SEASONAL VARIATIONS IN URINARY CALCIUM AND SODIUM EXCRETION

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Summary : Serum levels and urinary excretion of calcium, sodium and creatinine have been studied in 25 male subjects in summer and winter seasons. In contrast to the reports from the West, urinary calcium excretion was significantly less in summer than in winter. Urinary sodium excretion too was decreased in summer. The mechanisms possibly responsible for the observed seasonal variations have been discussed.

Key words : urinary sodium urinary calcium summer winter sweat

INTRODUCTION

Seasonal variation in urinary calcium excretion was first reported in 1943 by Mc Cance and Widdowson (10). Balance studies by the authors revealed it to be due to greater intestinal absorption of calcium in summer than in winter. Since then many other workers have made similar observations and have ascribed the variation in the intestinal absorption of calcium to a difference in the cutaneous production of vitamin D (12, 15). Due to shorter hours of sunshine and foggy weather, a significant fall in serum 25-hydroxy vitamin D levels have been reported in winter in the U.K. (17). Regarding urinary sodium, seasonal variations in its excretion are likely to occur because of large sodium losses in the sweat during hot summer months (5,16). This study was conducted to observe the extent of seasonal variation, if any, in the urinary excretion of calcium and sodium in Haryana.

MATERIAL AND METHODS

The study was conducted in 25 male medical students aged 20-22 years residing in the hostel. 24 hr urinary collection was made on two consecutive days with usual

precautions (20) in January (mean maximum temperature 25°C and minimum 5°C) and June (mean maximum temperature 43°C and minimum 26°C). Values of the two days were averaged as a single observation. The students were on similar diet throughout the two periods. Fasting blood sample was taken on the morning of second day's collection. Blood and urine samples were analysed for calcium by the oxalate permanganate procedure, creatinine by Jaffe reaction and sodium by flame photometry (19). Serum calcium levels were corrected to the specific gravity of 1.027 (6).

RESULTS

No significant difference was observed in serum calcium, sodium and creatinine levels in summer and winter months (Table I). Mean 24-hr urinary calcium excretion was 99.8±45.6 *mg* in summer compared to 146.5±75.9 *g* in winter ($P<0.01$). Urinary calcium excretion was also calculated per gram creatinine and as calcium/creatinine ratio and these parameters too revealed significantly less calcium excretion in summer. Urinary sodium and creatinine excretions were also significantly decreased in summer. Urinary sodium/calcium ratio was however similar in winter and summer months (Table I).

TABLE I : Results of investigations in winter and summer seasons (Mean ± S. D.)

	Winter	*Summer*	*P value*
Serum calcium, *mg%*	10.0±0.6	9.8±0.5	>0.05
Serum sodium *mEq/l*	135.1±6.8	133.2±5.2	>0.05
Serum creatinine *mg%*	0.87±0.2	0.85±0.1	>0.05
24-hr urinary volume, *ml*	1370±247	1294±208	>0.05
24-hr urinary calcium, *mg*	146.5±75.9	99.8±45.6	<0.01
24-hr urinary sodium, *mg*	4380.4±1336	3302.8±1278	<0.05
24-hr urinary creatinine, *mg*	1306.3±199.2	1173.1±137.5	<0.05
Urinary calcium/*gm* creatinine, *mg*	114.2±60.4	85.0±39.4	<0.05
Urinary calcium/creatinine ratio	0.112±0.06	0.085±0.03	<0.05
Urinary sodium/creatinine ratio	30.07±14.54	33.16±12.43	>0.05

DISCUSSION

In contrast to earlier reports from the West (10,12,15), we have observed significantly lesser urinary calcium excretion in summer than in winter (Table I). Though 24-hr creatinine excretion was also less in summer, it was probably a seasonal variation (1). 24-hr urinary volume did not differ significantly in the two seasons. Moreover, urinary calcium excretion expressed per gram creatinine and as calcium/creatinine ratio was also significantly less in summer than in winter. Diminished urinary calcium could

be due to decreased intestinal absorption of calcium in summer season. Estimation of serum 25-hydroxy vitamin D has revealed only border-line sufficiency of vitamin D in North Indian population (13). During summer its cutaneous production, the major source of vitamin D in the body (7), is likely to be decreased because, due to intense hot weather, exposure to sunshine is avoided by all except those involved in outdoor duties. This possibility can, however, be confirmed only by estimation of serum 25-hydroxy vitamin D levels in the two seasons. Diminished urinary calcium excretion in summer is partly explained by the loss of calcium through an additional route i.e. the skin. During heavy sweating, dermal calcium loss has been estimated to be 10 *mg* per hr (4).

