The Sodium-Potassium Ratio in Saliva of Children with or without Nutritional Dystrophy
(Studies on the Nutrition of Children in Hirosaki Area)
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As will be seen from a preceding paper from our Laboratory,1) an abnormal response to Thorn’s test was found in 5 cases out of 18 cases of the children with nutritional dystrophy. In 1952 Grad2) reported that the sodium-potassium ratio in saliva might be a good index representing the adrenocortical salt-regulating activity. In the present paper the adrenocortical activity of children with nutritional dystrophy3),4) will be discussed from the viewpoint of the sodium-potassium ratio in saliva of them.

EXPERIMENTAL

Method and Material

Samples of unstimulated mixed saliva2) are obtained at 11 a.m., centrifuged, and aliquots of upper clear layer are used for estimation of sodium and potassium. For flame analysis of sodium and of potassium, Shimadzu-flame-photometer (Type Q B-50) was used, and dilution of saliva made up to 1:20 and 1:40 for estimation of sodium and for that of potassium respectively.

The estimation of sodium and of potassium in saliva was made on 29 boys from 8 to 10 years of age. These boys were divided into 2 groups (Groups I and II). Group I includes 15 boys without nutritional dystrophy, and Group II 14 boys with nutritional dystrophy.

Results and Comment

The mean values of the sodium-potassium ratio in saliva were 0.57±0.04 and 0.48±0.06 in Groups I and II respectively. (Cf. Tables I and II).

So the mean value of the sodium-potassium ratio in saliva tends to
be lower in the boys with nutritional dystrophy than in those without nutritional dystrophy.
The sodium-potassium ratio in the unstimulated mixed saliva of normal persons ranges from 0.2 to 0.6, according to Grad\textsuperscript{5} who used flame analysis. Our results show a fairly good accordance with those of Grad\textsuperscript{5} and Hoffmeister \textit{et al.}\textsuperscript{6} using chemical methods for the estimation of these minerals in saliva, reported that the normal mean value of the sodium-potassium ratio in saliva which was collected by stimulation with paraffine-chewing was 0.59±0.04.

Thus it will be seen that a fall or a rise in the sodium-potassium ratio in saliva is taken to indicate an increase or a decrease in adrenal cortical salt regulating activity, whether it is the unstimulated mixed\textsuperscript{2} saliva or the saliva collected by stimulation with paraffine-chewing.\textsuperscript{7}

As regards the relation between dietary deficiency and endocrine glands, McCarrison\textsuperscript{8} reported that the adrenal glands were hypertrophied and that the adrenalin content was high when pigeons and monkeys were fed on the diet which was deficient in B vitamine, suitable in protein and disproportionately rich in starch. In 1950, Skelton\textsuperscript{9} showed that, on the experimentation of rats, B-complex deficiency, per se, caused adrenal hypertrophy and thymus atrophy and that it must be considered as a non-specific stress.

On autopsy of pellagrins, atrophy of the adrenals was reported by Susman\textsuperscript{10} and Thannhauser.\textsuperscript{11} According to Jackson,\textsuperscript{12} however, atrophy of the adrenals could not be anticipated consistently in chronic malnutrition and in pellagra.

Gillman and Gillman\textsuperscript{13} described that in the early stage of malnutrition and of pellagra, there might be no visible structural changes in the adrenals, while later the glands, they stated, might be hypertrophied and subsequently undergo atrophy.

The majority of the boys who were included in Groups II in the present investigation must be taken to be in a state of nutritional dystrophy, because, apparently healthy as they were, they had the following items: arboflavinotic signs,\textsuperscript{3} low level of riboflavin in blood\textsuperscript{14} and in urine,\textsuperscript{15} pellagrous skin lesions,\textsuperscript{3} a decrease in urinary excretion of N\textsuperscript{3}-methyl-nicotinamide,\textsuperscript{11} macrocytic anemia,\textsuperscript{3,17} a decrease in protein bound iodine in serum,\textsuperscript{14} a decrease in albumin and an increase in globulins in electrophoretic pattern of serum\textsuperscript{19} and histopathological lesions of the biopsied livers.\textsuperscript{20}

The explanation for low value of the sodium-potassium ratio in saliva of these malnourished children may be given in one of the following two ways:—Firstly, it results from hyperactivity of the adrenals, which develops as a prescriptive stage to atrophy of the adrenals in malnutrition,\textsuperscript{18} or which is caused by a factor or factors\textsuperscript{21} other than deficiency in nutrients in malnutrition. Secondarily, it is explained by the relation of hepatic
lesions to the adrenal hormones. According to Bongiovanni et al.\textsuperscript{22}) and Bruckel et al.\textsuperscript{23}) adrenal cortical hormones are inactivated in the liver, and urinary output of corticoids is increased in acute hepatitis and in Laennec’s cirrhosis. Sato,\textsuperscript{20}) in our Laboratory, confirmed histopathologic-al alterations in the biopsied liver specimens from the children with nutritional dystrophy. It is therefore suspected that an inactivation of adrenal cortical hormone is decreased in the livers of children with nutritional dystrophy.

**SUMMARY AND CONCLUSIONS**

The mean value of the sodium-potassium ratio of the unstimulated mixed saliva is slightly lower in boys with nutritional dystrophy than in those without it. A rise in salt regulating activity of the adrenals of the boys with nutritional dystrophy is suggested.

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**References**

1) Sasaki & Hashimoto, Hirosaki Igaku (Japan), 1953, 4, 39.
4) Arakawa, Wada, & Takahashi, ibid., 1951, 55, 61.
14) Kagaya, Vitamins (Japan), 1954, 7, 557.
15) Kagaya, Riboflavine Concentration of Urine from Children with or without Nutritional Dystrophy. To be published in a coming issue of Vitamins.  
16) Masuda, Vitamins (Japan), 1953, 6, 187.