THE EFFECT OF SHORT-TERM PROTEIN DEPRIVATION ON PLASMA LIPIDS OF NIGERIAN ADULTS

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ABSTRACT

The effect of short-term deprivation (10 days) on plasma cholesterol, triglyceride, phospholipids, free-fatty acids, high density lipoprotein cholesterol (HDLC) and low density lipoprotein cholesterol (LDLC) were investigated in seven medical students (Urban adults) aged between 21 and 24 years and eight Village Adults aged between 30 and 40 years.

There were significant falls in all the plasma lipids except free fatty acids and the plasma triglycerides of the village adults. Plasma proteins in all subjects were reduced while the fall in albumin was significant only for the urban adults.

Positive correlation of M body fat with plasma lipids was only significant for HDLC in the urban adults and triglycerides for the village adults. There was no correlation between plasma proteins and lipids except with HDLC for village adults. The village adults however, were observed to show a less stressful effect on plasma lipids than the Urban adults though they reacted to the short-term deprivation more or less in the same manner.

The fall in plasma lipids have been attributed to a fall in the lipo-protein fractions which are the chief carriers of cholesterol, triglycerides and phospholipids while free-fatty acids were not affected within the short period of the experiment.

Key words: Protein Deprivation Plasma Lipids

Introduction

The setting of safe dietary allowances for protein by Food and Agricultural Organisation/World Health Organisation (FAO/WHO) are based in part on estimates of obligatory nitrogen losses in which protein is deprived on a short-term basis. A subject deprived of protein is unable to maintain nitrogen equilibrium leading to a steady depletion of body proteins. Associated with this condition are changes in body cell mass and a decreased synthesis and fractional turnover of some secretory proteins such as albumin and a decrease in the size of the body urea pool. However, the effect of this deprivation on lipid metabolism has often been ignored. Maclean *et al*[2] reported that protein deficiency might interfere with the optimum utilization of energy by interfering with fat absorption. It is also clear that a diet low in protein will result in poor lipid metabolism since nutrient requirements appear to be inter-dependent. The deficiency or excess of one nutrient can modify the utilization of another.

Therefore, our understanding of the changes in the general body metabolism that occur with altered nutrient intake is basic to the critical evaluation of approaches used for estimating human protein and in different population groups. The purpose of the present study was to determine the effect of a short-term protein deprivation on the plasma lipids of some Nigerian rural and urban adults.

Experimental

Subjects and Experimental Design

Seven College Students of the College of Medicine, University of Ibadan aged between 21 and 24 years and eight rural adults in Osegere (a village 45km from the University of Ibadan, Ibadan) aged between 30 and 40 years consented to participate in the study after been fully informed of the purpose, nature and design of experimentation.

The subjects were free of any abnormalities detectable by medical history, physical examination and routine laboratory tests.

The village subjects (Rural Adults) were camped together at the rural Health Centre throughout the period of the study under close medical supervision while the usual level of physical activities were maintained through in-door games, story telling, light cleaning etc. whereas the medical students (Urban Adults) were studied on an outpatient basis living in the nearby medical hostel in the hospital premises and under close medical supervision. This group of subjects continued their normal daily routines which included their full academic schedules but refrained from any unusual physical activity.

The diet was essentially proteinfree being less than 0.1g protein/kg body weight and calorie intake maintained at 45 Kcal/kg body weight/day. Tables I & II show the diet composition of the rural and urban groups respectively. Diets were standadized based on local food usually consumed and given in a meal pattern at 8–9 a.m. 1.00–2.00 p.m. and 7.00–8.00 p.m. Complete vitamin and mineral supplements were provided to ensure no vitamin and mineral were lacking.

The experimental period lasted ten days and during this period subjects were required to adhere to the experimer eat only food prepared by the consumed under her supervis

Samples and Measurements

Daily weight of each su standardized conditions (pre- voiding and stripped to unde obtained before breakfast. An measurements like height, a rence, skinfold thickness mea biceps, hiceps, subscapular ar sites according to the techniqu [4] were taken at the beginnin the study.

From the anthropometric n arm muscle circumference, index[5] and percentage body calculated.

