 10% receiving the placebo. The preceding data indicate that boron is an essential nutrient for healthy bones and joints, and that further research into the use of boron for the treatment or prevention of arthritis is warranted. — Environ Health Perspect 102(Suppl 7):83–85 (1994)

Key words: boron, arthritis, bone, osteoarthritis

Introduction

In 1963, I hypothesized that the lack of dietary boron would enhance the occurrence and severity of some forms of arthritis, or that boron supplementation could alleviate arthritic conditions in animals and humans. This hypothesis was the result of the alleviation of my own arthritic pain, swelling, and stiffness by boron supplementation (6 mg elemental boron/day as sodium tetraborate).

Shortly thereafter, other people with arthritis were convinced to try boron supplementation; many had their arthritic symptoms alleviated. Between 1976 and 1981, 90,000 bottles of elemental boron (100 tablets containing 3 mg, called Bor-Rex) were sold without advertising; word-of-mouth recommendations of satisfied users was all that was necessary. After receiving hundreds of positive comments from others who had tried boron supplementation, I presented my experiences and successes to the Australian and New Zealand Association for the Advancement of Science in Auckland, New Zealand in 1979, and at the International Symposium on Trace Elements in Man and Animals-4

(TEMA-4) held in Perth, Australia, in 1981 (1).

In the TEMA-4 paper, I presented data that showed that arthritic femur heads contained half the boron content of healthy femur heads (29.6 ppm vs 56 ppm). Subsequently, similar findings were obtained by Havercroft and Ward (2); they found lower boron concentrations in bones and synovial fluid from people with rheumatoid arthritis than from those without this disorder.

In 1981, Australia instituted a regulation that declared boron and its compounds were poison in any concentration. This regulation effectively stopped the sale of boron supplements in Australia. This action impelled me to obtain scientific evidence for the dietary need for boron. My first research efforts were directed towards establishing an epidemiologic relationship between arthritis and low boron exposure. The results of this research have been published (3,4). The findings suggested that in areas of the world where boron intakes usually were 1 mg or less/day, the estimated incidence of arthritis ranged from 20 to 70%. On the other hand, in areas of the world where boron intakes were usually 3 to 10 mg, the estimated incidence of arthritis ranged from 0 to 10%.

While the epidemiologic evidence was accumulating, other findings appeared that supported the concept that boron is beneficial to bone health; some of these were reviewed recently (5). They include the

observations of surgeons that bones of patients who use boron supplements are much harder to cut than bones of patients who do not use supplements, the clinical observation that boron supplements apparently accelerate the healing of broken bones, and that rats given an arthritic adjuvant developed less inflammation and arthritis when administered boron either orally or intraperitoneally. It also has been reported recently that boron alone and in combination with garlic oil showed antiarthritic activity against formaldehyde-induced arthritis in rats (6).

Materials and Methods

To date, the most convincing evidence that boron may be useful in the treatment of arthritis was the result of a double-blind trial conducted at the Royal Melbourne Hospital, Australia, between 1983 and 1987 (7). Twenty patients presenting radiographically confirmed osteoarthritis were recruited to the trial, which compared daily oral dosages of 6 mg boron/day (55 mg of sodium tetraborate decahydrate) to a placebo (66% dextrose, 33% dicalcium phosphate, 1% magnesium stearate) in the treatment of their arthritis symptoms. These subjects had exhibited arthritis symptoms for fewer than 10 years duration. The patients were under 75 years of age and free of cardiac and renal disease. The patients were assessed three times—prior to taking the tablets, after 3 weeks on the tablets, and after 8 weeks on the tablets.

This paper was presented at the International Symposium on Health Effects of Boron and Its Compounds held 16–17 September 1992 at the University of California, Irvine, California.

Address correspondence to Dr. R. E. Newnham, Cracoe House Cottage, Nr. Skipton, North Yorkshire BD23 6LB, England. Telephone 0756 730240

The following scale was used to grade the responses to treatment: *a*) completely cured (i.e., pain-free and no restriction of movement); *b*) much better but not completely cured; *c*) only slightly better; *d*) no different; *e*) slightly worse; *f*) far worse.

