Estimation of Zinc Level among Diabetic Type 2 Patient, at ELHassahiesa Hospital in, Gezeira State, Sudan (2018)

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(B.SC. in Medical Laboratory University of Omdurman Islamic, (2007)

A Dissertation

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Faculty of Medical Laboratory Sciences

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Supervision Committee:

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Date: / / 2018
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Date
Declaration

I authorized that my dissertation Assessment Estimation Of Zinc Level among Diabetic Type 2 Patient at Gazira state ELHassahiesa Hospital (2018)

”, submitted by me, under the supervision Dr. Albadawi Abdelbagi Talha for the partial fulfillment for the award of Master degree in Medical Laboratory Sciences in Clinical Chemistry. University of Gezira Faculty of Medical Laboratory Sciences Department of Clinical Chemistry; Wad- Madani, Sudan and this is original and it was not submitted in part or in full, in any printed or electronic means, and is not being considered elsewhere for publication.

Name and Signature of Candidate:

Name: ______________________________
Signature ...................................
Place: .....................................
Date: ..........................
Dedication

To my Father who gave me confidence
To my mother who taught me the meaning live and gave me love
To my brothers and sisters
To my teachers
To my friends
Acknowledgments

Firstly, I thank Allah for blessing my life, helped me to start this work, and supported my strength to complete this humanity Work.
I would like to give my great sincere thanks to my supervisor  Dr. Albadawi Abdelbagi Talha for his constructive guidance, help, and support in each step to establish valuable and useful work.
I would like to extend special thanks to co-supervisor, my lovely mother and gorgeous father for their kind supporting and motivating me to do my best and they never complain from my needs.
I am very thankful for the staff of Al -Geziera University for offering me an ideal environment to perform my research project. I would like to extend thanks to my brothers and sisters, my teachers, friends and all people support me and believe me.
تقييم مستوى الزنك في الدم بين مرضى داء السكري النوع الثاني في مستشفى الحصائصا
ولاية الجزيرة - السودان 2018

أمجد منصور عبدالحميد محمد
ملخص الدراسة

يتم قبول العناصر النزرة باعتبارها ضرورية لصحة الإنسان المثلى. ففي الأونة الأخيرة، هناك أدلة متراكمة على أن التمثيل الغذائي لهذه العناصر النزرة في الزنك والكروم والمغنيسيوم خاصة يتغير في مرض السكري، وهذه العناصر قد تكون لها أدوار محددة في تقدم المرض. أجريت هذه الدراسة لتقييم مصل الزنك في مرضى السكري النوع الثاني. أظهرت هذه الدراسة أن أوجه القصور في الزنك تؤدي إلى عدم تحمل الجلوكوز وتعزيز تطور مضاعفات السكري مثل أمراض القلب والأوعية الدموية واعتلال الشبكية واعتلال الكلية. تم اختيار المرضى بعد التأكد من اصابتهم بمرض السكر النوع الثانى، بأخذ 50 عينة منهم من النوع الثاني من مرضى السكري، كما تم إدراج 50 شخصا باعتبارهم صحيين وطبيعين على ما يبدو من خلال الفحص السريري بدون أي تاريخ من أي مرض في الدراسة. تم جمع عينات الدم الصائم من جميع الأشخاص ومعالجتها بشكل مناسب لتحليل الجلوكوز باستخدام الإجراء الكيميائي. معدلات النتائج أوضحت أن متوسط معدل الخارصين في مرضى السكري كانت (Mean±std) (20,4±4,24) والجلوكوز في مرضى السكري كانت (Mean±std) (17,4±5,1) والفرق المعنوي بينه كان (219,1±355,1) لل الخارصين) صحيين (12,3±5,6) والجلوكوز (17,4±5,1) خلصت هذه الدراسة إلى أنه يوجد ارتفاع في مستوى الخارصين لمرضى داء السكري النوع الثاني.
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CHAPTER ONE

1.1 Introduction:

Diabetes mellitus is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, and blood vessels. (American Diabetes Association, 2004)

Diabetes mellitus is the most common endocrine disorder in industrialized countries. Type1 diabetes, previously called insulin-dependent diabetes mellitus or juvenile-onset this form of diabetes, which accounts for only5–10% of those with diabetes, results from a cellular-mediated autoimmune destruction of the b-cells of the pancreas. Markers of the immune destruction of the B cell include islet cell autoantibodies. Insulin resistance characterizes Type2 diabetes, formerly known as non-insulin-dependent or adult - onset diabetes mellitus, with an insulin secretory defect leading to relative insulin deficiency. This group accounts for 90-95% of patients with diabetes and has a strong genetic predisposition. Type 2 patients are usually, but not always, older than 40 age at presentation. Obesity is a frequent finding and, in the United States, is present in 80-90% of these patients.(Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2003)

Diabetes has acquired and epidemic character due to the large increase in the number of individuals affected over recent decades (American Diabetic Association: Diabetic care. 2013)in 1985 an estimated 30 million people around the world where diagnosed with diabetes; in 2000 that figure rose to over 150 million, and in 2012 the international diabetes federation estimate 371 million people with diabetes, the number is projected to rise to 552 million by 2030 (International Diabetic Federation2013),although the prevalence of both type 1 and type 2 diabetes mellitus increasing worldwide, the prevalence of type 2 diabetes mellitus is excepted to rise more rapidly in future(Alvin CP ,2001).
1.2 Trace elements

