بسم الله الرحمن الرحيم

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تم رفع هذه الرسالة بواسطة / سلوي محمود عقل

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

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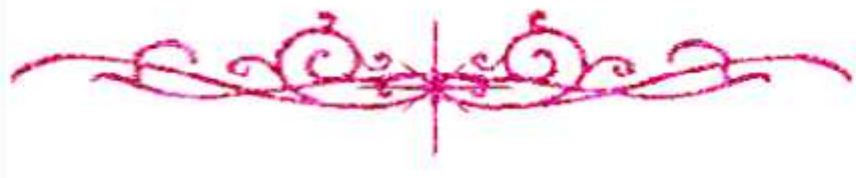
Salwa MAHMOUD Aki

تم بحمد الله



Serum Zinc level before and after low carbohydrate diet in overweight and obese Ain Shams University Students

Thesis

Submitted for Partial Fulfillment of Master Degree in Clinical Nutrition

By

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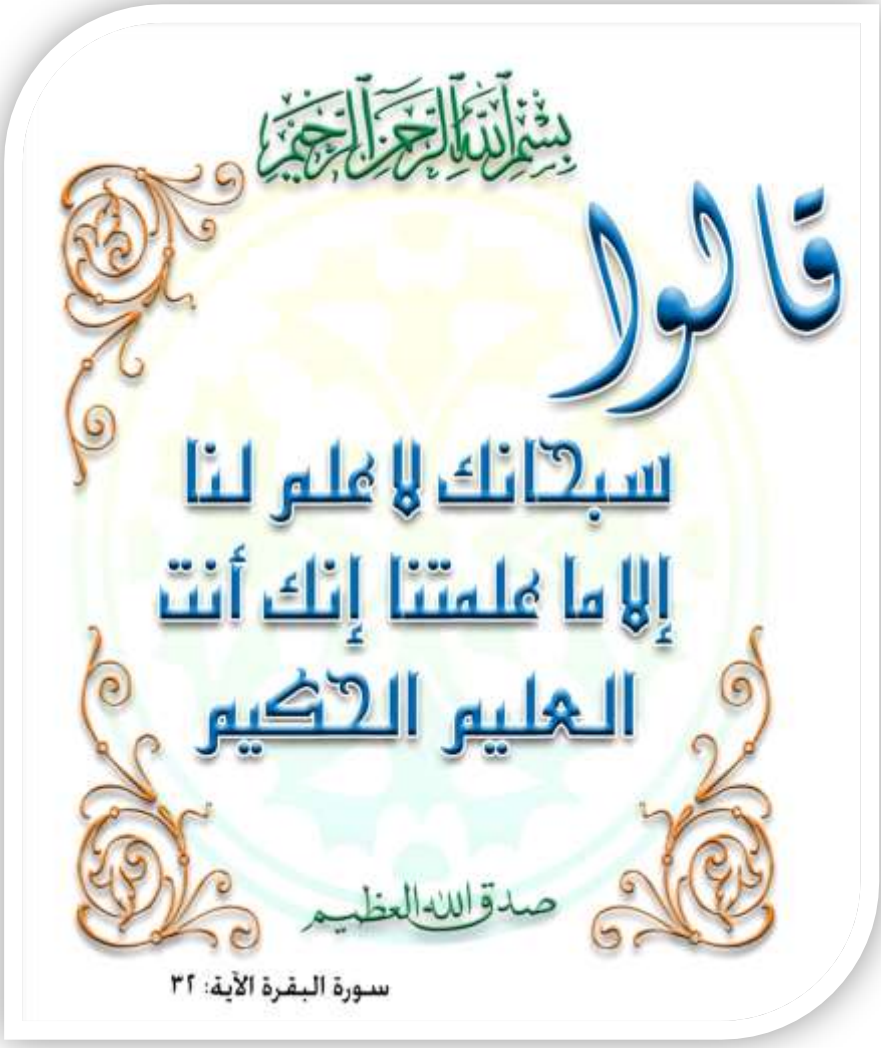
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سبحانك لا علم لنا
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صدق الله العظيم
سورة البقرة الآية: ٣٢

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Mennat Allah Ali Ali Shetaya

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List of Abbreviations

Abbr.	Full-term
ADHD	**:** Attention deficit hyperactivity disorder
ASU	**:** Ain Shams University
BMI	**:** Body mass index
CRP	**:** C-reactive protein
DNA	**:** Deoxyribonucleic acid
IDF	**:** International Diabetes Federation
IL	**:** Interleukin
LChD	**:** Low carbohydrate diet
NAFLD	**:** Nonalcoholic fatty liver disease
NAMS	**:** Nutritional Assessment of Medical Students
PTP1B	**:** Protein tyrosine phosphatase 1B
RNA	**:** Ribonucleic acid
SD	**:** Standard deviation
SPSS	**:** Statistical package for social science
T2DM	**:** Type 2 diabetes mellitus
TNF- α	**:** Tumor necrosis factor-alpha
VLChD	**:** Very-LCHD
WHO	**:** World Health Organization
Zn	**:** Zinc

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Introduction

Overweight and obesity are defined as abnormal or excessive fat accumulation leading to health impairment. Body mass index (BMI), a simple index of weight-for-height commonly used to classify overweight and obesity in adults, is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m^2). For adults, the World Health Organization (WHO) defines overweight and obesity as follows: overweight is a BMI greater than or equal to 25 and Obesity is a BMI greater than or equal to 30 ***(World Health Organization, 2020).***