Venous blood samples before breakfast at the begin of the experimental dietary pe was separated and stored a assayed for lipids and protein

Analytical Procedure

Plasma proteins was meas biuret method[8] and albumin b of Doumas and Billis[9] based ing capacity of plasma albumi cresol green.

Plasma total cholesterol w by the modification of the me and Berguist,[10] phospholip method of King and Woole ride[12], free fatty acid,[13] high protein cholesterol[14] while lipo-protein cholesterol wa indirectly by the method of *al.*[15]

All analytical methods we zed and validated with the u serum (Wellcome Series) at th ten batch determination.

TABLE I

THE COMPOSITION OF THE LOW PROTEIN DIET (GM/PERSON/DAY) FOR RURAL ADULTS

Ingredients	*Amount (GM)*	*Protein (G)*	*Energy (KCAL)*
Cassava (Grated)	200	2.0	674
Custard Flour	100	0.6	354
Refined Cane Sugar	30	–	120
Pepper Dried	2	0.24	6.6
Tomato Fresh	20	0.2	4.4
Onion Fresh	20	0.24	8.2
Red Palm Oil	40	–	360
Okro	28	1.4	8
Orange Drink	360	–	360
Caloreen Powder (Glucose Polymer)	100	–	400
Total		4.68	2295.2

TABLE II

THE COMPOSITION OF THE LOW PROTEIN DIET (GM/PERSON/DAY) FOR URBAN ADULTS

Ingredients	*Amount (GM)*	*Protein (G)*	*Energy (KCAL)*
Cassava (Grated)	200	2.0	674
Custard Flour	100	0.6	354
Refined Cane Sugar	50	–	200
Pepper Dried	2	0.24	6.6
Tomato Fresh	20	0.2	4.4
Onion Fresh	20	0.24	8.2
Red Palm Oil	40	–	360
Okro	28	1.4	8
Orange Drink	360	–	360
Caloreen Powder	200	–	800
Total		4.68	2775.2

Statistical Analysis

Statistical analysis of results was carried out with the aid of the computer facilities of the International Institute of Tropical Agriculture (IITA) Ibadan, Computing Centre using the SPSS Programme (IBM). The standard Student t-test was used to test differences. A difference was considered to be statistically significant if P-Value was less than 0.05.

Results

Body Weight

The daily weight changes
the period of experiment is
illustrated in Fig. I A conti
the body weight was found
the study in both groups. The
for the urban adults did no
the fall of 2.955% observed f
adults ($P<0.05$).

