BIOCHEMICAL CHANGES OF PLASMA NUTRIENTS DURING PREGNANCY

THESIS

Submitted in Partial Fulfilment
for the Degree of
MASTER OF SCIENCE

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Ein Shams University
Cairo

1983

ACKNOWLEDGEMENT

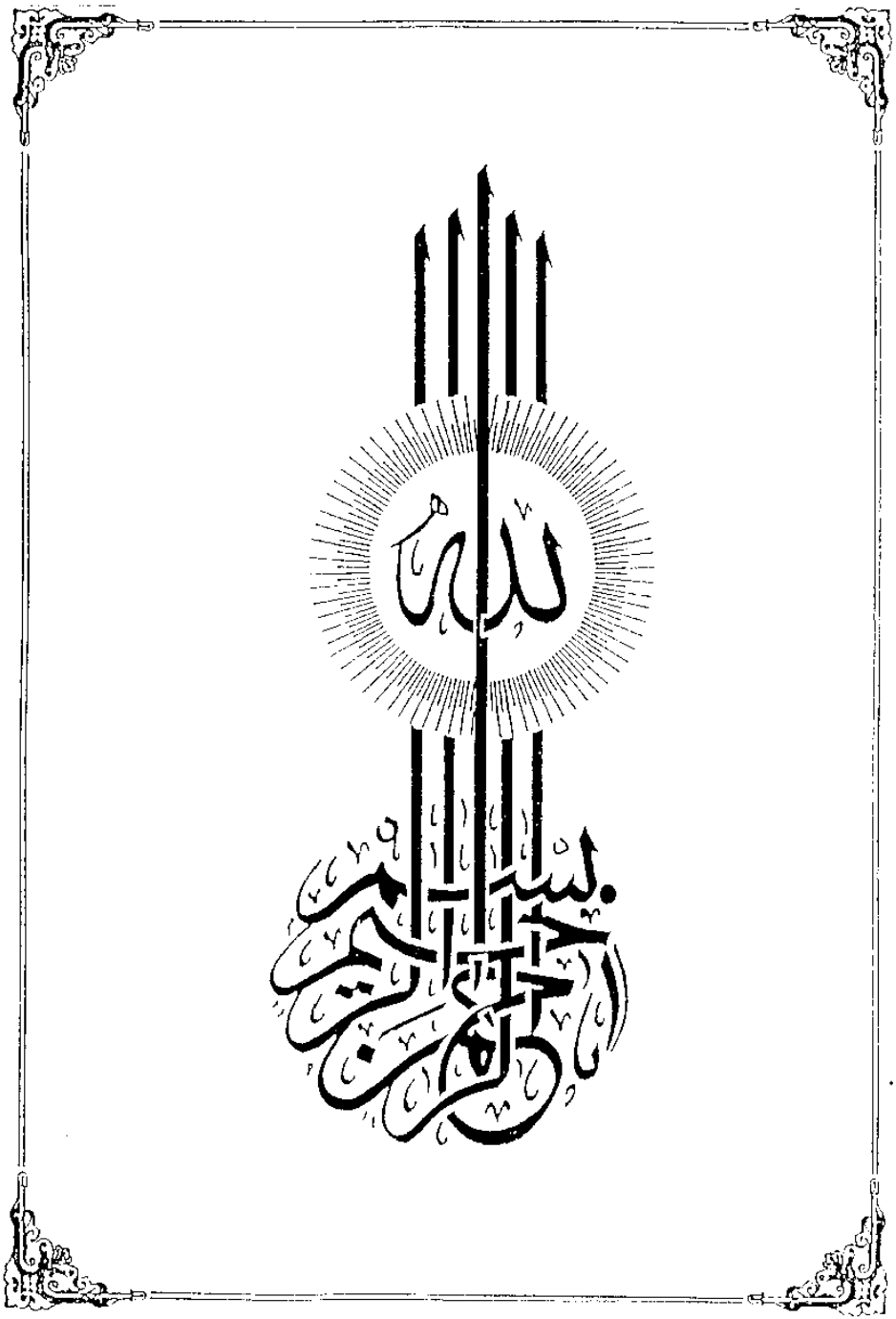
I wish to express my deep gratitude to Prof. Dr. **EISA AHMED EISA** Professor of Biochemistry, Faculty of Science, Ain Shams University for his indispensable guidance and supervision.