Currently, obesity is the fifth greatest risk factor for mortality. The increase in obesity rates presents a major public health concern as it is associated with a number of co-morbidities such as cardiovascular diseases, hypertension, stroke, type 2 diabetes mellitus (T2DM), dyslipidemia, osteoarthritis, as well as some cancers ***(Schutz et al., 2019).***

Nutritional disorders and obesity commonly co-exist, studies have attempted to clarify the disturbance in mineral metabolism in the presence of obesity. Some studies have shown that zinc (Zn) concentrations in plasma and erythrocytes are reduced in obese people whereas Zn supplementation improves various physiological functions in such patients ***(Martins et al., 2014).***

Indeed Zn is required for many biological functions including DNA synthesis, cell division, gene expression, and the activity of various enzymes in humans and animals ***(Ishikawa et al., 2005).***

Dietary carbohydrate restriction has long become a topic of interest to both overweight and obese patients as well as clinicians. In low-carbohydrate diets, energy from carbohydrate is generally replaced by energy from fat. Low-carbohydrate diet is defined as <130 g/d or <26% of total daily energy consumption ***(Friedman et al., 2012).*** Different potential benefits of carbohydrate restriction may include fat mobilization, oxidation and reductions in the TG/HDL ratio, a marker of insulin resistance ***(Scott et al., 2019).***

Taken together the benefits of carbohydrate restriction in overweight/obese patients and the altered serum Zn levels in these patients, it was tempting to further investigate serum Zn levels before and after low carbohydrate diet in overweight/ obese youth, where to our knowledge, this is the first clinical study targeting this subject in Egypt.

Aim of the work

This study is a part of The Nutritional Assessment of Medical Students of Ain Shams University (NAMS/ASU). The project was designed to evaluate the nutritional status of the undergraduate medical students.

The aim of the present work was to:

Evaluate serum zinc levels before and after 40 days of low carbohydrate diet in overweight and obese medical students in Faculty of Medicine Ain Shams University.

Obesity and associated co-morbidities

Obesity is a complex, multifactorial, and largely preventable disease, affecting, along with overweight, over a third of the world's population. If secular trends continue, by 2030 an estimated 38% of the world's adult population will be overweight and another 20% will be obese ***(Kumar et al., 2019).***

Obesity greatly increases the risk of chronic disease morbidity namely disability, depression, T2DM, cardiovascular disease, certain cancers, and mortality. Childhood obesity results in the same comorbidities, with premature onset, or with greater likelihood in adulthood. Thus, the economic and psychosocial costs of obesity alone, as well as when coupled with these comorbidities, are striking ***(Chooi et al., 2019).***

Table (1): Common Classifications of Body Weight in Adults and Children ***(Hruby and Hu, 2015)***

	Age	Indicator	Normal	Overweight	Obese
Adults[b]	≥20 years	BMI (kg/m^2)	18.50 to 24.99	≥25.00 *Preobese*[c]*: 25.00 to 29.99*	≥30.00[a] *Class 1: 30.00 to 34.99* *Class 2: 35.00 to 39.99* *Class 3: ≥40.00*
Children *International*					
WHO 2006[d]	0-60 months	BMI Z or WH Z	>−2 to ≤2 SD *At risk of overweight: >1 to ≤2 SD*	*>2* to ≤3 SD	>3 SD
WHO 2007[e]	5-19 years	BMI Z	>−2 to ≤1 SD	>1 to ≤2 SD	>2 SD
IOTF[f]	2-18 years	Growth curve for BMI at age 18		BMI = 25	BMI = 30
USA [g]	2-19 years	BMI percentile	≥5th to <85th	≥85th to <95th	≥95th

BMI: body mass index; IOTF: International Obesity Task Force; SD: standard deviation; WHO: World Health Organization; WH: weight-for-height; Z: *z* score.

Obesity effects and comorbidities

a) Anatomical Effects

An obese person with stable weight, as compared with a person without overweight or obesity, has larger fat and lean mass, along with higher resting energy expenditure, cardiac output, blood pressure and greater pancreatic β-cell mass ***(Hall et al., 2010).*** Moreover, insulin secretion in the fasting

state and after a glucose load increases linearly with the BMI ***(Grant and Dixit, 2015).***

Excess adiposity also imposes a mechanical load on joints, making obesity a risk factor for the development of osteoarthritis ***(Goldring and Otero, 2011)***. In addition, with weight gain over time, excess lipids are distributed to many body compartments. Obesity is often accompanied by an increase in pharyngeal soft tissues, which can block airways during sleep and lead to obstructive sleep apnea ***(Grant and Dixit, 2015).***

Furthermore, an increase in intraabdominal pressure accounts for the elevated risks of gastroesophageal reflux disease, Barrett's esophagus, and esophageal adenocarcinoma among persons who are overweight or obese ***(Tse et al., 2018).***

b) Metabolic effects and comorbidities

Adipocytes synthesize adipokines (cell-signaling proteins) and hormones, the secretion rates and effects of which are influenced by the distribution and amount of adipose tissue present. Excessive secretion of proinflammatory adipokines by adipocytes and macrophages within adipose tissue leads to a low-grade systemic inflammatory state in some persons with obesity ***(Tchkonia et al., 2013).***