In analytical chemistry, a trace element is an element in a sample that has an average concentration of less than 100 parts per million measured in atomic count or less than 100 micrograms per gram. In biochemistry, a trace element is a dietary mineral that is needed in very minute quantities for the proper growth, development, and physiology of the organism (Bishop ML, 2005). Trace element, also called Micronutrient, in biology, any chemical element required by living organisms in minute amounts, usually as part of a vital enzyme, a cell-produced catalytic protein. (Bishop ML, 2005)

1.3 Rationale

Serum level of several trace elements such as zinc (Zn) are altered in type 2 DM and its deficiencies are associated with the development of microvascular and macrovascular complications, Diabetes mellitus. It is characterized by chronic hyperglycemia associated with disturbances of carbohydrate, fat and protein metabolism, which result from defects in insulin secretion, insulin action. Zinc (Zn) is required for synthesis, storage, and secretion of insulin. Lower levels of Zn may affect the ability of pancreatic islet cells responsible for the production and secretion of insulin.

1.4 Objectives

1.4.1 General Objective:

To estimate Zinc level among diabetic type 2 Sudanese patients.

1.4.2 Specific objectives:

- To measure and compare level of Zinc level in DM type 2 patients and control group.

- To association between level of zinc level of DM type 2 and control group.
2. Literature review

2.1 Diabetes mellitus

Diabetes mellitus is a syndrome characterized by chronic hyperglycemia and relative insulin deficiency, resistance or both (Tripathy S, Sumathi S et al, 2004). Insulin enables cells to absorb glucose in order to turn it into energy. This causes glucose to accumulate in the blood leading to various potential complications (Kumar P, 2003). It has been defined by the World Health Organization (WHO), on the basis of laboratory findings as a fasting venous plasma glucose concentration greater than 7.0 mmol/L (126 mg/dl) or greater than 11.1 mmol/L (200 mg/dl) two hours after a carbohydrate meal or two hours after the oral ingestion of the equivalent of 75 g of glucose, even if the fasting concentration is normal (Pannall, 1998).

2.2 Glucose metabolism & regulation:

Glucose is a primary source of energy for humans. The nervous system, including the brain totally depends on glucose from the surrounding extracellular fluid (ECF) for energy. Nervous tissue cannot concentrate or store carbohydrates; therefore, it is critical to maintaining a steady supply of glucose to the tissue. For this reason, the concentration of glucose in the ECF must be maintained in a narrow range. When the concentration falls below a certain level, the nervous tissues lose the primary energy source and are incapable of maintaining normal function (Bishop M2003, Bishop ML et al, 2005). The principal organ of glucose homeostasis is the liver, which absorbs and stores glucose (as glycogen) in the post absorptive state and releases it into the circulation between meals to match the rate of glucose utilization by peripheral tissues. About 200 g of glucose is produced and utilized each day (Kumar P, 2003).

The liver, pancreas, and other endocrine glands are all involved in controlling the blood glucose concentrations within a narrow range. During a brief fast, glucose is supplied to the ECF from the
liver through glycogenolysis. When the fasting period is longer than one day, glucose is synthesized from other sources through gluconeogenesis. Control of blood glucose is under two major hormones: insulin and glucagon both produced by the pancreas. Their actions oppose each other. (Bishop M, 2003, Bishop ML et al, 2005)

Insulin is the major regulator of intermediary metabolism, although its actions are modified in many respects by other hormones, its actions in the fasting state and postprandial states differ. In the fasting state its main action is to regulate glucose release by the liver, and in the post prandial state, it additionally facilitates glucose uptake by fat and muscle. (Kumar P, 2003)

The effect of counter-regulatory hormones (glucagon, epinephrine, cortisol, and growth hormone) is to cause greater production of glucose from the liver and less utilization of glucose in fat and muscle for a given level of insulin. (Kumar P, 2003)

Both insulin deficiency and glycosuria are known to inhibit the tubular-absorption of phosphate. This inhibition has previously been evaluated either in the fasted state or on a normal phosphate diet (Bishop M, 2003). Glucagon is the primary hormone responsible for increasing glucose levels. It is synthesized by the α cells of islets of Langerhans in the pancreas and released during stress and fasting states. When these cells detect a decrease in body glucose, they release glucagon. (Mooradian AD, 1994)

2.3 Classification of Diabetes mellitus.

2.3.1 Primary Diabetes mellitus:

Diabetes mellitus divided into two major types called type 1 and type 2. Type 1 diabetes is characterized by an absolute lack of insulin, while type 2 is a relative deficiency of insulin without loss of production. Historically, type 1 diabetes mellitus has been called juvenile onset diabetes. A name for type 1 diabetes that is used more often is insulin – dependent diabetes mellitus (IDDM). These descriptions inferred the early age of onset and dependence of these individuals on exogenous insulin for survival. (Bishop ML, 1996)

Type 2 diabetes mellitus, with its relative lack of insulin, has been termed adult-onset diabetes and non –insulin – dependent diabetes mellitus (NIDDM). (Bishop ML, 1996)
2.3.2 Type 1 Diabetes mellitus:
Type 1 diabetes mellitus is characterized by loss of the insulin-producing beta cells of the islets of Langerhans in the pancreas, leading to insulin deficiency. This type can be further classified as immune-mediated or idiopathic. The majority of type 1 diabetes is of the immune-mediated nature, in which beta cell loss is a T-cell-mediated autoimmune attack. (Bishop ML et al ,2005)