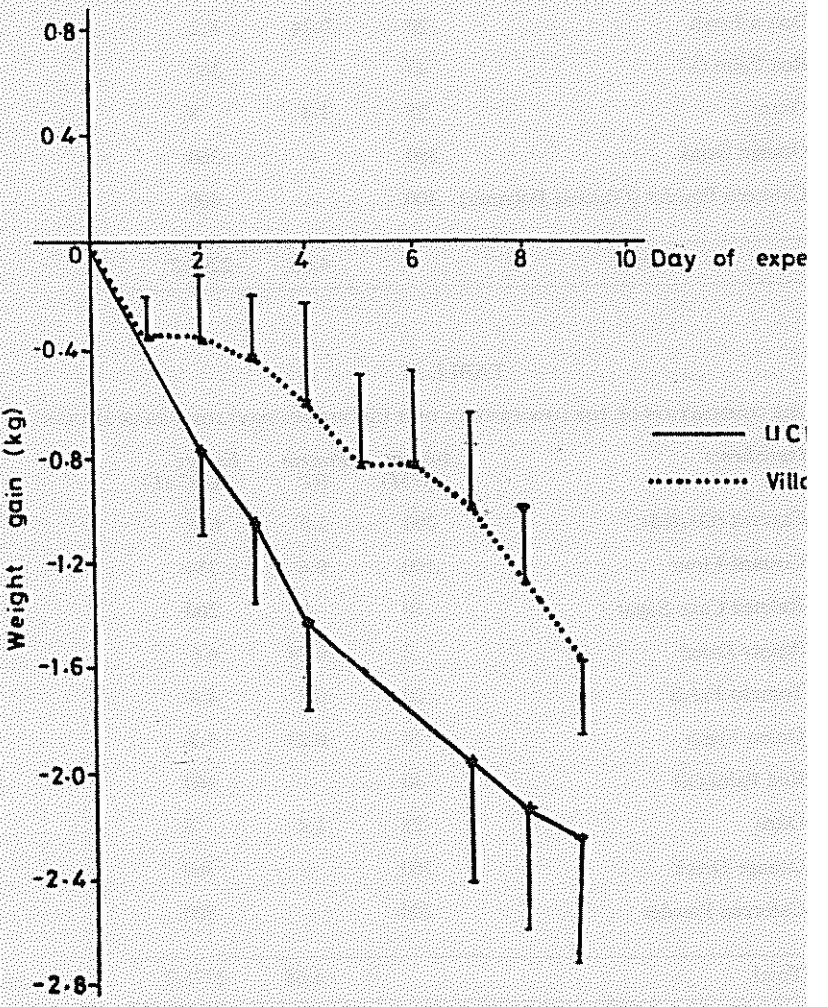

Fig. 1: Weight changes During The Low Protein Period

Height, Weight, Quatelet Indices, Muscle Circumference and Percentage Body Fat

The mean heights, weights, quatelet indices and muscle circumference are shown in Table III. On the average, the rural adults were another shorter and weighed less than the urban adults. Mean quatelet index and percentage body fat were higher ($P<0.005$) for urban adults but the falls observed in both groups were not statistically different. Muscle circumference was not different in both groups ($P<0.1$) but the fall at the end of the low protein diet was significant only for the urban adults. However, the different fall in muscle circumference was found not statistically different ($P<0.5$).

Protein and Albumin

Table IV shows the fall in the plasma proteins and albumin. Plasma proteins of all the subjects were reduced but the reduction in albumin was significant only for the urban adults. However, a higher reduction in both proteins and albumin was observed for the urban adults ($P<0.001$).

Lipo-Proteins

Table V represents the effect of the low-protein diet on plasma lipo-proteins. Both HDLC and LDLC were reduced and the percentage falls of these lipo-proteins at the end of the dietary regime were not statistically different between the two groups.

Cholesterol, Triglyceride, Phospholipids and Free Fatty Acids

Table VI shows the effect of the protein free diet on mean plasma cholesterol, triglycerides, phospholipids and free fatty acids.

Though the mean plasma cholesterol triglyceride and phospholipids as well as the falls observed at the end of the protein free diet were higher for the Urban adults, yet they were not statistically different from that of the rural adults.

The reduction in plasma triglyceride at the end of the protein free diet was significant only for the urban adults.

Free fatty acids however, showed a significantly higher mean plasma level for the urban adults while the falls in values at the end of the diet regime for both groups were not significant. Percentage fall in both groups did not differ statistically.

Relationship between % body Fat and Plasma Lipids

Table VII shows the correlation coefficient of lipids with percentage body fat with their probabilities. A significant positive correlation was observed with high density lipo-protein cholesterol.

This correlation was still maintained even at the end of the low-protein diet but lower for the urban adults. On the other hand the village adults showed a positive correlation with higlyceride at the beginning and end of the protein free diet.

Correlation Between Proteins and Albumin to Plasma Lipids

The rural adults showed a positive correlation between proteins and albumin with plasma HDLC, the correlation however was not significant for albumin at the end of the low protein diet (Table VIII).

TABLE III

ANTHROPOMETRIC CHARACTERISTIC OF SUBJECTS

	RURAL ADULTS		*URBAN ADULTS*
Study	*Day 1*	*Day 10*	*Day 1*
MEAN HEIGHT (M)	1.64=0.03**	1.64=0.08	1.79=0.03
MEAN WEIGHT (KG)	51.70=2.20**	50.11=2.02	67.03=2.45
MEAN QUATELET INDEX (KG/M²)	19.27=0.31**	18.69=0.26*	21.26=0.53
MEAN MUSCLE CIRCUMFERENCE	24.97=0.85	24.67=0.47	26.10=0.54
MEAN % BODY FAT	10.90=0.48**	10.31=0.49*	13.44=0.52