To Prof. Dr. **SOHAIR SALEM**, Professor of Nutritional Biochemistry, Child Health Laboratory, National Research Centre, I owe more than can be expressed, for her kind supervision, unlimited effort, valuable suggestions and time she freely gave during the course of this study.

Ever lasting gratitude and thanks for Dr. **ABDEL HALEM ABDEL HADY**, Assistant Professor of Biochemistry, Faculty of Science, Ain Shams University whose great effort was behind the accomplishement of a major part of this work.

My thanks to Prof. Dr. OSMAN GALAL, Professor of Pediatrics and Head of Child Health Laboratory, National Research Centre for his sympathetic and encouraging attitude.

Special and sincere thanks are due to Prof. Dr. **ONSEY METWALLY**, Professor of Nutritional Biochemistry, Nutrition Department, National Research Centre for his great encouragement and ceaseless help.



The analysis of electrolytes and trace metals of this work have been lightened and made pleasant by the greatly appreciated help of Prof. Dr. MOHAMED MOUSTAFA EL-FOULY, Professor of Plant Physiology, and ADEL ABDEL KHALIK EL-SAYED, Assistant Lecturer of Plant Physiology and also all members of the plant laboratory, National Research Centre.

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Nutritional status of women during pregnancy is generally assumed to influence fetal growth. The collection of reliable data from mothers on their dietary intake is usually encountered with great difficulties. In Egypt information referring to the nutritional status of pregnant women and its impact on fetal growth are scarce.

It is the objective of this work to investigate the nutritional status of a group of pregnant women that are living under low-socioeconomic conditions .

Other criteria were shown to be equally valuable in assessing the nutritional status of the mother. These include anthropometric measurements of the mothers and biochemical indicators of plasma nutrients.

Anthropometric measurements that included weight, mid upper arm circumference and thigh circumference were measured. Plasma nutrients that included iron, electrolytes (sodium, potassium and calcium), trace metals (copper and zinc), total proteins, albumin, and globulins were determined. Changes occuring in these criteria with the progress of pregnancy were as well studied.

THEORETICAL SECTION

I R O N

Function and distribution :

Iron is an essential element for the synthesis of many body compounds. These are classified into two groups:-

1. Compounds that serve metabolic or enzymatic functions.
2. Compounds associated with iron transport and storage.

The first group consists of heme proteins . Its function is related to oxidative metabolism, and it comprises haemoglobin, myoglobin, and other enzymes . Haemolgobin accounts for more than 65 % of body iron and its function is oxygen transport via blood. Myoglobin accounts for 5 % only of body iron, and is the red pigment of muscles. It stores oxygen for utilization during contraction. Iron enzymes are needed for a wide variety of metabolic processes that contain or require iron as a cofactor (Cecil, 1977 . They include cytochrome system, catalase and peroxidase (Politt and Leibel, 1975 .

The second group includes iron compounds associated with its transport and storage such as transferrin, ferritin and hemosiderin.

Iron is transported through the plasma and extracellular spaces bound to β_1 globulin as transferrin the liver paranchymal cells are the major sites for transferrin synthesis (Morgan, 1974), though human lymphocytes may be a minor source (Solty and Boudt, 1970). The major role of transferrin is to transport iron released from haemoglobin catabolism or that absorbed from intestine back to the bone marrow for synthesis of haemoglobin (Bullman, 197-). The serum transferrin concentration is 1.8 - 3.6 mg per ml. Corresponding to a total iron binding capacity of 250--00 ug 100 ml. and accounts only for 1% of body iron (Jacobs, 1977).

Compounds concerned with iron storage are ferritin and haemosiderin. One third of stored iron is found in the liver , another third in the erythroid precursors of the bone marrow, and the remaining third in the spleen and other tissues (Fairfield, 197-). Stored iron exists primarily as ferric salts protein complexes.

Ferritin is formed of a spherical protein shell, apoferritin, which contains up to 25% of iron (Harrison et al., 197-). The serum ferritin concentration is related to

body iron stores (Walters et al., 1973). It is normally present in concentration of 20-300 ug/L. (Jacobs and Warwood, 1975). It decreases with iron deficiency and increases with iron overload.

Haemosiderin forms the other half of iron storage. As iron storage increases, haemosiderin makes a greater proportion of the total iron stored in the tissues (Weinfeld, 1964). Ferritin is in equilibrium with serum iron, and easily available when needed, where as haemosiderin is is less available (Silmen et al.,1974).

