

## Serum Uric Acid Levels of Healthy Caucasian, Chinese and Haida Indian Males in British Columbia

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### ABSTRACT

Because previous studies have shown that serum uric acid levels are higher in members of the Filipino and Maori races than in Caucasians, and because gout seemed unexpectedly common in the Chinese population of Vancouver, a study of serum uric acid levels in Caucasian, Chinese and Haida Indian males was undertaken. The serum uric acid levels of 200 Caucasian, 100 Chinese and 237 Haida Indian males were determined by the ultraviolet spectrophotometric method of Dubbs, which gives a result 0.5 mg. % below that of the more commonly employed method of Grayzel. The mean level of the Caucasians was 4.55 mg. % and that of the Haida Indians 4.41 mg. %; in contrast, the Chinese mean was 5.44 mg. %, a significantly higher figure than the means of the other two groups. No explanation for this finding can be given at present.

### SOMMAIRE

Sur la foi de rapports précédents à l'effet que l'uricémie était plus élevée chez les Philippins et les Maoris que chez les Caucasiens, ayant constaté que la goutte était particulièrement fréquente au sein de la population chinoise de Vancouver, les auteurs ont entrepris d'étudier l'uricémie chez des mâles Caucasiens, Chinois et Indiens Haida. La concentration sanguine d'acide urique a été ainsi déterminée chez 537 mâles, dont 200 Caucasiens, 100 Chinois et 237 Indiens. La méthode utilisée était celle de Dubbs, méthode spectrophotométrique à l'ultra-violet qui donne des chiffres inférieurs de 0.5 mg. % à la méthode plus couramment employée de Grayzel. La concentration moyenne a été de 4.55 mg. % chez les Caucasiens, de 4.41 mg. % chez les Indiens, alors qu'elle atteignait 5.44 mg. % chez les Chinois, chiffre notablement plus élevé que dans les deux autres groupes. On ne peut actuellement fournir aucune explication à cette constatation.

SOME rheumatologists in Vancouver have recently gained the clinical impression that gout is seen with greater than expected frequency in Chinese males. In order to investigate this possibility, a study was undertaken to determine if the serum uric acid levels of Chinese males differed from those of Caucasian males. The levels in these two populations were also compared to those of Haida Indian males, these latter samples being obtained during a survey of rheumatic disease in the Haida Indians of Masset and Skidegate on the Queen Charlotte Islands.<sup>1</sup>

### METHODS

Table I shows the method of selection of the healthy males in the three ethnic groups studied. In each of the groups the great majority of those asked to donate blood samples co-operated and a 'volunteer bias' for the selection process was thus believed to have been excluded. It was not possible to collect blood samples at a fixed time of day or in constant relation to meals. Serum samples containing much lipid were found to give unsatisfactorily high absorbance readings on the spectrophotometer, and thus, wherever possible, repeat fasting samples were obtained from individuals

whose first samples showed much lipid; this was done in 21 of the 100 Chinese subjects. Serum was separated from the clotted blood on the day of collection in almost all cases. It was routinely frozen and not thawed again until the uric acid determination was performed.

The estimation of serum uric acid was performed by the enzymatic technique of Praetorius, as modified by Dubbs, Davis and Adams.<sup>2</sup> A slow digestion of uric acid by uricase is the basis of this method. Worthington uricase dissolved in glycine buffer pH 9.4 was used at a concentration which gave a decrease in absorbance of the standard uric acid solution of 0.001 to 0.003 absorbance unit per minute. The determinations were made on a Beckman D.B. ultraviolet spectrophotometer set at a wave length of 292 m $\mu$ . and a narrow slit width. Serum, 0.1 ml., was added to 10 ml. uricase buffer and the absorbance was read immediately; after 18 hours' incubation at 25° a subsequent reading was obtained. When the initial absorbance was over .500, 0.1 ml. of serum was added to 20 ml. uricase buffer to obtain readings in the most accurate range of the instrument. In testing the precision of the method, recovery experiments were performed and 3.0-7.5  $\gamma$  per ml. of uric acid was added to serum samples; recoveries varied from

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TABLE I.—SELECTION OF MEN FOR STUDY

Ethnic group	No. of serum samples		Source of serum samples
	Total	In sub-groups	
Caucasian	200	159	Blood bank donors
		28	Doctors, technicians, medical students at Vancouver General Hospital
		13	Convalescent "healthy" hospital patients
Chinese	100	A 23	University undergraduates at a meeting of the Chinese Varsity Club
		B 22	Chinese members at a meeting of a branch of the Canadian Legion
		C 23	Chinese doctors, technicians and medical students at the Vancouver General Hospital
		D 32	Friends of a Chinese obstetrician and husbands of her obstetric patients
Haida Indian	237		A population survey with a completion rate of 84%

97.7% to 102.9% (average 99.9%). Eighty determinations on seven control sera, varying from a serum uric acid level of 3.2 to 5.7 mg. %, gave a standard deviation of .16 from the respective means. All samples were estimated in duplicate; moreover, a standard uric acid solution and a standard serum were estimated with each batch of 12 sera tested at one time.

