

Diet and Serum Cholesterol Levels Among the "Black Caribs" of Guatemala

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SERUM cholesterol levels have been found to be markedly reduced among lower socioeconomic urban groups in Guatemala,¹⁻³ and the incidence and severity of atherosclerotic heart disease in these people is also very low when compared with that in business and professional persons.^{4,5} The people in the rural lower socioeconomic groups in Guatemala are predominantly Mayan Indian in racial origin while those in the upper income groups are primarily European caucasoid and mestizo. This racial difference is not considered responsible for the findings, however, since similar differences in atherosclerosis are found between racially homogeneous persons in the upper and lower income groups in Costa Rica.^{2,5} Environmental conditions must, therefore, be responsible; among the environmental variables which have received special attention are dietary differences.

In general, the population in the lower socioeconomic groups of this area consumes little fat, and this almost entirely of vegetable origin.^{2,3} They also have low intakes of animal protein, vitamin A and riboflavin.⁶ In contrast, the population in the upper socioeconomic groups in Guatemala consumes a diet relatively higher in fat and in other

essential nutrients, and similar in quantity and quality to the average diet in North America.⁷

It is frequently suggested that in comparisons between different socioeconomic groups, factors other than diet may be of major importance and that the correlation with diet is secondary rather than primary. The present study is concerned with another racial group found in significant numbers in Central America, and known as the "Black Caribs."^{8,9} This group, spread along the Atlantic Coast of Central America, lives at a social and economic level similar to many Mayan Indians, except for a diet much higher in proteins and fat. They also make greater use of coconut and seafood than other groups in Guatemala. The Black Caribs, therefore, provide an opportunity to determine in people living under poor socioeconomic conditions the effect on serum cholesterol levels of those dietary habits which customarily characterize upper income groups.

MATERIAL AND LOCALITY

A total of eighty-eight males and ninety-four females ranging in age from six to eighty-nine years were studied. For most decades of age it was possible to study ten persons of each sex as planned. These persons speak both Carib and Spanish and many also know English. They lived in Livingston, Guatemala, a town at the mouth of the Rio Dulce river, isolated from railroad and highway connections with the interior of Guatemala and an hour's ride by boat from the Atlantic port of Puerto Barrios. The mean annual temperature is 25.8°C. All were persons with black skin and other physical features of West Indian and African Negroes,

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TABLE I
General Characteristics and Serum Cholesterol Levels of Black Caribs in Livingston, Guatemala

Age (yr.)	No.	Weight (lb.)		Height (in.)		Skin- fold (mm.)		Blood Pressure (mm. Hg)				Serum Cholesterol (mg./100 ml.)	
								Systolic		Diastolic			
		Mean	S.D.*	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Males													
6 to 12	10	52	11	48	3	5	3	...	..	..	..	140	20
13 to 19	10	119	26	64	5	7	2	123	9	74	5	162	26
20 to 29	13	145	13	68	2	6	2	117	15	73	11	173	60
30 to 39	8	143	21	68	4	5	2	130	15	79	8	180	35
40 to 49	10	146	16	66	3	5	1	129	17	74	12	181	28
50 to 59	12	136	18	66	3	4	1	138	33	80	15	184	42
60 to 69	10	143	33	66	3	5	2	140	25	82	14	175	40
70 to 79	11	125	21	65	2	4	1	143	20	83	8	170	28
80 to 89	4	134	..	67	..	5	..	142	..	85	..	197	..
Females													
6 to 12	10	72	28	54	6	8	7	...	..	..	..	159	40
13 to 19	11	100	12	60	3	11	3	120	12	74	10	174	29
20 to 29	10	120	18	63	3	12	8	120	9	75	10	174	26
30 to 39	11	146	32	63	2	13	10	124	16	74	9	168	36
40 to 49	13	134	23	62	2	12	6	138	21	86	12	190	23
50 to 59	13	124	25	60	2	7	7	160	27	89	18	222	87
60 to 69	12	128	28	61	3	10	8	150	28	89	18	198	51
70 to 79	12	119	21	62	2	11	7	158	29	91	16	244	59
80 to 89	2	109	..	62	...	8	..	185	..	95	..	234	..

* S.D. = standard deviation.

and all belonged to a social and racial group identified as "Black Caribs." Members of the community known to represent Indian, white and oriental admixtures were excluded from the present study.