Requirements and Sources :

The needed for iron is determined by the requirements for tissue growth and haemoglobin synthesis and the replacement needs due to iron losses in urine, feces, and sweat, and, in female, the additional losses in menstruation, gestation, and lactation. The need for iron is greatest during the first 2 years of life, during the period of rapid growth and haemoglboin increase in adolescence, and throughout the childbearing period in women.

Clinical studies have indicated that an additional 0.8-1 mg. of iron per day is needed to maintain normal haemoglobin concentration in children and in adolescents to provide for increased stores of iron in the growing body. The average loss of iron in the healthy adult male is estimated to be only about 1 mg./d., ranging from 0.4-2 mg. In adult women, the average loss of blood during a menstrual period is 35-70 ml. which represents a monthly loss of 16-32 mg of iron, or an additional average loss of 0.5-1 mg/d . This amount of iron is easily obtained from the diet. For women with excessive menstrual blood loss and a resultant chronic iron - deficiency anemia, a supplement of 100 mg . of iron per day as ferrous sulfate is required. Pregnancy increases the requirement to approximately [illegible] mg/d.

A defect in haemoglobin synthesis, resulting in anemia, is commonly found during copper deficiency in most animals. Abnormalities in iron metabolism during copper deficiency appear to be due to defects in cellular and plasma transport of iron

The recommended daily amounts of iron currently suggested by nutritional authorities are as follows :-

A. Infants : 10-15 mg.

B. Children : 1-3 years of age, 15 mg , 4-10 years of age, 10 mg.

C. Older children and Adults : Males : 11-18 years of age, 18 mg., after 19 years of age, 10 mg.

Females : 11-50 years of age, and during pregnancy or lactation , 18 mg. After 51 years of age, 10 mg.

It should be noted that these requirements for iron take into account the low amount of iron actually absorbed from orally injested iron.

The recommended allowance of 10 mg/d. for adult males is readily obtained from the normal diet in the U.S.A. ,which provides about 6 mg. of iron per 1000 K Cal. However, the recommended allowance for females (18 mg/d), based on 2000 K Cal/d, is difficult to obtain from dietary sources without further iron fortification of foods .

The best dietary sources of iron are "organ meats" : liver, heart, kidney, and spleen. Other good sources are

egg yolk, wheat, fish, oysters, clams, nuts, dates, figs, beans, asparagus, spinach, molasses, and oatmeal (Harper et al.,1979).

Absorption from the gastrointestinal tract:

A piculiar and possibly unique feature of the metabolism of iron is that it occurs in what is virtually a closec system. Under normal concitions very little dietary iron is absorbed, the arounts excreted in the urine are minimal, and a high proportion of the total body iron is continuously redistributed throughout the body in several metabolic circuits (Harper et al.,1979). Because there is no way to excrete excess iron, its absorption from the intestine must be controlled.

Factors affecting iron absorption:

Most of the iron in foods occurs in the ferric Fe^{3+} state either as ferric hydroxide or as ferric organic compounds. In an acid medium, these compounds are broken down into free ferric ions or loosely bound organic iron (Harper et al., 1979). The gastric hydrochloric acid, peptic

digestion and organic acids of the foods are important for this purpose (Brock and Taylor, 1934; Forth et al., 1965; Rummel, 1965). Reducing substances in foods, SH group (e.g., Cysteine), and ascorbic acid convert ferric iron to the reduced ferrous state. In this form, iron is more soluble and should therefore be more readily absorbed Moore et al.,1939; Hopping and Ruliffson, 1963; Conrad and Schade, 1968; Höglund and Reizensteins, 1969, Harper et al., 1979). Iron absorption is enhanced by protein , possibly as a result of the formation of low molecular - weight digestive products (Peptides, amino acids) such as histidine, cysteine, and lysine. These amino acids can form soluble iron chelates (Van Campen, 1973). Inorganic iron also forms soluble complexes with normal gastric juice (Harper et al., 1979); A diet high in phosphate, oxalate or phytate causes a decrease in the absorption of iron since they bind ionic iron and reduce its solubility (Hegsted et al., 1949; Sharpe et al., 1950 ; Forth and Rummel, 1966 ; Peters et al., 1971).