The epidemiology of type 1 diabetes is a disease resulting in insulin deficiency. It usually presents during childhood and has been suggested that many cases follow a viral infection which has destroyed the β-cells of the pancreatic islets. (Kumar P, 2003) Type 1 diabetes is common among Caucasians and African–Americans; it is uncommon in Asians, American Indians, African blacks, Inuits and other certain races. (Bishop ML, 1996)

In western countries, almost all patients have the immune-mediated form of the disease. Type 1 diabetes is prominent as a disease of childhood, reaching a peak incidence around the time of puberty, but can present at any age. This may be difficult to distinguish from type 2 diabetes. The highest rates of type 1 diabetes in the world seen in Finland and other northern European countries, with the exception of the island of Sardinia, which for unknown reasons has the second highest rate in the world. The incidence of type 1 diabetes appears to be increasing in most populations. In Europe, the annual increase is of the order of 3-4 %, and is most marked in children under the age of 5 years. (Kumar P, 2003)

2.3.3 Type 2 Diabetes mellitus:
The epidemiology of type 2 diabetes is the most common form of diabetes. Typically this disease is characterized by an under production of insulin or insulin insensitivity at target tissues. Type 2 diabetes is three to four times as prevalent in people of African and Caribbean ancestry and four to seven times more prevalent in people of Hispanic American origin and in those from south Asia and Arabia living western lifestyles, than in white Europeans. Indolent well-fed populations are two to twenty times as likely to develop type 2 diabetes as lean populations of the same race (Bishop M, 2003).

Diabetes type II is characterized by insulin resistance with relative insulin deficiency. This type accounts for 90% of all diabetic cases and commonly appears in adults so it’s called adult-onset diabetes. In this type of diabetes, insulin is present in little amounts. Fatty acids are incorporated
into triglycerides for the release of very low–density lipoproteins. So they are at increased risk of developing macrovascular and microvascular complications. (World Health Organization, 1999)

2.4 Causes of type 2 Diabetes mellitus include the following:

2.4.1 Genetics:
Genetic factors may play a greater role in this disease than in type 1 diabetes. Concordance rates for type 2 diabetes in identical twins are 100%. Currently, a genetic marker has not been discovered for type 2 diabetes. (Lawrence JM et al., 2008) The genetic causes of some rare forms of type 2 diabetes have, however, emerged over the last 15 years. Dozens of mutations of the insulin receptor affect a tiny proportion of all type 2 patients. These usually cause type 2 diabetes with obesity, marked insulin resistance, hyper-androgenism in women and often an area of hyper-pigmented skin (acanthosis nigricans). (Kumar P, 2003)

Individuals with some mutations or deletions of mitochondrial DNA develop type 2 diabetes or impaired glucose tolerance. A rare variant of type 2 diabetes is referred to as maturity onset diabetes of the young (MODY). This is dominantly inherited (Kumar P, 2003)

2.4.2 Environmental factors (early and late):
A strong association has been noted between weight at birth and at 12 months of age and glucose intolerance later in life, particularly in those who gain excess weight as adults. The concept is that poor nutrition early in life impairs beta-cell development and function, predisposing to diabetes in later life. Low birth weight has also been shown to predispose to heart disease and hypertension in later life. (Kumar P, 2003) Diet factor may play an important role in the development of type 2 diabetes. Obesity, especially of the abdominal viscera, is common in individuals with type 2 diabetes. Changes in the normal substrate concentrations delivered to the liver, adipose tissue, and skeletal muscle are thought to affect the normal functioning of the insulin receptor. (Bishop ML, 1996)

2.4.3 Immunological factors:
There is no evidence of immune involvement in the pathogenesis of type 2 diabetes, but as noted earlier a proportion of late – onset patients carry islet auto-antibodies-ICA and GAD- at diagnosis
and these are more likely to progress to insulin therapy. Such cases are probably type 1 diabetes masquerading as type 2 diabetes. (Kumar P, 2003)

2.5 Secondary Diabetes mellitus.

Diabetes mellitus associated with other conditions include:

I- Absolute insulin deficiency due to pancreatic disease (Chronic pancreatitis, haemochromatosis, cystic fibrosis).

II- insulin deficiency due to excessive growth hormone (acromegaly), glucocorticoid secretion (Cushing’s syndrome) or increased plasma glucocorticoid concentrations due to administration of steroids.

III- Drugs such as thiazide diuretics and corticosteroid therapy. (Kumar P, 2003)

2.6 Gestational Diabetes mellitus:

Gestational diabetes occurs temporarily during pregnancy in women with an inherited predisposition, over weight; family history of diabetes. (Mooradian AD et al, 1994) Gestational diabetes mellitus (GDM) resembles type 2 diabetes in several respects, involving a combination of relatively inadequate insulin secretion and responsiveness. It occurs in about 2–5% of all pregnancies and may improve or disappear after delivery. Gestational diabetes is fully treatable, but requires careful medical supervision throughout the pregnancy. About 20–50% of affected women develop type 2 diabetes later in life (Lawrence JM et al, 2008)