METHODS

The clinical examinations were carried out during May 1957, and included measurements of body weight, height, skinfold and blood pressure. After fasting, blood samples were extracted from the finger tips of these subjects for cholesterol analysis and were also used for determination of ABO blood type. The clinical examination followed a standard technic for nutrition surveys described by Muñoz and Pérez-Avendaño.¹⁰ The dietary information was obtained through daily interview for seven consecutive days of families taken at

random and calculated using the INCAP food composition tables.¹¹ The intake of fatty acid was calculated from the tables of Hardinge and Crooks.¹² The first dietary survey in December 1957 was made in the middle of the dry season; the second survey in June 1958 in the middle of the rainy season.

Total serum cholesterol levels were determined by the method of Abell et al.¹³ using 0.05 ml. samples. Skinfold thickness measurements were made in triplicate over the mid-triceps, using the Keys' caliper and following the recommendations of the Committee on Nutritional Anthropometry of the Food and Nutrition Board of the National Research Council (U.S.).¹⁴ The standard slide agglutination technic was used for ABO blood typing, and genotype frequency distribution was calculated using formulas cited by Mourant.¹⁵

TABLE II
Blood Group Frequencies Among Black Caribs in
Livingston, Guatemala

Phenotype		Genotype	
Group	Frequency (%)	Gene	Frequency (%)
O	52.3	O	72.32
A	19.9	A	13.69
B	22.2	B	15.03
AB	5.7	...	...

RESULTS

The mean and standard deviation of values for weight, height, thickness of skinfold over the triceps, blood pressure and serum cholesterol are given in Table I. Average heights and weights for each decade beyond thirty years of age remained relatively constant. Skinfold thickness was remarkably constant among adults of both sexes, although the women showed both higher values and greater variation. Women over thirty years of age also had consistently higher mean blood pressure readings. Almost half of those over forty years of age had blood pressure readings above 140/90 mm. Hg, and twelve of ninety-nine had values on or above the lower limits of hypertension by the criteria of Master et al.¹⁶

Serum cholesterol levels were higher in females at all ages and showed a tendency to in-

crease in women over fifty years of age. There were three cases of hypercholesterolemia in the 182 subjects studied. One, a twenty-three year old man, had a value of 339 mg. per 100 ml. The other two were women fifty-six and seventy years of age, with 452 and 369 mg. per 100 ml. of serum cholesterol, respectively. Analysis of variance indicated that the over-all differences between men and women were significant for all measurements, as were the age trends among adults for weight and blood pressure, but not for skinfold thickness or serum cholesterol levels.

The ABO phenotype distribution and the calculated genotype frequencies are shown in Table II. The frequency of blood type O was 52.3 per cent, those of types A and B were 19.9 and 22.2 per cent, respectively, and type AB was found with a frequency of 5.7 per cent.

Table III gives the average daily dietary intake of the Black Carib population. Adequate calories, total protein and animal protein were consumed. Of the 67 gm. of total fat, 33 gm. were of animal, and 34 gm. of vegetable origin. Coconut fat contributed 13 gm. daily. Thirty-one per cent of calories were derived from fat, 6 per cent of which came from coconut fat. The saturated, monounsaturated and polyunsaturated fatty acids in the diet amounted to 28.7, 24.9 and 6.3 gm. daily, respectively, and contributed 13.3, 11.5 and 2.9 per cent of the total calories. The diets supplied only about a

TABLE III
Dietary Intake of Black Caribs in Livingston, Guatemala

Nutrients	Average Daily Intake (mg.)	Nutrients	Average Daily Intake (gm.)	Per cent of Calories
Calories.....	1949	Total protein.....	53.3	10.9
Vitamins.....		Animal protein.....	23.1	4.7
Vitamin A*.....	1053	Carbohydrates.....	289.4	59.4
Thiamine.....	0.79	Total fat.....	66.6	30.8
Riboflavin.....	0.39	Animal fat.....	32.6	15.1
Niacin.....	8.38	Coconut fat.....	13.2	6.1
Vitamin C.....	56	Fatty acids.....	63.3	29.2
Minerals		Saturated.....	28.7	13.3
Calcium.....	220	Unsaturated.....	31.2	14.4
Phosphorus.....	790	Monounsaturated.....	24.9	11.5
Iron.....	12	Polyunsaturated.....	6.3	2.9

* International units.

quarter of the recommended allowances for calcium, vitamin A and riboflavin, and slightly less thiamin, niacin and ascorbic acid than recommended.

