According to current views, stigmata of CE OF LOW SERUM CALCIUM VALUES IN THE SOUTH AFRICAN BANTU


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According to accepted standards, the diet of the South African Bantu, in common with that of many indigenous peoples dwelling in tropical and semitropical countries, is markedly deficient in calcium\(^{14}\). Moreover, as we have mentioned elsewhere,\(^7\) the dietary intake of vitamin D is negligible, that of phytate phosphorus is high, the calcium-phosphorus ratio is adverse (occasionally as wide as 1 : 10), and the intakes of protein and fat are less than are usual among White communities. These dietary factors are listed by many authorities, for example Bicknell and Prescott,\(^6\) as being unfavourable for the absorption of calcium. There is, of course, plenty of sunlight (an average of 9 hours per diem in the Transvaal) although some authorities like Hess\(^8\) consider that a dark skin militates against the production of vitamin D from radiation. According to current views, stigmata of calcium deficiency should be apparent, and low levels of the element in the blood serum have been listed by some investigators.\(^9, 10\) That low levels are common among Natives of Southern Africa, who are habituated to a low intake of calcium, is borne out by local evidence.\(^12, 13\) Nevertheless, the view that low serum calcium values are evidence of calcium deficiency, and of reduced body stores, etc., is of questionable validity and open to a number of criticisms which will be discussed in this paper.

For a number of years at this centre we have been interested in the subject of calcium metabolism under conditions of low intake, and consequently we have determined serum calcium values on children and adults as opportunity offered. Particular attention has been given to pregnant and multiparous long-lactating mothers, among whom the effects of the drain of the element on serum values are of obvious interest.

We wish to stress that our studies concern Bantu children and adults in outward good health, and that subjects with altered serum calcium concentrations arising from various metabolic disorders, including rickets, have been excluded. The metabolism of calcium in the latter disease will be discussed in another paper.

SUBJECTS AND METHODS

(1) Boys. (a) 23 subjects, aged 7-12 years, were out-patients at Coronation Non-European Hospital, Johannesburg, suffering from cuts, minor burns, and other ailments not likely to influence serum calcium levels. (b) A further group of 54 boys, aged 14-15 years, were delinquents at Diepkloof Reformatory, Johannesburg. They had been detained there for some months, and were employed on farm lands producing food (including milk) for their own consumption.

(2) Adult Males. 48 men, aged 18-40 years, were newcomers from different Southern African territories examined in Johannesburg and passed as medically fit for service on the gold mines.

(3) Adult Females. The 33 adult women were either out-patients or newly-admitted in-patients at Bara-
gwanath Non-European Hospital, Johannesburg, suffering from ailments unlikely to affect their serum calcium levels.

(4) Pregnant Women. The 38 subjects examined were out-patients in their last trimester attending either Baragwanath Hospital, or a peri-urban health centre (Mooiplaats) near Pretoria, for routine examination. Medical officers considered their state of health to be representative of urban Bantu pregnant women.

(5) Lactating Women. The 55 subjects studied were either patients in Baragwanath Hospital admitted on occasions when their babies required treatment, or were out-patients attending that hospital or the peri-urban health centre mentioned previously. The mothers selected and studied were considered to be representative. Subjects had had 2 or more children, and had fed their babies for at least 5 months up to 12 months, the babies deriving all or almost all their nourishment from the breast milk.

Blood samples were taken by venipuncture, usually about 11 a.m. Serum calcium was determined by the method of Tisdall and Kramer as modified by Clark and Collip.

The results are summarized in Table I. For comparison, data on other groups of subjects are included.

![Table I.—Serum Calcium Values in Bantu and Other Groups](image)

The initial question is whether these low values are compatible with good outward health, or whether they are essentially pathological and likely to be associated with relevant clinical stigmata. The Porto Rican soldiers studied by Ashford and Hernandez, the Bechuana Bantu investigated by Squires, and also the Bantu mine-workers studied by us, all were in good outward health; moreover, the last group was passed as medically fit for hard physical work. Yet both Squires' subjects and our own were drawn from populations known to have been habituated to a calcium intake considerably less than that common among Europeans. The first point then is that low serum calcium values are common and that they occur in apparently healthy hard-working people.