2.7 Pathophysiology of Diabetes mellitus:

In both type 1 and type 2 diabetes mellitus, individual will be hyperglycemic, which can be severe. Glucose-uria can also occur after the renal tubular transporter system for glucose becomes saturated. This happens when the glucose concentration of plasma exceeds roughly 180mg/dl in an Individual with normal renal function and urine output. (Bishop ML, 1996)As hepatic glucose overproduction continues, the plasma glucose concentration reaches a plateau around 300 to 500 mg /dl (17 to 28 mmol /l) provided renal output is maintained. (Bishop ML, 1996)The individual with type 1 has higher tendency to produce ketones. Type 2 diabetes patients seldom generate
ketones, but instead have a greater tendency to develop hyper smolar non ketotic states. The difference in glucagon and insulin concentrations in these two groups appears to be responsible for the generation of ketones through increased B-knoops oxidation. In type 1, there is an absence of insulin with an excess of glucagon. This permits gluconeogenesis and lipolysis to occur. In NIDDM, insulin is present as is (sometimes) hyper-insulinemia therefore glucagon is attenuated. Fatty acid oxidation is inhibited in type 2 diabetes. (Bishop ML, 1996) This causes fatty acids to be incorporated into triglycerides for release as very low density lipoproteins (VLDL). (Bishop ML, 1996)

2.8 Clinical presentation of diabetes:

Acute and sub acute presentations often overlap.

2.8.1 Acute presentation:
Polyuria due to the osmotic diuresis that results when blood glucose levels exceed the renal threshold. Thirst due to the resulting loss of fluid and electrolytes. Weight loss due to fluid depletion and the accelerated break down of fat and muscle secondary to insulin deficiency. Ketoacidosis may be the presenting feature if these early symptoms are not recognized and treated in a type 1 diabetes patients (Bishop ML, 1996)

2.8.2 Sub acute presentation:
The clinical onset may be over several months or years, particularly in older patients. Thirst, polyuria and weight loss are usual features, but medical attention is sought for such symptoms as lack of energy, visual blurring ((owing to glucose – induced changes in refraction)), or pruritus vulvae or balanitis that is due to Candida infection. (Bishop ML, 1996)

2.9 Complications of Diabetes.

2.9.1 Acute metabolic complications:
Patients with diabetes mellitus may develop one of the several metabolic complications; these include diabetic ketoacidosis and hyperosmolar non-ketotic coma. (Mayne PD. 1998)

2.9.2 Long-term complications:
Vascular disease is a common complication of diabetes mellitus.
I-Macrovascular disease: Due to abnormalities of large vessels, may present as coronary artery, cerebrovascular or peripheral vascular insufficiency. The condition is probably related to alterations in lipid metabolism. (Bishop M, 2003).

II-Microvascular disease: Due to abnormalities of small blood vessels particularly affects the retina ((diabetic retinopathy)) and kidney, the incidence of both may be related to in adequate glucose control. (Bishop M, 2003).

• Diabetic eye disease: Diabetes can affect the eyes in a number of ways. The most Common and characteristic form of involvement is diabetic retinopathy. (Kumar P et al, 2003)

• Diabetes has been the most common cause of blindness in the population as a whole up to the age of 65 years. (Kumar P et al, 2003) Other forms of eye disease may also occur.

• Diabetic kidney: The kidney may be damaged by diabetes in three main ways: Glomerular damage, Ischemia resulting from hypertrophy of afferent and efferent arterioles, and ascending infection. (Kumar P et al, 2003)

(iii)Ischaemic lesions: Arteriolar lesions, with hypertrophy and hyalinization of the vessels, can occur in patients with diabetes. The appearances are similar to those of hypertensive disease and lead to ischemic damage to the kidneys. (Kumar P et al, 2003)

(iv) Infective lesions: Urinary tract infections are relatively more common in women with diabetes, but this does not apply to men. Ascending infection may occur because of bladder stasis resulting from autonomic neuropathy, and infections more easily become established in damage drenal tissue. (Kumar Petal, 2003)

(v) Diabetic neuropathy: Diabetes can damage peripheral nervous tissue in a number of ways. The vascular hypothesis postulates occlusion of the vasa nervorum as the prime cause. This seems likely in isolated mono-neuropathies, but the diffuse symmetrical nature of the common forms of neuropathy implies a metabolic cause. Since hyperglycaemia leads to increased formation of sorbitol and fructose in Schwann cells, accumulation of these sugars may disrupt function and structure (Kumar P et al, 2003).

The complications that cause excess death in early -onset patients are mainly related to diabetic nephropathy, but there is also a considerable excess cardiovascular mortality. Heart disease,
peripheral vascular disease and stroke are the major causes of death in patients over the age of 50 years (Kumar Petal 2003)

2.10. Zinc

The discovery of a variety of zinc-related clinical disorders have directly demonstrated the importance of zinc in human nutrition. It is second to iron as the most abundant trace element in the body (Alan Shenkin et al., 2008)

2.11 Chemistry of zinc

Zinc (atomic number 30, relative atomic mass 65.39) is a particularly stable ion. Zinc has fast ligand exchange kinetics and flexible coordination geometry, and is a good electron acceptor (strong Lewis acid), with no redox reactions. There is a hypothesis that zinc ions, present in the cytoplasm at 10 mol/L and in equilibrium with numerous zinc metallo-enzymes and transcription factors, act as “master hormone,” particularly in relation to cell division and growth. (Alan Shenkin et al., 2008)