The clinical examinations revealed few positive findings. Among the 182 persons examined, only one case each of angular stomatitis, cheilitis, abnormally red tongue and xerosis of the skin were noted. Follicular hyperkeratosis, common in most Guatemalan populations, was found in only two cases. The most suggestive positive signs were the occurrence of either hypertrophy or atrophy of the papillae of the tongue in four of the twenty preadolescents, eight of twenty-one adolescents and twenty-four of 141 adults. One preadolescent and five adults had some degree of nasolabial seborrhea.

Although increased vascularization and thickening of the bulbar conjunctiva were noted in a considerable proportion of this group, they were considered to be due to the effects of sun and dust rather than a deficiency. Forty-eight adults were noted to have marginal gingivitis associated with loss of teeth and poor dental hygiene; it was not of the generalized type associated with a dietary deficiency. The general physical appearance of the group was very good. None were classified as undernourished.

COMMENTS

Despite the apparent deficiency of certain vitamins in the diet, the clinical examinations gave the impression that the people in Livingston were well nourished and not suffering from significant deficiencies of specific nutrients. The body measurements also supported this impression. Adult heights were not markedly different from those reported for the populations in the United States¹⁷ and Canada.¹⁸ While mean body weights were lower than those for the United States,¹⁷ few subjects were markedly underweight and some were obese. With the single exception of the group of women age fifty to fifty-nine years, the skinfold measurements were within normal limits for well nourished populations, although they averaged less than the mean values reported in the United States.^{17,19}

The serum cholesterol levels among the Black Caribs are much higher than those found in the population of any other low income group thus far studied in Central America, although the general living conditions are not markedly different from those of some populations in which relatively low serum cholesterol values are found.

Since the diet of the Black Caribs in amount and variety of fat and protein approaches, although it does not equal the diet of upper socioeconomic groups in the area, the present data seem to present one more example of cholesterol levels paralleling dietary calorie, fat and protein differences rather than racial, climatic or other non-dietary factors. Even though the diets of the study group appeared to be deficient in calcium, riboflavin and vitamin A, there is no indication that this influenced either physical appearance or cholesterol levels.

It has been previously noted that persons of Negro origin living in this hemisphere have a relatively high frequency of hypertension.^{20,21} In Panama, this is particularly striking because they are living alongside a mestizo group with a very low prevalence of hypertension. There has been much speculation as to the relative role of genetic and environmental factors.²¹ The present frequency of hypertension in nearly 10 per cent of adults over forty years of age living under conditions apparently identical with some Indian and mestizo populations with a low prevalence of hypertension is suggestive of a genetic susceptibility. As Bays and Scrimshaw²² have pointed out, however, comparative data of this type are subjected to many fallacies and do not afford conclusive evidence of a genetic effect.

SUMMARY

A nutritional and dietary survey was conducted among the Black Carib population of Livingston. Eighty-eight males and ninety-four females ranging in age from six to eighty-nine years were examined, and blood samples were obtained for blood typing and serum cholesterol determinations. The diets were markedly low in vitamin A, riboflavin and calcium, although upon clinical examination, no evidence of severe nutritional deficiencies

was found. Body height, weight and arm skinfold thickness indicated a relatively well nourished population, although nearly 10 per cent of those over forty years of age had significantly elevated blood pressures. The serum cholesterol levels were found to be considerably higher than those observed among other rural lower income Guatemalans, and paralleled the higher total fat and greater contribution of saturated and monounsaturated fatty acid in their diets. Their serum cholesterol and dietary protein and fat intakes were only slightly lower than those of upper income persons in Guatemala and populations studied in the United States. Serum cholesterol levels observed in the Black Caribs are higher than in other Guatemalans living under similar circumstances. This is believed to be due primarily to dietary differences most probably in fat and proteins rather than to other environmental or social factors.