In addition, paracetamol was provided to the subjects to be used as an analgesic when required; the amount taken was used as a measure of pain. Also determined at each visit were weight, pulse, blood pressure and temperature, and blood variables of white blood cell count, hemoglobin, polymorphs, platelet count, erythrocyte sedimentation rate (ESR), alkaline phosphatase (AP), aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma-glutamyltransferase (γ GT), bilirubin, albumin, sodium, potassium, bicarbonate, urea, and creatinine. The patients were examined also for other abnormalities, including FBA film abnormalities, mental impairment, and inflammation or desquamation of the skin.

Results

The results were analyzed by SPSSX package (8). Two-way contingency tables were assessed by Fisher's exact test and the goodness of χ^2 test. Differences in ratings were assessed by Kendall's rank correlation coefficient. Table 1 shows the nature of the arthritis presented by the patients in the first visit. The affected joints were 7 necks, 7 backs, 5 shoulders, 1 elbow, 12 wrists, 2 hands, 3 knuckles, 4 hips, 25 knees, 1 ankle, 3 feet, and 10 toes. There were no significant locational differences, nor a difference in average severity of arthritis between the two groups. Pain on passive movement was present at the first visit in 56 (60%) of the affected joints, as was swelling, warmth, or deformity. Restricted movement was present in 62 (67%) of the affected joints.

Two patients, one each in the placebo and boron groups, dropped out of the trial before the second examination—the placebo patient probably ceased participation because of the lack of response to treatment, and the boron patient because of intercurrent medical problems. Neither had improved nor worsened during the short participation in the trial. Table 2 illustrates the responses of the remaining 18 patients after three weeks of study. Although slightly more patients on boron (four) than on the placebo (two) claimed to have improved during the first 3 weeks, 12 claimed either to have worsened or stayed the same. Statistically, the groups showed

Table 1. Characteristics of study subjects.

Variable	Boron group	Placebo group	All subjects
Age	64.9	64.0	64.5
Years of arthritis	6.3	6.4	6.4
Number of joints affected	4.2	5.1	4.7
Severity of joints affected	1.7	1.9	1.8
With pain on movement (%)	50.0	69.0	60.0
With swelling, etc. (%)	50.0	69.0	60.0
With restricted movement (%)	64.0	69.0	67.0
Palliatives per day prior to visit 1	0.9	1.8	1.3

Table 2. Characteristics of patients after 3 weeks on trial.

Variable	Boron group	Placebo group	All subjects
Number of joints affected	4.2	5.7	4.9
Condition of worst joint	4.1	4.6	4.3
Condition of all joints	3.7	3.5	3.6
With pain on movement (%)	45.0	65.0	56.0
With swelling, etc. (%)	55.0	61.0	58.0
With restricted movement (%)	61.0	65.0	63.0
Palliatives per day between weeks 0 and 3	2.3	2.7	2.5

Table 3. Characteristics of patients after 8 weeks on trial.

Variable	Boron group	Placebo group	All subjects
Number of joints affected	4.0	5.8	4.9
Condition of worst joint	3.3	4.6	4.1
Condition of all joints	3.0	3.9	3.6
With pain on movement (%)	27.0	70.0	54.0
With swelling, etc. (%)	46.0	57.0	53.0
With restricted movement (%)	54.0	70.0	64.0
Palliatives per day between visits 1 and 3	0.8	2.5	1.8

Table 4. Ancillary clinical, hematological and biochemical data.

Variable	Values of patients on supplement for 8 weeks	Values of patients at first visit or on placebo	Overall mean
Weight	62.8 ^a	71.3	68.9
Pulse	73.9	73.9	73.9
Blood pressure	138/81	147/80	144/80
Temperature	36.9	36.9	36.9
White cell count	7.3	7.5	7.5
Hemoglobin	13.1	13.7	13.5
Polymorphs	4.2	4.6	4.5
Lymphocytes	2.2	2.0	2.0
Platelets	328.1	301.2	309.0
ESR	19.3	21.9	21.2
AP	78.7	84.3	82.6
AST	23.7	22.9	23.1
ALT	20.9	29.9	27.2
γ GT	20.7	26.3	24.7
Bilirubin	7.0	6.7	6.8
Albumin	42.8	42.0	42.2
Sodium	139.9	140.5	140.3
Potassium	4.4	4.2	4.3
Bicarbonate	26.7	27.0	26.9
Chloride	102.7	104.0	103.6
Urea	6.7	6.9	6.8
Creatinine	0.09	0.09	0.09

Abbreviations: ESR, erythrocyte sedimentation rate; AP, alkaline phosphatase; AST, aspartame aminotransferase; ALT, alanine aminotransferase; γ GT, gamma glutamyltransferase. ^a Difference largely caused by weight loss in one woman who was later found to have Hodgkin's lymphoma.

no significant difference in their responses at this time.