2.12 Dietary sources of zinc

Zinc is widely distributed in food mainly bound to proteins. The bioavailability of dietary zinc us dependent upon the digestion of these proteins to release zinc and allow it to bind to peptides, amino acids, phosphate, and ligands within the intestinal tract. The most available dietary sources of zinc are red meat and fish. Wheat germ and whole bran are good sources, but their zinc content is reduced by miling and food processing. The median intake for men in the United States is about 14mg/day and for women 9mg/day. (Alan Shenkin et al., 2008)

2.13 Absorption, transport, metabolism and excretion of zinc

Regulation of the net intestinal uptake of zinc is by control of absorption efficiency and usually ranges from 20% to 50% of the dietary content. At an intake of 12.2mg zinc per day, the fractional absorption is 26%, but at the very low intake of 0.23mg zinc per day this has been shown to increase to 100%. Interaction with other dietary constituent, such as phytate, fiber,
calcium, and iron, reduce the net absorption of zinc. Iron at supplemental dosages (up to 65mg/day) may decrease zinc absorption so that pregnant and lactating women taking iron require zinc supplementation (Alan Shenkin et al., 2008).

Absorbed zinc is transported to the liver where active incorporation into metallo-enzymes and plasma proteins occurs. About 80% of plasma zinc is associated with albumin and most of the rest tightly bound in the high molecular proteins α2-acrolobulin (Alan Shenkin et al., 2008). Total adult body content of zinc is about 2 to 2.5g and the metal is present in the cells of all metabolically active tissue and organs. About 55% of the total is found in muscle and approximately 30% in bone. Red cell zinc concentration is about 10 times higher than in plasma, due to the large amounts of carbonic anhydrase. (Alan Shenkin et al., 2008)

Zinc binding to the metal-regulatory transcription factor 1 (MTF1) activates metallothionein (Mt) expression. This multifunctional, low molecular weight protein (9000 to 10,000 Da) has a high content of cysteine and reversibly binds zinc. Mt is important in intracellular zinc trafficking and helps to maintain intracellular zinc concentrations. Hepatic synthesis of Mt is induced by interleukin-1, Interleukin-6 and glucocorticoids in response to infection, trauma, and other stressors. Fecal excretion includes both unabsorbed dietary zinc and zinc re-secreted into the gut. Urine output of zinc is normally only about 0.5 mg/day, but increases greatly during catabolic illness and ketosis. The release of intracellular contents from skeletal muscle has been established as the source of the excess urinary zinc. (Broun ER et al., 1990)

### 2.14 Functions of zinc

More than 300 zinc metallo-enzymes occur in all six categories of enzyme systems, important examples in human tissue include alkaline phosphatase, RNA and DNA polymerases, thymidine kinase carboxpeptidases. The key roles of zinc in protein and nucleic acid synthesis explain the failure of growth and impaired wound healing observed in individuals with zinc deficiency. “zinc fingers.” have important roles in gene expression by acting as DNA-binding transcription factors and play a key role in developmental biology and also in the regulation of steroid, thyroid, and other hormone synthesis. (Alan Shenkin et al., 2008)

### 2.15 Deficiency of zinc

As might be expected from the multiple biochemical functions of zinc, the clinical presentation of deficiency disease is varied, nonspecific, and related to degree and duration of the depletion.
Signs and symptoms include depressed growth with stunting, increased incidence of infection, possibly related to alteration in immune function, diarrhea, skin lesion, and alopecia. (Alan Shenkin et al, 2008)

2.16 Effects on growth
Dietary zinc deficiency is prevalent in countries worldwide where a cereal-based diet high in phytate and fiber, but low in animal proteins, is common. In children, reduced growth and other developmental abnormalities are reversible by zinc supplementation. Zinc in human breast milk is efficiency absorbed because of the presence of factors such as picolinate and citrate. (Alan Shenkin et al, 2008)

2.17 Parental Nutrition
Some patients requiring intravenous feeding after surgery are likely to be significantly zinc depleted because of poor oral intake before and after surgery. They may also have increased zinc losses from intestinal tract via diarrhea and in urine from catabolism of muscles during periods of negative nitrogen balance. (Broun ER et al, 1990)

2.18 Infectious disease
Zinc depletion impairs immunity and has a direct on gastrointestinal tract, which increases the severity of infections. A review of controlled trails of zinc supplementation of children in low-income countries found significant clinical benefits in cases of persistent diarrhea and respiratory diseases. provision of zinc alone increases in the incidence of respiratory infection, but when vitamin A is also added, respiratory infections are decreased. (Alan Shenkin et al, 2008)

2.19 Subclinical effects of zinc deficiency
When zinc deficiency is not server enough to cause clinical signs and symptoms, it may still have a subclinical effect on immune function, the synthesis and action of hormones, and neurological function (Alan Shenkin et al, 2008)

2.20 Immune function
Patients with zinc deficiency in the middle east were known to die before the age of 25 because of various infections and parasitic disease. In zinc deficiency, there is a reduction in the activity of serum thymulin, the thymus-specific hormone that is involved in T-cells function, and an
imbalance develops between Th1 and Th2 helper cells. The lytic activity of natural killer cells also decreases. These complex changes result in an impairment of cells mediated immunity. (Alan Shenkin et al, 2008)

2.21 Hormones synthesis

Zinc has a role in the synthesis and actions of hormones, via zinc transcription factors. Zinc depletion is associated with low circulating concentrations of testosterone, free T4, insulin-like growth factors (IGF)- I, and thymulin. Both plasma IGF-I and growth velocity increased in zinc-supplementation children. (Alan Shenkin et al, 2008)