At the completion of the study it was evident that our mean serum uric acid level for the Caucasian population was below that reported by other investigators.<sup>3-7</sup> It was then observed that the Dubbs method differed from the more commonly employed method of Liddle, Seegmiller and Laster<sup>8</sup> in not including a "biological fluid blank". Further sera were therefore obtained from 50 Caucasian and 25 Chinese males. The serum uric acid levels of these sera were then determined by the Dubbs method with and without the inclusion of the "biological fluid blank". In both groups of sera the mean level obtained with the inclusion of this blank was 0.5 mg. higher than if the blank was omitted. With the inclusion of this blank the method gave a mean serum uric acid for Caucasians similar to that of the 5.0-5.1 mg. % range reported in other studies.<sup>3-7</sup>

## RESULTS

Table II shows the results obtained by the method of Dubbs, Davis and Adams.<sup>2</sup> There was no difference between the mean serum uric acid levels of the Caucasians and the Haida Indians; moreover, there was no significant difference between the levels of those below 30 years of age and those above 30 years. The mean level of serum

uric acid of the Chinese was, however, significantly different from the means of the other two groups. For the Caucasian and Chinese means the standard error of the difference of the means was 0.12; as the observed difference between the means was 0.9 mg. %, a t-statistic of 7.5 resulted, giving a P value of < .01. The means of the four subgroups of Chinese are also given in Table II. The members of the Canadian Legion were found to have the highest level of serum uric acid, although lesser elevations were present in the other three subgroups. The high level in the Legion group did not seem to be related to factors operating at the time of the meeting because blood was drawn from 11 of the 22 members at a later date in the fasting state, and these latter results were used for the study. Although this group had a higher average age than the remainder, this also could not account for their high serum uric acid levels. It was not possible to estimate the effect of dietary factors in the differences between this B subgroup of Legion members and the other three subgroups.

TABLE II.—COMPARISON OF MEAN SERUM URIC ACID LEVELS IN THE THREE ETHNIC GROUPS

Ethnic group	Age	No. of cases	Serum uric acid Mg.%*	Standard deviation
Caucasian	< 30 years.....	54	4.7	
	> 30 years.....	146	4.5	
	Blood donors.....	159	4.5	
	Hospital staff.....	28	4.7	
	Convalescent patients.....	13	4.5	
	Total.....	200	4.55	1.02
Chinese	< 30 years.....	48	5.2	
	> 30 years.....	52	5.6	
	Subgroups A.....	23	5.5	
	B.....	22	6.1	
	C.....	23	5.0	
	D.....	32	5.3	
	Total.....	100	5.44	1.08
Haida Indian	< 30 years.....	103	4.3	
	> 30 years.....	134	4.5	
	Total.....	237	4.41	0.99

\*Method of Dubbs, Davis and Adams gives values 0.5% mg. less than method of Grayzel.

In Table III the proportions of the three ethnic groups having high serum uric acid levels are compared. More Chinese were found at each level of hyperuricemia, a level of 6.4 mg. % being selected as the upper limit of normal by the Dubbs method. Fig. 1 shows the frequency distribution curves of the proportions of the respective populations within successive 0.4-mg. increments of serum uric acid, this figure confirming the findings recorded in the previous two tables. Whereas the curves for both the Caucasian and the Haida Indian

TABLE III.—PROPORTION OF ETHNIC GROUPS WITH SERUM URIC ACID LEVELS ABOVE "NORMAL" BY THE DUBBS METHOD

	Serum uric acid > 6.4 mg.%	Serum uric acid > 6.8 mg.%	Serum uric acid > 7.2 mg.%
Caucasians.....	3.0%	1.5%	1%
Chinese.....	14.0%	8.0%	3%
Haida Indians...	2.5%	0.0%	0%

