

# Fat Metabolism in Juvenile Diabetes Mellitus

By

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All lipide fractions of the blood are elevated in metabolic disturbances of diabetic origin. The beta lipoprotein value is also significantly higher than in children with normal metabolism. In cases of pathologically increased fatty acids the increment of saturated fatty acids exceeds that of essential fatty acids. The difference is most pronounced in the fraction of free fatty acids.

A disturbance of fat metabolism is a regular concomitant of diabetes. Glycerophosphate, necessary for the synthesis of fat, is provided by glycolysis. If something prevents glucose from being incorporated by the cells, free fatty acid is not converted into lipide and its level in the blood will rise, a phenomenon due to that fatty acids passing into or formed in the liver do not require glycerophosphate, since glycerol, released by the splitting of fat, is converted by the liver into glycerophosphate by means of glycerokinase. It is in the form of lipoprotein that fats pass from the liver into the circulation. Lipoprotein can be utilized by the adipose tissue only if lipoproteinase, mobilized by insulin, splits off the protein.

The present study had the object to examine general conditions regarding lipides as also their qualitative changes in juvenile diabetes mellitus.

## MATERIAL AND METHODS

The material consisted of 20 diabetic children aged 5 to 18 years. Blood samples were taken after a fasting of 10 hours. In 10 cases gas chromatography was also done. The value for total serum lipide was determined according to SWAHN [16] and that for beta lipoprotein according to WATSON [18]. Of the blood lipide fractions, triglyceride was estimated according to LAURELL [10], phospholipide according to BARTLETT [3], free fatty acid according to DOLE and MEINERTZ [5], cholesterol ester according to RAPPAPORT and EINHORN [12].

For gas chromatography, serum lipide was extracted by the method of FOLCH et al. [7] and purified by 0.02 N hydrochloric acid (vol. 0.2). Two thirds of the extract were separated into the said fractions on 20×20 cm glass plates with thin Kieselgel G-Merck layer after activation at 110 °C and preliminary runs. The solvent was petroleum ether : diethylether : acetic acid (85 : 15 : 3).

The blood lipide fractions and the residual extract were converted into methyl-ester [1.0] All solvents were purified and



distilled. Distribution of the fatty acids was estimated at 170°C in heptane solution of the methyl esters on a 6-foot high Hewlett Packard 402 Gas Chrom Q 8% DEGS column [8, 15].

### RESULTS

As can be seen from Table I, the blood level of lipides was significantly higher in the diabetic children than in the normal controls.

the value was lower in one case, while the values for lipoproteins and total lipides were above the normal. It follows that in diabetes the high total lipide value is associated with a significantly high beta lipoprotein value.

The level of unsaturated fatty acids in the various lipide fractions was likewise determined.

Table II shows only the values for arachidonic and linoleic acid since no

TABLE I  
Blood lipide level in diabetic children

	Normal value	Diabetes
Total lipides	430–750 mg per 100 ml	813 ± 76
Triglyceride	10–140 mg per 100 ml	226 ± 47
Free fatty acid	0.3–0.6 mM/l	1.287 ± 0.227
Phospholipide	175–202 mg per 100 ml	236 ± 12
Cholesterol ester	90–180 mg per 100 ml	182 ± 12
Beta lipoprotein	360–640 mg per 100 ml	664 ± 37

The controls used for this study [3, 17, 18] displayed values within normal limits. KRÁMER and BALOGH [9] obtained similar results.

The correlation between the fasting beta lipoprotein value and that of total lipides was likewise studied.

Results, summed up in Fig. 1, were approximated in the form of a straight line by means of regression analysis. The general formula of the regression line is thus  $y = ax + b$ , where  $a = 571/1000$ , while the value of  $b$  is practically zero.

Only four of the examined cases fell into the normal zone (marked in Fig. 1 with dotted line). In the rest,

significant deviation was found in the other unsaturated acids. The quantitative decrease of acids containing unsaturated bonds was most marked in the fraction of free fatty acids.

### DISCUSSION

In contrast to individuals with normal metabolism the blood level of lipides is elevated in diabetic patients. The elevation applies to all fractions, a phenomenon in harmony with earlier findings [2]. High total lipide values were found to go hand in hand with a high beta lipoprotein level.



TABLE II  
Unsaturated fatty acid level in diabetic children

	Linoleic acid		Arachidonic acid	
	normal	diabetes	normal	diabetes
Total lipides	27.75 ± 5.13	19.5 ± 3.7	6.24 ± 1.14	4.0 ± 0.74
Cholesterol ester	47.08 ± 0.99	33.9 ± 6.0	5.3 ± 0.52	2.9 ± 0.74
Triglyceride	12.24 ± 0.72	7.4 ± 0.57	3.06 ± 0.49	1.2 ± 0.47
Phospholipide	21.53 ± 0.98	10.7 ± 3.4	3.06 ± 0.21	2.1 ± 0.83
Free fatty acid	13.14 ± 0.80	6.1 ± 0.77	2.39 ± 0.22	below 1%

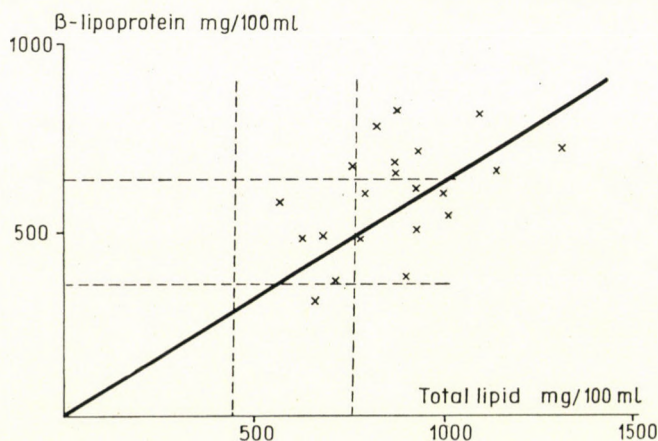


FIG. 1. Beta-lipoprotein value in dependence on total lipide level

The relatively low level of essential fatty acids in the fractions is a noteworthy feature. It has been pointed out by several authors [1, 6, 13, 14] that a quantitative increase in the fatty acids of juvenile diabetics is accompanied by a decrease in the amount of unsaturated acids. The higher the number of unsaturated bonds in the fatty acid, the lower its percentage value reference to the total sum of fatty acids.

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