Greater loss of sodium in the sweat also accounts for the significant decrease in urinary sodium excretion observed in summer (Table I). Elebuti has reported a similar seasonal variations in urinary sodium excretion in Ghana (8). In numerous experiments, acute exposure to heat stress has been shown to result in decreased urinary sodium excretion since salt deficiency produced by cutaneous losses leads to increased aldosterone secretion (2,9,18).

The incidence of renal stone disease shows a seasonal variation, being highest in summer (14). According to one school of thought urinary sodium is an important inhibitor of the calcium-oxalate precipitation (3) and the high predisposition to renal lithiasis in summer may be due to decreased urinary sodium/calcium ratio (11,16). In this region inspite of diminished urinary sodium excretion in summer, we have observed unchanged urinary sodium/calcium ratio due to concurrent decrease in calcium excretion as well.

REFERENCES

1. Ahuja, M. M. S. and N. J. Sharma. Adreno-cortical function in relation to seasonal variations in normal Indians. *Ind. J. Med. Res.*, **59** : 1893–98, 1971.

2. Ashworth, A. and A. D. B. Harrower. Protein requirement in tropical countries : Nitrogen losses in the sweat and their relation to nitrogen balance. *Br. J. Nutr.*, **21** : 833–843, 1967.

3. Arora, A. L., A. S. Rao and V. Srimathi. Effects of constituents of artificial urine on spontaneous precipitation of calcium oxalate monohydrate. *Ind. J. Med. Res.*, **72** : 273–283, 1980.

4. Consolazio, C. F., L. O. Matoush, A. A. Nelson, G. J. Issac and J. E. Cahnam. Comparisons of nitrogen, calcium and iodine excretion in arm and total body sweat. *Am. J. Clin. Nutr.*, **18** : 443–448, 1966.

5. Dahl, L. K. Salt inake and salt needs. *New Engl. J. Med.*, **258** : 1152–1157, 1958.

6. Dent, C. E. Some problems of hyperparathyroidism. *Br. Med. J.*, **12** : 1419–1422, 1962.

7. Dent, C. E. and T. C. B. Stamp. In metabolic bone disease Eds. Alvioli, L. V. and S.M. Krane, *New York Academic Press*, p. 243, 1977.

8. Elebuti, O. Seasonal variations in urinary output and electrolyte excretion in adults. *Ghana Med. J.*, **13** : 12–17 1974.

9. Luestscher, J. A. Jr. and B. B. Johnson. Observations on sodium retaining corticoid (aldosterone) in urine of children and adults in relation to sodium balance and oedema. *J. Clin. Invest.*, **33** : 1141–1146, 1954.

10. Mc Cance, R. A. and E. M. Widdowson. Seasonal and annual changes in the calcium metabolism in Man *J. Physiol.*, **102** : 42–49, 1943.

11. Modlin, M. The aetiology of renal stone : A concept arising from studies on stone free population. *Ann. Roy Coll. Surg. Engl.*, **40** : 155–178, 1967.

12. Parry, E.S. and J. S. Lister. Sunlight and Hypercalciuria. *Lancet*, **1** : 1063–1065, 1975.

13. Preece, M. A., S. Tomlinson, C.A. Ribot, J. Pietrek, H. T. Korn, D. M. Davies, J. A. Ford, M. D. Dunnigan and J. L. H. O. Riordan. Studies of vitamin D deficiency in man *Q. Jl. Med.*, **44** : 575, 1975.

14. Prince, C. L., P. L. S. Cardini and C. T. Wolan. The effect of temperature, humidity and dehydration on the formation of renal calculi. *J. Urol.*, **75** : 209–215, 1956.

15. Robertson, W.G., J. C. Gallaghe, D. H. Marshal, M. Peacock and B. E. C. Nordin. Seasonal variations in urinary excretion of calcium. *Br. Med. J.*, **4** : 436–437, 1974.

16. Salem, S. M. Renal stone and sodium. *Lancet*, **1** : 1223, 1967.

17. Stamp, T. C. B. and J. M Round. Seasonal variation in levels of 25 hydroxy vitamin D. *Nature*, **247** : 563–565, 1974.

18. Thorn, G.W., E. J. Ross, J. Crabbe and W. V. Hoff. Studies on aldosterone secretion in man *Br. Med. J.*, **2** 955–966, 1957.

19. Varley, H. Practical Clinical Biochemistry. New Delhi. *Arnold-Heinemann*, p. 197, 442, 490, 1975.

20. De wardener, H.E. The kidney. London, *Churchill Livingstone*, p. 34, 1974.