* Significantly lower than Day 1 at P<0.05
* Significantly lower than Value for Urban Adults at P<0.05
*** Fall significantly lower than for Urban Adults at P<0.05

TABLE IV

PROTEIN FREE DIET AND CHANGES IN PLASMA PROTEINS AND ALBUMIN

	RURAL ADULTS		*URBAN ADUI*
Study	*Day 1*	*Day 10*	*Day 1*
PROTEIN (9g/dl)	6.92**	6.72(***)	7.70
S.E.	0.18	0.18	0.22
ALBUMIN (g/dl)	3.88**	3.81***	4.42
S. E.	0.11	0.10	0.13

* Significantly lower than Day 1 at P<0.05
** Significantly lower than Value for Urban Adults P<0.05
*** Fall Significantly lower than for Urban Adults P<0.05

TABLE V

EFFECT OF THE PROTEIN DIET ON PLASMA HIGH DENSITY LIPO-PROTEIN CHOLESTEROL (HDLC) AND LOW DENSITY LIPO-PROTEIN CHOLESTEROL (LDLC)

	RURAL ADULTS		*URBAN ADULTS*	
	Day 1	*Day* 10	*Day* 1	*Day* 10
MEAN LDLC (mg/dl)	93.68	79.06*	108.65	78.44*
S. E.	5.49	4.22	10.54	7.57
MEAN HDLC (mg/dl)	48.30	46.02*	53.42	47.33*
S. E.	0.71	0.87	3.11	3.10

Significantly lower than Day 1 $P<0.05$
**Significantly lower than Value for Urban Adults $P<0.05$
***Fall significantly lower than for Urban Adults $P<0.05$

TABLE VI

THE EFFECT OF THE PROTEIN DIET ON MEAN PLASMA TOTAL CHOLESTEROL, TRIGLYCERIDE, PHOSPHOLIPIDS AND FREE FATTY ACIDS

	RURAL ADULTS		*URBAN ADULTS*	
	Day 1	*Day* 10	*Day* 1	*Day* 10
MEAN TOTAL CHOLESTEROL (mg/dl)	159.48	142.10*	181.49	143.33*
S. E.	5.60	4.10	10.18	5.97
MEAN TRIGLYCERIDES (mg/dl)	87.47	85.13	97.05	87.71*
S. E.	2.41	5.10	5.40	3.78
MEAN PHOSPHOLIPIDS (mg/dl)	205.16	196.54*	217.43	203.18*
S. E.	6.14	3.73	6.27	6.64
MEAN FREE FATTY (ACIDS (mg/dl)	15.17**	13.87	19.18	19.00
S. E.	1.09	0.85	0.86	0.74

*Significantly lower than Day 1 at $P<0.05$
**Significantly lower than Value for Urban Adults $P<0.05$
***Fall significantly lower than Urban Adults $P<0.05$

TABLE VII

CORRELATION CO-EFFICIENTS OF LIPIDS WITH PERCENTAGE BODY FAT DURING LOW PRO

% BODY FAT

	DAY 1		*DAY* 10
	r-VALUE	*P*	*r-VALUE*
CHOLESTEROL			
URBAN	-0.412	0.179	–0.6642
VILLAGE	–0.0054	0.495	–0.0657
HDLC			
URBAN	+0.8446	0.008*	0.7376
VILLAGE	–0.4744	0.117	0.0039
LDLC			
URBAN	+0.3503	0.221	–0.1602
VILLAGE	0.0652	0.459	–0.1685
TRIGLYCERIDE			
URBAN	–0.3054	0.253	–0.3628
VILLAGE	0.9418	0.000*	0.3351
PHOSPHOLIPIDS			
URBAN	0.4990	0.127	0.5928
VILLAGE	–0.3606	0.190	–0.2749
FREE FATTY ACID			
URBAN	0.3961	0.136	0.4753
VILLAGE	–0.3961	0.166	–0.2703