REFERENCES

1. MANN, G. V., MUÑOZ, J. A. and SCRIMSHAW, N. S. The serum lipoprotein and cholesterol concentrations of Central and North Americans with different dietary habits. *Am. J. Med.*, 19: 25, 1955.
2. SCRIMSHAW, N. S., TRULSON, M., TEJADA, C., HEGSTED, D. M. and STARE, F. J. Serum lipoprotein and cholesterol concentrations. Comparison of rural Costa Rican, Guatemalan and United States populations. *Circulation*, 15: 805, 1957.
3. SCRIMSHAW, N. S., BALSAM, A. and ARROYAVE, G. Serum cholesterol levels in school children from three socio-economic groups. *Am. J. Clin. Nutrition*, 5: 629, 1957.
4. TEJADA, C. and GORE, I. Comparison of Atherosclerosis in Guatemala City and New Orleans. *Am. J. Path.*, 33: 887, 1957.
5. TEJADA, C., GORE, I., STRONG, J. P. and MCGILL, H. C. Comparative severity of atherosclerosis in Costa Rica, Guatemala and New Orleans. *Circulation*, 18: 92, 1958.
6. FLORES, M. and REH, E. Estudios de hábitos dietéticos en poblaciones de Guatemala. I. Magdalena Milpas Altas. *Bol. Ofic. san. panam.* (supp. 2), p. 90, 1955.
7. MÉNDEZ, J., SCRIMSHAW, N. S. and FLORES, M. Serum cholesterol levels of North American women living in Guatemala City. *Am. J. Clin. Nutrition*, 7: 590, 1959.
8. TAYLOR, D. M. Black Carib of British Honduras. New York, 1951. Wenner-Gren.
9. SOLIEN, N. L. West Indian characteristics of the Black Carib. *Southwestern J. Anthropology*, 15: 300, 1959.
10. MUÑOZ, J. A. and PÉREZ-AVENDAÑO, C. El examen clínico nutricional. I. Signos físicos. *Rev. Col. med. Guatemala*, 5: 117, 1954.
11. Instituto de Nutrición de Centro América y Panamá: Tercera edición de la tabla de composición de alimentos de Centro América y Panamá. *Bol. Ofic. san. Panam.* (supp. 1), p. 129, 1953.
12. HARDINGE, M. G. and CROOKS, H. Fatty acid composition of food fats. *J. Am. Dietet. A.*, 34: 1065, 1958.
13. ABELL, L. L., LEVY, B. B., BRODIE, B. B. and KENDALL, F. E. A simplified method for the estimation of total cholesterol in serum and demonstration of its specificity. *J. Biol. Chem.*, 195: 357, 1952.
14. Recommendations concerning body measurements for the characterization of nutritional status. In: *Body Measurements and Human Nutrition*, p. 1. Edited by Brozek, J. Detroit, 1956. Wayne University Press.
15. MOURANT, A. E. The Distribution of the Human Blood Groups, p. 215. Springfield, Ill., 1954. Charles C Thomas.
16. MASTER, A. M., DUBLIN, L. I. and MARKS, H. H. The normal blood pressure range and its clinical implications. *J. A. M. A.*, 143: 1464, 1950.
17. OHLSON, M. A., BIESTER, A., BREWER, W. D., HAWTHORNE, B. E. and HUTCHINSON, M. B. Anthropometry and nutritional status of adult women. In: *Body Measurements and Human Nutrition*, p. 79. Edited by Brozek, J. Detroit, 1956. Wayne University Press.
18. PETT, L. B. and OGILVIE, G. F. The Canadian weight-height survey. In: *Body Measurements and Human Nutrition*, p. 67. Edited by Brozek, J. Detroit, 1956. Wayne University Press.
19. NEWMAN, R. W. Skinfold measurements in young American males. In: *Body Measurements and Human Nutrition*, p. 44. Edited by Brozek, J. Detroit, 1956. Wayne University Press.
20. KEAN, B. H. Blood pressure studies on West Indians and Panamanians living on the Isthmus of Panama. *Arch. Int. Med.*, 68: 466, 1941.
21. Scrimshaw, N. S., CULVER, G. A. and STEVENSON, R. A. Toxic complications of pregnancy in Gorgas Hospital, Panama Canal Zone, 1931-1945. *Am. J. Obstet. & Gynec.*, 54: 428, 1947.
22. BAYS, R. P. and SCRIMSHAW, N. S. Facts and fallacies regarding the blood pressure of different regional and racial groups. *Circulation*, 8: 655, 1953.