

Cholesterol Levels of Maternal and Fetal Blood at Parturition in Upper and Lower Income Groups in Guatemala City

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POPULATION DIFFERENCES in serum cholesterol levels have received attention because of the association of high values with the prevalence of atherosclerosis in certain areas. The Guatemalan and Costa Rican lower income populations have been found to be relatively free of the complications of atherosclerosis^{1,2} and to have lower serum cholesterol values than persons in either the upper income groups in Guatemala^{3,4} or the general population groups in the United States and western Europe.⁵ Although similar serum cholesterol differences have been observed among school children in Guatemala⁶ no comparable information is available for children under school age in this region. In the present study the total serum cholesterol levels of two widely different socioeconomic groups of newborn infants and their mothers at the time of delivery in Guatemala City were determined.

MATERIAL AND METHODS

Twenty-one mothers who, as wives of business and professional men and patients of pri-

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vate physicians, represented an "upper socioeconomic group," and 23 women delivered in a general hospital for charity patients in Guatemala City who belonged to a "lower socioeconomic group," were studied. Blood samples were obtained within 5 minutes after delivery by venipuncture of the mothers and by drainage from the placental end of the umbilical cord. Samples of cord blood were obtained at delivery of an additional 21 women of similar lower socioeconomic status in the maternity hospital of the Guatemalan Social Security System. Mothers with illnesses or obstetrical complications were excluded. Thirty days after delivery, a second blood sample was obtained from 20 of the same women chosen equally from each of the two socioeconomic groups. Serum cholesterol levels were determined in all samples by the method of Abell et al.⁷ adapted in this laboratory to be performed with 0.05 ml. of serum.

For comparison with information already available for women in the upper socioeconomic group,⁸ dietary data were obtained from the ten women selected for postpartum blood sampling from the lower socioeconomic group. Each woman was interviewed daily for one week to determine her food consumption pattern. The calorie, protein, and total fat content of the diets was calculated using the food composition table prepared by INCAP.⁹ For the estimation of the dietary fatty acid content the tables of Hardinge and Crooks¹⁰ and Hayes and Rose¹¹ were used.

RESULTS

As shown in Table I, the total serum choles-

TABLE I
Body Weight and Serum Cholesterol Levels of Newborn Infants from Mothers of Two Different Income Levels in Guatemala City

Group	Males					Females				
	Cholesterol (mg./100 ml.)			Birth weight (gm.)		Cholesterol (mg./100 ml.)			Birth weight (gm.)	
	No. of Cases	Mean	S. D.*	Mean	S. D.	No. of Cases	Mean	S. D.	Mean	S. D.
Upper income	8	52	16	3650	451	13	65	18	3283	354
Lower income	20	56	8	3063	414	24	71	21	2916	365

*Standard deviation.

terol levels of the newborn infants gave no indication of significant differences among babies born to mothers of the two groups. The combined values for both sexes were 60 mg. for those in the upper income group and 63 mg./100 ml. for those in the lower income group. Nevertheless, the newborn infants of the mothers in the upper socioeconomic group were consistently heavier than those of mothers in the lower socioeconomic group.

The differences in serum cholesterol levels between sexes, were significant ($P < 0.01$)*; the males had a tendency to lower levels (averages of 52 and 56 mg./100 ml.) than females (averages of 65 and 71 mg./100 ml.). In both groups newborn male babies appeared heavier at birth than female babies, a difference which was more apparent in the upper socioeconomic group.

The cholesterol levels for selected samples from the two groups of mothers at parturition and 30 days afterwards are shown in Table II. In the upper socioeconomic group there was a slightly higher mean serum cholesterol concentration at the time of delivery, 255 mg., compared with 231 mg./100 ml., but this difference was not statistically significant. There is no indication of a significant correlation between the mother's serum cholesterol level at parturition and the level observed in their children at birth ($r = 0.15$, 42 D.F.). In women in the lower income group there was a significant decrease postpartum in serum cholesterol levels from averages of 238 to 202 mg./100 ml. For women in the upper income group the values of

* The difference observed still proved significant after due consideration of the heterogeneity of variances.

TABLE II
Serum Cholesterol Levels (mg./100 ml.) of Guatemalan Mothers in Two Different Income Groups

Group	At Delivery			30 days Postpartum		
	No. of Cases	Mean	S. D.*	No. of Cases	Mean	S. D.
Lower income	23	231	48	10	202	71
Upper income	21	255	59	10	246	18

* Standard deviation.

255 at delivery and 246 mg./100 ml. thirty days later showed essentially no change.