If low values are not pathognomonic per se, what is their significance, i.e. what do they indicate or measure? The following 2 points are relevant:

1. It has been observed that subjects habituated to a low calcium intake, and who have low serum calcium levels, may have the latter raised by improvements in diet. Thus, a group of Chinese mothers in poor nutritional condition had an average serum calcium value of 8.6 mg. %; after consuming the hospital diet the value became 9.3 mg. %.

2. The Indian repatriated prisoners-of-war studied by Walters et al. had an average serum calcium value of 8.6 mg. %; on hospitalization this was raised to 10.2 mg. %. The Central African patients of Orr and Gilks had an average value of 9.3 mg. % before entering hospital; after treatment (for tropical ulcer) the mean value became 10.5 mg. %.

Further,
although our data on the Bantu boys in Groups 1a and 1b are not strictly comparable, it is probable that the higher mean value for the boys from Diepkloof Reformatory was due to their consumption of a diet of superior nutritional value compared with the diet of the outpatient boys living in Coronationville. The rise in values in the examples described may have been due either to the consumption of a more nourishing diet (more protein, etc.), or to the ingestion of a higher calcium intake, or to both causes.

(2) With White subjects, investigation has shown that administration of calcium supplements can slightly elevate serum calcium levels.\textsuperscript{29-31} The elevations occur within 2 hours after ingestion of the supplementary calcium; further, the elevations appear to be transitory, lasting for a few hours only and returning to previous levels once the supplements are no longer given. The rapidity of elevation and fall suggests that serum calcium levels are unrelated to extent of body stores; also, it may be inferred that the elevations described in the previous paragraph were due to increased calcium intake rather than to other changes in diet.

Briefly then, it would seem reasonable to consider that low mean serum calcium values in population-groups probably reflect habitually low intakes of the element, and do not essentially indicate low body stores.

**Serum calcium in pregnant Bantu women.** In White women it is a common observation that as pregnancy progresses serum calcium concentration falls, but returns to its previous level after parturition.\textsuperscript{32} If serum calcium concentration in the Bantu responds to pregnancy in the same way in White women, then, assuming the groups to be comparable, one would expect the mean concentration for the group at term to be lower than the mean value for the non-pregnant group. Our Table, however, indicates an apparent rise during the pregnancy of Bantu women; moreover, the value at term approximates to that for the groups of White mothers mentioned.

**Serum calcium in multiparous long-lactating Bantu mothers.** An average White mother has a total body-calcium of approximately 900-1,100g.\textsuperscript{33} During pregnancy, she provides the foetus with 20-30g calcium,\textsuperscript{34} and if she feeds her baby exclusively by breast feeding for 6 months, she loses an average of 60 g calcium.\textsuperscript{34} For the Bantu, neither the total calcium in the mother nor the amount of the element in the foetus has yet been determined. The drain of calcium from the breast milk, however, is known to be similar to that for White mothers.\textsuperscript{35,36} It will be apparent, therefore, that lactation, especially prolonged lactation as is usual among the Bantu, constitutes a much greater demand for the element than occurs during pregnancy. It is interesting therefore that the mean serum calcium concentration for our 55 multiparous long-lactating mothers was found to be higher than the mean value in the non-pregnant state and also higher than the mean value at term. Unfortunately, no corresponding data for long-lactating White mothers have been reported. Our findings are in harmony with the absence of reports of the occurrence of osteomalacia in pregnant and lactating Bantu women, despite their being accustomed to a diet of low calcium content. To throw additional light on the subject it is our intention to determine serum calcium values from early pregnancy until late in lactation in the same individual Bantu women. To obtain such data will obviously take a considerable time, and it has been thought worth while to publish such information as we have already secured.

