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THE CORRELATIONS BETWEEN PLASMA GLUCOSE AND ESSENTIAL FATTY ACIDS LEVELS IN SUDANESE WOMEN AND THEIR NEONATES

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ABSTRACT

Essential fatty acids are polyunsaturated fatty acids (PUFA) which are not synthesize in body and should be provided in diets. The aims of our research is to estimate the correlation between the saturated, N -3 and N-6 fatty acids with blood glucose levels of non pregnant, pregnant Sudanese women and their neonates. 5 mls venous blood was dropped from the study groups, with detailed history and examination. Plasma lipids were extracted by Folch method and separated by Gas Liquid Chromatography (GLC). Blood glucose was measured using electronic glucometer. Data was analyzed by using SPSS version 16(SPSS, Chicago, IL, USA). Data was analyzed by using SPSS version 16(SPSS, Chicago, IL, USA). The results are given as mean and standard deviation (mean ± SD). In addition to P values and correlation for some parameters. Our study demonstrated a positive co relation between saturated and omega-6 fatty acids whereas a negative co relation was found between omega-3 fatty acids with glucose levels of the study groups.

KEYWORDS: LCPUFA Long Chain Polyunsaturated Acid, Omega-3 fatty acids, Omega-6 fatty acids, GLC gas liquid chromatography.

INTRODUCTION

Strictly, the term essential fatty acids (EFA) apply to both α-linolenic (C18:3; ALA) acid and linoleic acid (C18:2; LA) due to the fact that mammals cannot insert double bonds more proximal to the methyl end than the seventh carbon atom,[1] however, the term is now widely used to include fatty acids in the n-6 and n-3 PUFA families because of the indispensability of LCPUFA in brain, retinal development and infant growth.[2]

The metabolism of these essential fatty acids in humans takes place primarily in the liver but can also occur in other tissues such as brain, heart and lungs. Once obtained from the diet, both LA and ALA are desaturated and elongated to highly unsaturated members of their respective families. Although the pathways for the conversion of EFA are independent, they both compete and use the same desaturation and elongation enzymes, which are membrane-bound in the endoplasmic reticulum (ER) of many tissues. The conversion of LA to AA; and ALA to EPA takes place in the ER and consists of sequential alternating Δ^6 desaturation, elongation and Δ^5 desaturation steps by Δ^6 desaturase, elongase and Δ^5 desaturase. The Δ^6 desaturase is now accepted to be the rate limiting enzyme in the biosynthesis of long-chain n-6 and n-3 fatty acids, and its activity is altered or influenced by a variety of hormonal, dietary factors and EFA-deficient diets.[3] High intake of carbohydrates for example decreases Δ^6 desaturation activity, whereas proteins are activators.[4] Deficiency of trace minerals such as iron, zinc magnesium and selenium also reduce Δ^6 – and Δ^5 – desaturase activity.[5] Some hormone such as glucagon, epinephrine and thyroxin act as depressors of Δ^6 desaturase activity, while insulin acts as activator.[6] The affinity of Δ^6 desaturase for ALA appear to be greater than for LA. However, the high intake of LA and also greater concentration and lower concentration of ALA in tissue lipids results in greater conversion of n-6 fatty acids. LA too, limits oleic acid synthesis by inhibiting desaturation of stearic acid.

The fatty acid composition of the cell membrane is a dynamic system, and the regulation mechanisms are not fully understood. Both genetic and lifestyle-related factors, including diet and physical activity seem to play a part in determining the fatty acid composition of skeletal muscle phospholipids.[7] Study of skeletal muscle composition after specific fat diets regime, demonstrate that the fatty acid composition of skeletal muscle lipids reflects the fatty acid composition of the diet in healthy men and women.[8] Skeletal muscle is an important organ for energy metabolism like glucose uptake facilitated by insulin and fatty acid oxidation. The fatty acid composition of skeletal muscle phospholipids has been related to peripheral insulin sensitivity and obesity in several human populations.[9]

MATERIALS AND METHODS

Study design: Cross sectional prospective study.

Study area (setting): Khartoum, Maternal and Bahri Hospitals in Sudan.

Duration: From January 2010-to February 2014.

Subject and populations
Third trimester pregnant women (35-40) weeks having no organic conditions which may alter fatty acids level(HTN, DM).