Between week 3 and the last examination at week 8, three additional patients dropped out of the trial, apparently because of a significant deterioration in condition; two were on the boron supplement, the other on the placebo. Table 3 shows the responses of the remaining 15 patients after 8 weeks on the trial; seven patients taking the boron supplement and one taking the placebo claimed improvement, while the remaining two patients taking the boron supplement and seven patients taking the placebo claimed to have worsened or stayed the same. The favorable response to the boron supplement was significant ($P < 0.05$, Fisher's exact test) and was confirmed by the doctor conducting the trial.

As shown in Table 3, on the last visit, the average condition of all patients' joints was 3.3 for those taking the boron supplement, and 3.9 for those taking the placebo;

the difference was significant ($p < 0.05$, Kendall's rank correlation coefficient of 0.34). There was also significantly less pain on passive movement in patients taking the boron supplement ($p < 0.001$).

Other observations during the trial were that results did not vary by gender, and those who had suffered arthritis for a longer period of time did not respond as well as those with more recent arthritis. Also, older persons tended to show a poorer response than younger ones. People under 60 years of age generally responded within a month, while those between 60 and 70 needed up to two months to respond.

Table 4 shows that there were no apparent side effects to the boron supplementation. The boron supplementation had no significant effect on the clinical, hematological, and biochemical variables examined.

In summary, of those starting the trial, 50% receiving the boron supplement improved compared to only 10% receiving

the placebo. Considering only those who completed the trial, 71% improved while taking the boron supplement. The findings suggest that boron (as sodium tetraborate decahydrate) is safe and beneficial in the treatment of osteoarthritis.

Conclusion

In conclusion, over 30 years of accumulating evidence indicates that boron is essential for healthy bones and joints. Both epidemiologic and controlled animal and human experiments suggest that boron supplementation in amounts found in some diets throughout the world is effective in preventing or treating various forms of arthritis. Thus, boron is a nutrient and therefore should not be considered a poison or a pharmaceutical. Because boron is of apparent clinical and nutritional importance, efforts should be expanded to assure that people consume enough of this important element every day.

REFERENCES

1. Newnham RE. Mineral imbalance and boron deficiency. In: Trace Element Metabolism in Man and Animals. Trace Elements in Man and Animals (TEMA)-4 (Howell J McC, Gawthorne JM, White CL, eds). Canberra, Australia: Australian Academy of Science, 1981; 400-402.
2. Havercroft JM, Ward NI. Boron and other elements in relation to rheumatoid arthritis. In: Trace Elements in Man and Animals 7 (Momcilovic B, ed). Zagreb:IMI, 1991;8.2-8.3.
3. Newnham RE. Tentative evidence of relationships between boron supply and arthritic disorders. In: Trace Elements in Man and Animals-TEMA 5 (Mills CF, Bremner I, JK Chesters, eds). Farnham Royal, UK: Commonwealth Agricultural Bureaux, 1985;839-840.
4. Newnham RE. Boron problems and its essential nature. In: Current Trends in Trace Elements Research (Chazot G, Abdulla M, Arnaud P, eds). Nishimura, Japan: Smith-Gordon, 1989;89-91.
5. Newnham RE. The role of boron in human and animal health. In: Trace Elements in Man and Animals 7 (Momcilovic B, ed). Zagreb: IMI, 1991; 8.4-8.5.
6. Shah SA, Vohora SB. Boron enhances antiarthritic effects of garlic oil. *Fitoterapia* 61:121-126 (1990).
7. Travers RL, Rennie GC, Newnham RE. Boron and arthritis: the results of a double-blind pilot study. *J Nutr Med* 1: 127-132 (1990).
8. SPSS, Inc. SPSSX User's Guide. New York: McGraw-Hill, 1983.