While it is apparent that good health may be enjoyed despite low serum calcium levels, it may be of interest to enquire whether the latter predispose to certain conditions, for example low calcium concentration in breast milk, inferior mineralization of bone, proneness to fracture of bones, and increased incidence of dental caries.

**Calcium concentration in Bantu breast milk.** Since milk is isotonic with blood, and milk calcium is derived from blood calcium, the question arises whether the low serum calcium values sometimes, though infrequently, observed in lactating Bantu mothers (Group 5) prejudice the calcium concentration of the breast milk. Firstly, the calcium concentration of Bantu milk, as alluded to above, has been found to vary within wide limits,\textsuperscript{35,36} yet no wider than those limits and with the same average value that have been reported for American\textsuperscript{34} and British\textsuperscript{37} mothers' milks. Next, our detailed observations have revealed no correlation between serum calcium and breast-milk calcium values in the same mother. Observations on cows have shown that in the presence of low calcium intake and depleted calcium reserves, milk of normal calcium concentration is produced, but the yield is reduced.\textsuperscript{38,39} Local paediatricians, however, maintain that Bantu mothers almost invariably have a good yield of milk, and aver that for the first 6 months there is parity in growth and general health between European and Bantu babies when exclusively breast fed. This information suggests, therefore, that low calcium intake and occasionally low values in the serum prejudice neither the calcium concentration in the breast milk, nor the total yield of milk.

**Mineralization of bone.** In Ceylon, the general calcium intake is low,\textsuperscript{40} but unfortunately no serum calcium data are available. However, Nicholls and Nimalasuriya\textsuperscript{40} found the mineral composition of various bones from Singhalese subjects to be the same as for European subjects who had been resident and had died in Ceylon. We have carried out a similar though more extensive study in this country, reaching the same conclusion.\textsuperscript{41} Low serum values are therefore compatible with normal composition of bone.

**Proneness to fracture of bones.** Even though bone composition be normal it is conceivable that a low calcium intake and low serum calcium levels may reduce the total amount of bone laid down, thereby reducing tensile strength and predisposing to fractures. There appears to be no evidence that this is the case, in so far as fractures are concerned, for the view has been expressed that even with gross deprivation of calcium and other nutrients, adequate trauma is necessary to cause fractures.\textsuperscript{42,43} But exact data of this type on the Bantu, or indeed on any other population, are not easy to obtain. Indirect evidence is available from the 4 million Bantu mine-workers employed on the Wit-
watersand; for senior medical officers consider that these Natives, who are accustomed to hard and sustained physical work, are no more liable to fracture their bones than are Europeans. It is also considered that when fractures occur in the Bantu, callus formation is more extensive and rate of healing more rapid than are observed with Europeans suffering from corresponding injuries. While these impressions are not decisive, they suggest that low serum calcium values per se, correlate neither with a high incidence of fractures nor with a delayed rate of healing.

**Proneness to dental caries.** Many authors believe that a low intake of calcium militates against satisfactory dentition and promotes dental decay. A corresponding claim does not appear to have been made in respect of low serum calcium values. It may be added that evidence from this country,\(^4\),\(^6\) Bechuanaland,\(^6\) Southern Rhodesia,\(^4\) and Central African territories,\(^6\) indicates that the general incidence of dental decay among the Bantu is lower than among Europeans.

**SUMMARY**

Serum calcium values have been determined in groups of Bantu children and adults in good outward health. It has been found that, in common with other populations dwelling in tropical and semitropical countries, low serum calcium values are frequently observed.

Discussion of our results and other relevant information indicates the following: (1) Low serum calcium values are compatible with good outward health. (2) The values probably reflect habituation to a relatively low intake of calcium. (3) They do not provide an indication of the extent of stores of body calcium. (4) They do not predispose to (a) low concentration of calcium in the breast milk; (b) poor mineralization of bone; (c) proneness to fracture bones, or (d) an increased incidence of dental caries.

We are grateful to the Medical Officers at the various hospitals and other centres who facilitated our collection of blood samples. This paper is published with the permission of the South African Council for Scientific and Industrial Research.

**REFERENCES**