Exclusion criteria
- Non pregnant or pregnancy less than 35 weeks.
- Lactating.
- Has organic conditions which may alter fatty acids level (HTN, DM).

Control: From healthy non pregnant mature Sudanese females (14-40 years) not suffering from organic conditions which may alter the fatty acids level.

Data collections: Written and oral consent were taken from the participants before filling the questionnaire which express the personal, medical, obstetrical history, socioeconomic etc. . . . .

Procedure for determination of plasma phosphatidylcholine fatty acids
- 5 mls venous blood was dropped from the study group in lithium heparin tube.
- Separation of blood cells from plasma using centrifuge (2000rpm/15minuts).
- Add 50microL tissue homogenate to hexane (1ml) and (1ml) BF3/MeOH reagent 14%.
- Heat to 100c (1hour) and cooled to room temperature.
- Extraction of methyl ester after addition of H2O(1ml).
- Fatty methyl ester then analyzed using GLC.

Statistical analysis
Data was analyzed by using SPSS version 16(SPSS, Chicago, IL, USA). The results are given as mean and standard deviation (mean ± SD). In addition to P values and correlation for some parameters.

RESULTS

Table 1
Represents the personal criteria for the participants. The number was distributed as 66 control, 66 pregnant and 66 neonates. They were middle class socioeconomic status. They were mostly had University education and 38. 7% were of high family number, and most of them were originally from northern Sudan

No significant differences between control and target subjects (p≥0. 05).

Table 1: Personal parameters of study groups.

Criteria	Control (66)	Pregnant (66)	P value
Age Mean ±SD	24. 9±7. 3	26. 8±4. 5	p≥0. 05
Residence %			
1. khartoum	28. 8%	33. 3%	p≥0. 05
2. Omdurman	39. 4%	37. 9%	p≥0. 05
3. Bahri	31. 8%	28. 8%	p≥0. 05
Economical status			
1. low	13. 6%	18. 2%	p≥0. 05
2. lower middle	56. 1%	62. 1%	p≥0. 05
3. upper middle/high	30. 3%	19. 7%	p≥0. 05
Education %			
1. illiterate	0%	0%	p≥0. 05
2. primary	10. 6%	6. 1%	p≥0. 05
3. secondary	25. 8%	45. 5%	p≥0. 05
4. university	47. 0%	40. 9%	p≥0. 05
5. post university	16. 7%	7. 6%	p≥0. 05
Number of family			
1. two	5. 9%	7. 5%	p≥0. 05
2. two-five	20. 5%	20%	p≥0. 05
3. six to eight	34. 9%	33. 4%	p≥0. 05
4. more than eight	38. 7%	39. 1%	p≥0. 05

Ethnic group			
1. Northern	30%	31. 3%	p≥0. 05
2. Souhern	20%	19. 4%	p≥0. 05
3. Estern	19. 9%	21. 7%	p≥0. 05
4. Western	30. 1%	28. 6%	p≥0. 05

Table 2: Represents the neonatal measurements. There were 34 girls and 32 boys.

No significant differences concerning numbers, weight, height, head circumference and glucose level. Their mean weight was (3. 34kg) which was less than the standard full term babies weight (4. 0).[10] Their mean height t was (0. 3-0. 6m) which was similar to the standard full term babies height (0. 51m).[11] Their mean head circumference was (27-31cm) which was less than the standard full term babies head circumference (35cm).[12]

From the table we concluded that the gender has no significant effects, regarding the anthropometric and biochemical parameters, all were less than the international standards.

Table 2: Neonatal measurements.

Criteria	**girls (34)**	**boys (32)**	**P value**
Weight(kg)	3. 4±0. 52	3. 3±0. 5	p≥0. 05
Height(meter)	0. 5±0. 1	0. 5±0. 1	p≥0. 05
Head circumference(cm)	29. 8±0. 7	29. 7±0. 6	p≥0. 05
Glucose level mg/dl	84. 8±13. 1	83. 8±12. 1	p≥0. 05
Cholesterol level mg/dl	115. 7±13. 4	116. 8±14. 8	p≥0. 05

Table 3: Shows Correlation between saturated, omega-3, omega-6 fatty acids and omega-3/omega-6 ratio with the glucose biochemical parameter among the neonates and pregnant Sudanese women. A positive co relation was found between glucose with saturated fatty acids and omega-6 fatty acids, and negative with omega-3 and omega-3/omega-6 ratio among the pregnant women and neonates.