2.22 Neurological effects

Sever zinc deficiency is known to affect mental well-being, with varying degrees of confusion and depression being consistent with zinc enzymes having important activity in brain development and function. (Alan Shenkin et al, 2008)

2.23 Zinc toxicity

Zinc toxicity can occur in both acute and chronic forms. Acute adverse effects of high zinc intake include nausea, vomiting, loss of appetite, abdominal cramps, diarrhea, and headaches (Alan Shenkin et al, 2008). One case report cited severe nausea and vomiting within 30 minutes of ingesting 4 g of zinc gluconate (570 mg elemental zinc) (Lewis MR, et al 1998). Intakes of 150–450 mg of zinc per day have been associated with such chronic effects as low copper status, altered iron function, reduced immune function, and reduced levels of high-density lipoproteins (Hooper PL et al, 1980). Reductions in a copper-containing enzyme, a marker of copper status, has been reported with even moderately high zinc intakes of approximately 60 mg/day for up to 10 weeks. (Willis MS et al, 2005)

2.24 Zinc and diabetes mellitus

Zinc is an important essential mineral in human nutrition with a wide range of biological functions. Zinc fulfills catalytic, structural, or regulatory roles in more than 200 zinc-requiring metallo-enzymes (Faure P et al, 1992). The interaction of zinc with insulin induces conformational changes and enhances binding to the insulin receptor (Salgueiro MJ et al, 2001). With regard to glucose metabolism, zinc is a co-factor of several keyenzymes. Zinc is an activator of fructose-1-
6-bisphosphate aldolase, and an inhibitor of fructose-1-6-biphosphatase. (Salgueiro MJ et al, 2001) Zinc can also exert antioxidant activity, and is a cofactor in Cu-Zn SOD, a major antioxidant enzyme. There is accumulating evidence that the metabolism of zinc is altered in Insulin-dependent diabetes mellitus and that zinc might have specific roles in the pathogenesis and progress of this disease. Increased urinary loss of zinc is a commonly encountered feature of diabetes; some studies have reported zinc deficiency along with alterations in zinc metabolism in patients with diabetes. (Disilvestro RA et al, 2000, Zelko IN et al, 2002)

In another study, found that diabetes could alter copper, zinc, and lipid peroxidation. Plasma copper was higher and plasma zinc and plasma peroxide concentrations were lower in diabetic than in control subjects. (Walter RM et al, 1991) Consequently, considering the possible modulating effects of zinc on insulin sensitivity and its antioxidant functions, it was postulated that a restored Zn status in individuals with type 2 DM might counteract the deleterious effects of oxidative stress and help to prevent complications associated with diabetes. (Anne-Marie Rousselet et al, 2003). In patients with type II diabetes mellitus, these patients had decreased serum zinc concentrations, because there presence of male absorption of zinc which leads to hyperzincuria. (Kinlaw WB et al, 1983) In diabetes, zinc is decreased, copper excretion increased, and SOD activity decreased. (Quilliot D et al, 2001). Therefore it was postulated that elevated levels of Cu-Zn SOD, elicit a protective effect against diabetes. (Halliwell B et al, 1994)

Another study it was found that the amounts of copper were increased but there were no significant alternation in levels of serum zinc in DM. (Pedrosa et al, 1999) The amounts of Cu-Zn SOD activity was found reduced in diabetic patient, the copper and zinc status of these diabetic patients was reduced, providing further evidence of a role for these antioxidant trace elements in this disease. (Williams NR et al, 1995).

Because zinc can exert a number of indirect antioxidant functions, a hypothesis in humans that increased zinc intake will protect against oxidant stress in persons with tendencies for both moderate zinc deficiency and high oxidant stress. (Disilvestro RA et al, 2000)
CHAPTER THREE

MATERIAL & METHODS

3. Materials and Method

3.1 Study design and time

Case control study, conducted during the period of December to July(2018)

3.2 Study area

The study was conducted at Alhasahissa in Al-Gazira state.

3.3 Study population

Sudanese patient with DM type II (Diabetes Mellitus)

3.4 Sample size

50 patients and 50 as control.

3.5 Inclusion criteria

Test group: Sudanese patients with DM type II

Control group: healthy subjects.

3.6 Exclusion criteria

Patients with diabetes mellitus type I, hypertension, excluded from this study.

3.7 Data collection

Data was collected through interview using self-administered questionnaire
3.8 Ethical consideration

This study was approved by the ethics committee, faculty of Al-Gaziera. The participants informed about the purpose of study and the samples collected from whom agreed to participate. Privacy and confidentiality of participants was ensured.

3.9 Data presentation

Data were presented in form of tables and figures.

3.10 Sample collection

Five ml of blood sample were collected in sterile container from all patients and controls through venipuncture, after washing hands and put on gloves, position the patient with the arm extended, were selected the appropriate vein then Applied the tourniquet 3-4 inches above the collection site, we cleaned the puncture site by making a smooth circular pass over the site with the 70% isopropyl alcohol, moving in an outward spiral from the zone of penetration. Patients had fasted from 8 p.m to 8 a.m. Specimens were collected at standardized time to minimize any effect of diurnal variation. The serum was used for determination of zinc by using atomic absorption spectroscopy.

3.11 Methodology:

3.11.1. Glucose

Glucose was measured in the samples using commercially available kits Biosystem Glucose oxidase method.