* Significant at $P<0.05$

TABLE VIII

CORRELATION OF PLASMA PROTEINS (AND ALBUMIN) WITH PLASMA LIPIDS FOR THE LOW PROTEIN DIET

	PROTEIN				*ALBUMIN*			
	DAY 1		*DAY 10*		*DAY 1*		*DAY 10*	
	r-VALUE	*P*	*r-VALUE*	*P*	*r-VALUE*	*P*	*r-VALUE*	*P*
CHOLESTEROL								
URBAN	−0.307	0.252	0.483	0.136	−0.106	0.410	0.653	0.056
RURAL	−0.237	0.285	−0.211	0.307	−0.326	0.215	−0.077	0.427
HDLC								
URBAN	0.199	0.334	0.080	0.043	0.117	0.040	0.333	0.232
RURAL	0.925	0.000*)	0.667	0.035	0.922	0.00*	0.591	0.061
LDLC								
URBAN	−0.343	0.600	0.362	0.212	−0.014	0.382	0.641	0.060
RURAL	−0.334	0.208	−0.299	0.235	−0.415	0.305	−0.193	0.323
TRIGLYCERIDE								
URBAN	−0.088	0.425	−0.172	0.355	0.041	0.465	0.139	0.038
RURAL	−0.364	0.137	−0.305	0.231	−0.439	0.138	−0.031	0.470
PHOSPHOLIPIDS								
URBAN	−0.163	0.363	−0.070	0.044	−0.374	0.204	−0.318	0.243
RURAL	−0.017	0.484	−0.058	0.445	0.105	0.401	0.083	0.422
FREE FATTY ACIDS								
URBAN	−0.346	0.203	0.047	0.460	−0.312	0.247	0.463	0.147
RURAL	−0.116	0.391	−0.103	0.321	−0.80	0.425	0.376	0.179

* Significant at $P < 0.05$

Discussion

In Table III, the mean heights, weights, quatelet's indices percentage body fat as well as the arm muscle circumference of the rural adults were slightly but significantly lower except the arm muscle circumference than that of urban adults. Though this difference is small it may indicate either genetic differences or previous nutritional status of the rural adults [16, 17, 18]. Both groups were affected more or less in the same way on the low protein diet by the decline in their body weight, Quatelet's indices and percentage body fat (index of energy reserve) which did not differ significantly from each other, though higher falls were recorded for all parameters for the urban adults. This implies that their socio-economic status, age and so rural adults play no role in the effect of protein deprivation on a short-term basis on their physical measurements.

Plasma proteins and albumin are strong indicators of the nutritional state of proteins in man. Both urban and rural adults showed normal plasma levels with the urban adults having higher values. The reduction at the end of the low protein diet was significant for both protein and albumin except albumin in the rural adults. This probably is due to the fact that the effect of protein depletion during the low protein diet must have been more drastic in the urban adults while the rural adults showed a better adaptation to the low protein, since albumin is a good example of and adaptive mechanism to low protein intake [19].

The Urban adults exhibited mean values higher than those found in the rural adults for all the plasma lipids except free fatty acids where the difference was not significant. However, the changes observed at the end of the lov diet for both groups did not dif ficantly, though higher falls were for the urban adults.

All plasma lipids except free fa for both urban and rural adult as the triglyceride of the rural a significantly.

The fall observed in the plas has been attributed to a fall in protein (HDLC) and (LDLC) the chief carrier proteins o triglyceride, cholesterol and phos Free fatty acids however, ar chiefly by albumin in plasma an not significantly affected be effect of the short-term depri albumin was not very severe d adaptive nature of albumin supply of amino acids [19]. Bot were affected more or less in way by the protein deprivatio rural adults showed a less stres probably due to a better adap a low protein diet.

A high correlation factor observed between HDLC an albumin and proteins for the ru High density lipo-protein has teins and any fall in protein syn to insufficient amino acid sup bring about a reduction in fraction. The correlation value ficantly with the low protein with albumin which is adapti

However, no other significa tion was obtained among the with protein and albumin fo groups. The Urban adults positive correlation with H percentage body fat. This c protective mechanism against lerosis since the higher the HD less the chances of the corona

The rural adults however, showed a positive correlation with triglyceride and percentage body fat. The higher the % body fat the higher the adipose stored and therefore the higher the triglyceride released.

From the present study it has been observed that lipids are also affected during the short-term protein deprivation used for obligatory nitrogen losses in estimating safe protein level of allowances.

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