Table 3: Correlation between saturated, omega-3, omega-6 fatty acids and omega-3/omega-6 ratio with the biochemical parameters among the neonates and pregnant women.

Parameter	**Neonates(66)**				**Pregnant(66)**			
Fatty acids Type	SFA	N-3	N-6	N-3/N-6 Ratio	SFA	N-3	N-6	N-3/N-6 Ratio
Glucose	. 11**	-. 22**	. 23**	-. 18**	. 04**	-0. 52**	0. 45**	-0. 31**

Table 4: Shows the correlation between saturated, omega-3, omega-6 fatty acids and omega-3/omega-6 ratio with the Glucose biochemical parameter among the control and pregnant women. A positive co relation was found between glucose with saturated fatty acids and omega-6 fatty acids, and negative with omega-3 and omega-3/omega-6 ratio among the pregnant and controls.

Table 4: Correlation between saturated, omega-3, omega-6 fatty acids and omega-3/omega-6 ratio with the Glucose biochemical parameter among the control and pregnant women.

Parameter	**Control(66)**				**Pregnant(66)**			
Fatty acids Type	SFA	N-3	N-6	N-3/N-6 Ratio	SFA	N-3	N-6	N-3/N-6 Ratio
glucose	. 03**	-0. 24**	0. 43**	-0. 52**	. 042**	-0. 52**	0. 45**	-0. 31**

DISCUSSION

Sudanese pregnant diets contains 60% of carbohydrates[13] which is higher than the American (50%) and standard international diet components (55%).[14,15]

When we compared the mean glucose levels of pregnant (105±24. 3) to non pregnant (control) (95±31. 9), we found that there was significant increase of pregnant glucose level, (p≤0. 001) which may explained by the physiological alteration which needed by the growing fetus through enhanced pregnant hepatic gluconeogenesis and increase levels of insulin antagonist hormones like (cortisol, glucagon and Prolactin).

Alteration of pancreatic beta cell responsiveness occur in parallel with growing placenta and production of placenta related hormones such as human chorionic somatomammotropin (HCS), progesterone, cortisol, and prolactin which work as Insulin antagonist. Insulin resistance serves to shunt ingested nutrients to the fetus after feeding.[16]

A positive co relation was found between glucose, saturated fatty acids and omega-6 level of controls, pregnant women and neonates (r=0. 03, 0. 04, 0. 11, r= *0. 43*, *0. 45*, 0. 23) (p≤0. 05) respectively, and negative with omega -3 fatty acids and omega-3/omega-6 ratio of controls, pregnant and neonates (r = − 0. 24, − 0. 52, −. 227, r = − 0. 52, − 0. 31, − 0. 18) (p≤0. 05) respectively. Elevated plasma saturated fatty acids (SFA) concentrations inhibit insulin activation of glucose transport/phosphorylation activity, which lead to insulin resistance in human skeletal muscle by reducing insulin-stimulated glucose transport activity, and this resistance appears to be a consequence of altered insulin signaling through IRS-1–associated PI 3-kinase. This may suggest that SFA interferes with insulin-stimulated muscle glucose metabolism via a different mechanism.[17,18] Omega-3 essential fatty acids composition of skeletal muscle phospholipids cell membrane enhance glucose transport activity, activating insulin signaling cascades through IRS-1–associated PI 3-kinase.[19] High amount of cell membrane PUFAs may leads to an increase in membrane fluidity, number of insulin receptors, and insulin action. In humans, the ratio of n–6 to saturated fatty acids in serum phospholipids correlates with insulin sensitivity. Saturated Fatty acids are incorporated into cell membrane phospholipids, resulting in decreased fluidity of membranes and binding of insulin to its receptor, leading to impaired insulin action, insulin resistance, and hyperinsulinemia. In animal experiments, saturated fatty acids increased LA and lowered AA concentrations in tissue phospholipids, indicating inhibition of Δ6 desaturase.[20] The same results were obtained by Kelley et al.[21]

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