Principle

In the reaction, the glucose is oxidized to D-gluconate by the glucose oxidase with the formation of hydrogen peroxide. In the presence of peroxidase, a mixture of phenol and 4-aminoantipyrine is oxidized by hydrogen peroxide to form a red quinoneimine dye, which is proportional to the concentration of glucose in the sample.

Procedure

All reagents, samples and controls were brought to room temperature before starting the test. Serum samples free of hemolysis were used because any hemolysis will give false low result because the enzymes released will cause consumption of glucose. Also catalase liberated from RBCs will compete with peroxidase for hydrogen peroxide, giving untrue results. The test was carried out as follows: 1mL of colour reagent was pipetted in blank, standard and sample tube and 10µl of (distilled water, standard, and sample) was pipetted in reagent blank, standard, and sample tube respectively. Then tubes were mixed well and incubated for 10 minute at room
temperature. The final absorbance of the sample and standard was measured against the reagent blank.

3.11.2 Zinc

Zinc estimation by using colorimetric method using 5-Br-Paps zinc

Principle

Direct colorimetric test without deproteinization of the sample. At pH 8.6, in a buffered media, zinc reacts with the specific complex ant 5-Br-PAPS, forms a stable coloured complex. The colour intensity is proportional to the amount of zinc present in the sample.

Reagent

R1 (Buffer: 0.2 mol/L

R2 (color: 1.1mmol/L

R3 (reducing acid (powder).

Zinc CAL: Zinc primary standard 200 µg/dL

Preparation and stability

Working reagent (WR): Add one dose (dispense using the enclosed Spoon) of R3 to one vial of R1. Cap and mix gently to dissolve contents. Stability: 30 days at 2-8°C when stored tightly closed and contaminations prevented during their use.

- R2: Ready to use. After opening, is stable 90 days 2-8°C, if contamination avoided and vial recapped immediately after use.

-Zinkcal: Ready to use.

Samples

- Serum or plasma Nothaemolysed. Use only heparin salts as anticoagulants. Stability: 7 days at 2-8°C.

Centrifuge the sample at 3000 r.p.m. for 10-15 minutes.

Procedure

1. Allow reagents to reach working temperature before using. A
Proportional variation of the reaction volumes indicated does not change the result.

2. Assay conditions:

Wavelength: 560 nm (550-580)

Cuvette: 1 cm light path

Temperature: 25°C / 30°C / 37°C

3. Adjust the instrument to zero with distilled water.

4. Pipette into a cuvette

5. Mix and read the absorbance (A1) of the samples against the Blank. Add:

<table>
<thead>
<tr>
<th>Blank</th>
<th>Standard</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>B WR(ml)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Distilled Water</td>
<td>50</td>
<td>--</td>
</tr>
<tr>
<td>Standard(µl)</td>
<td>--</td>
<td>50</td>
</tr>
<tr>
<td>Sample(µl)</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

6. Mix and read the absorbance (A2) of sample and standard against Blank.

<table>
<thead>
<tr>
<th>Blank</th>
<th>Standard</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2(µl)</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Mix and read the absorbance (A2) of sample and standard against Blank. The color is stable for at least 1 hour.
Calculation


Conversion factor: µg/dL x 0.153 = µmol/L

3.12 Statistical analysis

All obtained results was analyze using Statistical Package for the Social Sciences (SPSS) version 21.0, with Pearson's chi-square test used to assess intergroup significance, and Student's t-test used to determine differences in means, other variables frequencies and odd ratio was calculate for comparison and presented in form of figures and tables. P value and odd ratio was use to assess the significance of the results.
CHAPTER FOUR

RESULTS and DISCUSSION

4.1 Results

A total of 100 Sudanese with Diabetes Mellitus disease participants, were enrolled in this study 50 of them as case and 50 of them as control group. The frequency of female were 56% in patients and 46% in control group, and The frequency of male were 44% in patients and 54% in control group. The ages ranged between (less than 30- more than 61) years in study (table 2). Most of the study participants were within the age group of 31-61 years (78%) in case group and (74%) in control group, followed by less than 30 years (14%) in case group (24%) in control group, while age group more than 61 years constituted the least (8%) in case group while (2) in control group. However, there was no significant difference in zinc level compared between case and control group (p > 0.05) in Table 3. Also showed there is significant (P value ≤ 0.05) in result of sugar level compared between case and control group.
Table 1: Show the number of sample under study according to gender:

<table>
<thead>
<tr>
<th>Gender</th>
<th>Patient</th>
<th>Percent of patient</th>
<th>Control</th>
<th>Percent of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>22</td>
<td>44%</td>
<td>27</td>
<td>54%</td>
</tr>
<tr>
<td>Female</td>
<td>28</td>
<td>56%</td>
<td>23</td>
<td>46%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>
Table 2: Show the Distribution of the study sample according to age group:

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Patient number</th>
<th>Percent of patient</th>
<th>Control number</th>
<th>Percent of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 30 years</td>
<td>7</td>
<td>14%</td>
<td>12</td>
<td>24%</td>
</tr>
<tr>
<td>31-61 years</td>
<td>39</td>
<td>78%</td>
<td>37</td>
<td>74%</td>
</tr>
<tr>
<td>More than 61 years</td>
<td>4</td>
<td>8%</td>
<td>1</td>
<td>2%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 3: compression of Zinc and sugar level in patients and control:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Patients (Mean ±Std)</th>
<th>Control (Mean ±Std)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc level</td>
<td>3.24±20.4</td>
<td>2.36±12.3</td>
<td>0.79</td>
</tr>
<tr>
<td>Sugar level</td>
<td>219.3±55.1</td>
<td>91.5±17.4</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Note:

p value is corresponding to t statistic test for the difference between the mean of the two groups. 