The estimated daily dietary intake of women in the socioeconomic groups studied are shown in Table III. In the lower income group, fat furnished 20 per cent of the total caloric intake and in the upper income group 37 per cent. In both groups 96 per cent of the total fat intake

TABLE III
Estimated Daily Dietary Intake of Guatemalan Women

	Lower Income Group	Upper Income Group
Calories	1906	2475
Proteins (gm./day)		
Animal origin	22	39
Plant origin	39	31
Fats (gm./day)		
Animal origin	25	46
Plant origin	18	55
Per cent of calories derived from fat	20	37
Fatty acids (gm./day)		
Saturated fatty acids	16	35
Unsaturated fatty acids		
acids	24	58
Oleic acid	17	46
Essential fatty acids	6	9

was accounted for in the calculation of the fatty acid composition of the diet. The saturated fatty acid content was much higher in the diets of the upper socioeconomic group. Although the unsaturated fatty acid content was also greater in the same group, this fraction was mainly oleic acid. The ratio of saturated fatty acid to essential fatty acid was 4.0 in the upper income group and 2.7 in the lower socioeconomic group. The amounts of protein of animal origin in the diets of mothers in the upper income group were also much greater than those of the mothers in the lower socioeconomic group, although there was little difference in their total protein consumption.

COMMENTS

In contrast to the differences in serum cholesterol levels reported for Guatemalan school children in various socioeconomic groups,⁶ the average serum cholesterol levels of children at birth do not vary with socioeconomic status according to the data presented. Moreover, the values in the newborn are very low as compared with those previously found in children and adults. At birth cholesterol values appear to be higher in females than in males, although no sex differences in serum cholesterol levels were observed in school children.

The finding that serum cholesterol values in the newborn are independent of their mothers' cholesterol levels, agrees with the reports of Slemon and Stander¹² and Bersohn and Wayburne.¹³ Similarly, in newborn children of European and African mothers in South Africa¹³ there was no significant difference in serum cholesterol levels in spite of marked differences in the mothers' cholesterol levels, dietary intake and socioeconomic status. These results are presumably due to the fact that the placenta is relatively impenetrable to fat and lipids. As Slemon and Stander¹² suggest, fetal fat is probably synthesized from glucose which is freely supplied by the mother to meet the demands of her offspring.

Changes in serum cholesterol must take place at a relatively early age, since differences among the various socioeconomic groups may be marked by the time children have reached school age. It is probable that the differences

begin soon after weaning, but this needs confirmation by direct observation. The values reported for newborn infants are, in almost all studies, much lower than those of adults, but there is no agreement as to the rate of increase. Gordon and Cohn¹⁴ demonstrated that the average serum cholesterol level at birth was about 89 mg./100 ml., remaining stationary in the first week of life, increasing during the first year to 136 mg. and reaching a value of 169 mg./100 ml. by the sixth year. Similarly Offenkrantz and Karshan¹⁵ have noted a gradual rise in the cholesterol level in plasma from the age of two months to levels essentially the same as reported for adults, at seven years. Sperry,¹⁶ on the other hand, reports that after a pronounced increase during the first four days of life, the serum cholesterol levels tend to remain constant. Hodges et al.¹⁷ report no significant differences in serum cholesterol values between children and adults, and describe values of 200 mg./100 ml. in children two to six months of age. All these studies were made in the United States. The values reported in Sweden by Josephson and Gyllensward¹⁸ for newborn infants are higher than those of other investigators^{14,19-21} and are also at variance with the values described in this paper.

Although a comparison of the serum cholesterol values of pregnant women with those of nonpregnant women of the same age and socioeconomic status indicated that serum cholesterol levels in both groups tended to become elevated during pregnancy, the increase was more pronounced in the lower socioeconomic group in which the levels were low to begin with. Mothers of both socioeconomic groups, selected at random, also showed a decrease in total serum cholesterol one month after parturition, although this observed reduction in serum cholesterol levels was significant only for the mothers in the lower socioeconomic group. Oliver and Boyd²² had previously reported that cholesterol values in pregnant women return to nonpregnant levels by five months after parturition. Obviously the failure to find a significant difference between maternal values in the two socioeconomic groups at parturition is due to the smaller increase during pregnancy in the group with higher initial values.



SUMMARY

Serum cholesterol levels of 37 newborn girls (68 mg./100 ml., S.D. 20) in Guatemala City were significantly higher than those in 28 newborn boys (55 mg./100 ml., S.D. 11). Although two different diets were studied, no tendency was observed for the infant's serum cholesterol levels to be related to the mother's, socioeconomic group, diet or serum cholesterol levels at parturition. Serum cholesterol levels rose during pregnancy in the mothers of both groups but the increase was more pronounced in the lower socioeconomic group. A corresponding drop in cholesterol was observed 30 days postpartum in the mothers in each group, but proved statistically significant only for those in the lower income category.

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