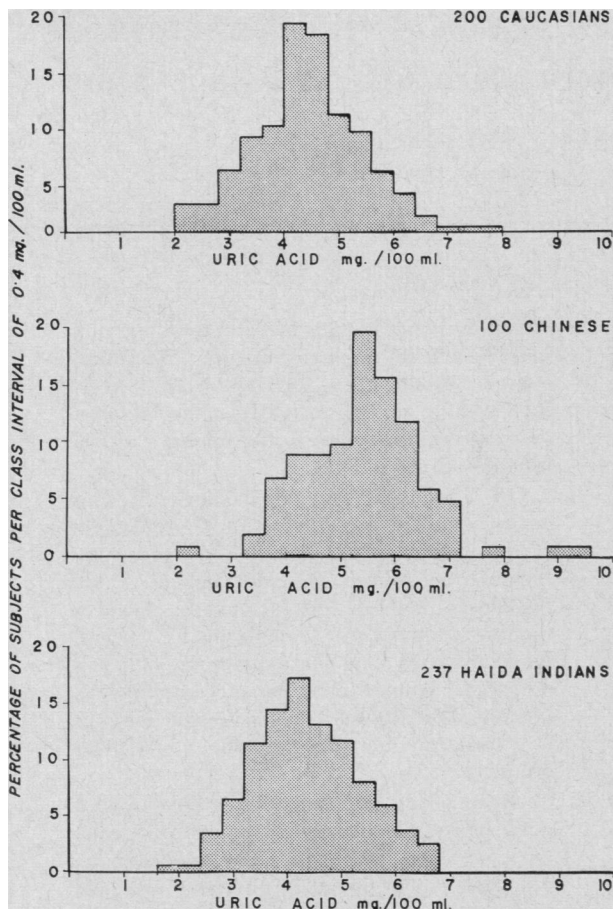


Fig. 1.—Distribution of serum uric acid in Caucasian, Chinese and Haida Indian males by the Dubbs method.

populations are symmetrical, that of the Chinese may be skewed.

#### DISCUSSION

Although it was not possible to perform a population study in an ideal manner in each of the ethnic groups investigated, certain observations can be made with reasonable certainty. When the "biological fluid blank" factor of 0.5 mg. is taken into consideration, the mean levels for the Indian and Caucasian groups conform to the 5.0-5.1 mg. % means of other recent studies performed by the ultraviolet spectrophotometric method. The Chinese in Vancouver, however, appear to have significantly higher serum uric acid levels and this may be more marked in particular groups of Chinese, though at the present time we have no satisfactory explanation for this.

Our study indicated that age had no significant effect on serum uric acid levels, and this is in accord with the findings of others.<sup>7, 9, 10</sup> Recently, Dunn *et al.*<sup>10</sup> have related serum uric acid concentration to social class; and earlier, Stetten and Hearon<sup>5</sup> showed that intelligence was related to serum urate levels. It may therefore be suggested, on the basis of the findings of Dunn *et al.*,<sup>10</sup> that our Chinese subjects were of a higher social class than the Caucasian group, 80% of whom were

blood donors. We are, unfortunately, not able to refute this by statistics but the suggestion is unlikely for the following reasons. The voluntary unpaid Red Cross donors represent the more responsible members of the community. The Chinese were certainly not of the executive class, although their mean serum uric acid level exceeded that reported by Dunn *et al.*<sup>10</sup> for executives. Almost certainly they were not above, but more probably below, the social class of Dunn's 76 Ph.D. scientists whose mean uric acid level was 5.3 mg. %. In fact the mean uric acid level of our Chinese individuals was 5.9 mg. % (Dubbs' method + 0.5 mg.), which is significantly greater than a level of 5.3 mg. %.

The present study could not be designed to obtain additional information which might relate to serum uric acid levels because language difficulties would have required the inclusion of a Chinese medical investigator to evaluate the effects of diet, the ingestion of drugs and the presence of other disease. Because of the method of case selection, however, we have no reason to believe that the taking of drugs or the presence of other diseases was a relevant factor. The diet of the Chinese subjects was not investigated, but it appeared that they tended to eat both Oriental and Western food. No attempt was made in this study to determine the regional origin of the Chinese or the date of their immigration into Canada.

The present study would indicate that Chinese, as well as Filipinos<sup>7</sup> and Maoris,<sup>11</sup> may develop significant hyperuricemia and gout when exposed to Western living conditions. It is planned to re-study the problem in university students in the near future.

#### SUMMARY

The serum uric acid levels of 200 Caucasian, 100 Chinese and 237 Haida Indian males were determined. The mean levels of the Caucasians and the Haida Indians were similar, but the Chinese males had a significantly higher serum uric acid concentration. The cause of this relative hyperuricemia was not revealed by this study.

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