P value < than 0.05 considered significant

Table 4: Show association between Zinc level and gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Zinc level</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Less than 0.6</td>
<td>0.6-1.1</td>
<td>More than 1.1</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>33(55.9%)</td>
<td>14(40%)</td>
<td>4(66.7%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>26(44.1%)</td>
<td>21(60%)</td>
<td>2(33.3%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59(100%)</td>
<td>35(100%)</td>
<td>6(100%)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1 - Gender

![Gender Chart]

Figure 2 - Age in Years

![Age in Years Chart]
figur-3-zinc level
Fig 1: scatter plot show relation between zinc level in case and duration of disease ($r = 0.08$, $p$ value $= 0.5$)
4.2 Discussion

In recent years, chronic diseases such as diabetes have been shown to be a major cause of death worldwide and there is accumulating evidence that the metabolism of these trace elements in particular zinc, chromium and magnesium is altered in diabetes mellitus and these elements might have specific roles in the pathogenesis progress of this disease. The present study was designed to evaluate serum levels of zinc in diabetic Type II patients and control group. This study was conducted on 100 individuals categorized into 2 groups, 50 normal subjects considered as control group and 50 patients with type II diabetes, age and gender of test group are matched with control group.

This study was carried out to determine Zinc level and glucose blood test of patients with diabetes mellitus disease in Gazira state. Age of study population ranged between less than 31- more than 61 years old. Both sexes were included in the study group, Female were (n=28) or 56% and male were (n=22) or 44% from study group. While control groups male were account were (n=27) or 54% and female (n=23) or 46%.

Zinc levels in diabetics in our study seem to be higher than control group. Our result agree with other studies that shown increased Zn in diabetes mellitus (Osman E et al, 2004, D’Ocon C et al, 1987, Mateo MC et al, 1978) The increase in zinc levels in diabetics could be explained by the finding that oxidative stress in diabetics could lead to destruction of β-cells, therefore to the release of high amounts of zinc from the cells into blood stream, therefore increase in zinc levels in serum occurs (Quilliot D et al, 2001, Faure P et al, 1992), the increase of plasma zinc can also reflect a deficient storage or a chronic hyper secretion of insulin in hyperglycemic patients (Mateo MC et al, 1978). Despite the increase in the zinc levels in diabetics, there was no correlation between Zn and glucose. The absence of any correlations between zinc and glucose is not restricted to studies which show an increase in the levels of glucose (Osman E et al 2004), but also in studies which have shown a decrease in the levels of glucose (Hunt JV et al, 1991).

And disagree with study done by Thiyam Romola (Thiyam Romola et al, 2016) that found Serum zinc level was significantly lower and another study by Naila Masood that found lower of zinc level (mean: 2.03±0.39 mg/dL) in diabetic patients as compared to control subjects (4.84±4.217 mg/dL) (Naila Masood et al, 2009)
In this study, there was no relation between duration of disease and age ($r = 0.080$ and $P.\text{value} = 0.5$. In this study, glucose showed significant different with serum zinc ($P.\text{value} 0.000$) and this disagree with study who reported that, there was insignicant correlation of blood glucose level with Zn.(Elsonni B et al 2011)
CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

- The serum levels of zinc are increase in patients with type II diabetes mellitus
- There was significant correlation between serum levels of zinc and plasma level of glucose.
- Duration of disease showed no correlation with age

5.2 Recommendation

- In order to get more information data, sample size should be increased in related subsequent researches.
- Regular follow up.
- Diabetic patients should be advised to increase the amount of food that contains zinc but after measurement of zinc.
- Generally, health education, diet control and exercise are important factors in lowering body weight especially in obese patients so as to achieve good control of diabetes mellitus. Also recommend to more detailed study on patients with diabetes mellitus.
References


• Elsonni B, serum chromium, zinc and magnesium levels in Sudanese patients with type 2 diabetes, Gezira Journal of Health. (2011); Vol 1


Mayne PD. Clinical Chemistry in diagnosis and treatment. 6th ed. ARNOLD (1998); 197-235.


Osman E., vliyaoğlu., Levent K., Nuriye U., Nazife K., Baysal K., Ruhan K., Naciye Y.,( 2004)-"Correlations of Serum Cu+2, Zn+2, Mg+2 and HbA1c in Type 2 and Type 2 Diabetes Mellitus ". Turk. J. of Endo.andMetab. 8(3) Page(s) 75-79.


Thiyam Romola Devi, Davina Hijam, Abhishek Dubey, Suman Debnath, Prabita Oinam, NG. Taruni Devi, W. Gyaneshwar Singh (2016). Study of Serum Zinc and Copper levels in Type 2 Diabetes Mellitus ,ISSN (Online): 2393-915X; (Print): 2454-7379 | ICV: 50.43 | Volume 3 | Issue 4 | April


• Women Health document, 06 may (2005).


1-QUESTIONNARE

Sex: Male ( ) Female ( )

Age: ....................................................

Occupational: ...........................................

Duration of disease: .................................

...................................................................................

......

Results:

Sugar result: ..................................................

Zinc level result: ............................................