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Relationship Between Obesity and Immunological Parameters Among Students at the PSAU University- Alkharj, KSA

Hayat Alafari

Dept of Biology, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia

Dalal. S. Alshaya

Dept of Biology, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia

Yaser Alnaam

Dept of CLS, Prince Sultan Military College for health Sciences, Dhahran, Saudi Arabia

Rawiah Alsiary

KAIMRC center, KSAU, Jeddah, Saudi Arabia

Abeer Alsofyani

KAIMRC center, KSAU, Jeddah, Saudi Arabia

Masha'el Altoub

Dept of Med Lab Sci, College of Appl Med Sci, KSU, Riyadh, Saudi Arabia

Talat Bukhari

College of Medicine, Um Qura University, Makka, Saudi Arabia

Aisha Alanazi

Prince Sultan Medical City, Military Hospital, Riyadh, Saudi Arabia

Noufa Alonazi

Prince Sultan Medical City, Military Hospital, Riyadh, Saudi Arabia

Maha Alanazi

Prince Sultan Medical City, Military Hospital, Riyadh, Saudi Arabia

Hajir Alsaihati

Dept of Med Lab Sci, College of Appl Med Sci, Hafr Albatan University, Saudi Arabia

Awal Zaki

Dammam Regional Lab, Dammam, Saudi Arabia

Abdulkarim S. Bin Shaya

Dept of Med Lab Sci, College of Appl Med Sci, Prince Sattam University. Alkharj, Saudi Arabia

Noura Aldheyan

Dept of Med Lab Sci, College of Appl Med Sci, Prince Sattam University. Alkharj, Saudi Arabia

Nahed Alharthi

Dept of Med Lab Sci, College of Appl Med Sci, Prince Sattam University. Alkharj, Saudi Arabia

Zyad Alanazi

Dept of Med Lab Sci, College of Appl Med Sci, Prince Sattam University. Alkharj, Saudi Arabia

Abdulrahman Alqahtani

Dept of Med Lab Sci, College of Appl Med Sci, Prince Sattam University. Alkharj, Saudi Arabia

Salman Alzehairi

Dept of Med Lab Sci, College of Appl Med Sci, Prince Sattam University. Alkharj, Saudi Arabia

Nadiyah Alenezi

Health Affairs, Madina, Saudi Arabia

Rakan Alanazi

Alfaisal University, Riyadh, Saudi Arabia

Naif Alruwaili

RT Dept, Prince Mohamed Hospital, Riyadh, Saudi Arabia

Hiba S. Al-Amodi

Department of Biochemistry, Faculty of Medicine, Umm Al-Qura University, Saudi Arabia

Essa E. Alanazi

Virology Lab, KSMC, Riyadh, Saudi Arabia

Fadel H. Alhababi

Virology Lab, KSMC, Riyadh, Saudi Arabia

Ibrahim M. Aldeajle

Virology Lab, KSMC, Riyadh, Saudi Arabia

Awwad K. Aalenezy

Dept. of Family and Community Medicine, Faculty of Medicine, NBU, Saudi Arabia

Abulrahman Zekri

Human Genetic Center Cancer Biology Department National Cancer Institute, Cairo, Egypt

Faris Q. B. Alenzi

Dept of Med Lab Sci, College of Appl Med Sci, Prince Sattam University. Alkharj, Saudi Arabia

Abstract--Obesity represents a major worldwide health problem, all aspects of which have not fully defined, nor fully understood. In the current study, we investigated a population of university students in terms of the relationship between incidence of obesity in individuals (n=171), within this larger cohort (n=500), with the comorbidities that these high BMI individuals also carried. We also report important statistical differences in blood levels each of cardiac-related protein (CRP)(p=0.002), IL-6(p=0.005), & leptin(p=0.02), when we related the blood values with individual student BMIs which were used as a measure of obesity.

Keywords--BMI, CRP, leptin, obesity, Saudi Arabia.

Introduction

Obesity is a global epidemic that affects large populations, both in rich and poor countries. There are nearly 500 million obese adults worldwide, and another 1.5 billion are overweight. Obesity results from an imbalance between food intake and energy expenditure leading to an excessive accumulation of adipose tissue (Weiss, J 200). Obesity has become more prevalent in the last few decades, especially young adults (WHO report 2000). Whilst obesity can be broadly defined as an excess in body fat which leads to ill health; however, the body mass index (BMI kg/m²) offers a more practical classification for identifying and monitoring obesity (Bray G 1998). BMI is calculated by dividing body mass (kg) by squared height (m²). Adults with a BMI ≥ 30 kg/m² are classified as obese, those with a BMI of 25–29.9 are regarded as overweight. A BMI between 18.5–24.9 is considered normal, whilst a BMI < 18.5 is considered underweight.

Links have been described between obesity and many risk factors, these include: smoking, cardiovascular disease (CVD), cancer, osteoarthritis and sleep apnoea (Bray G 1985 & Dandona P, 2004). In the US and UK, the prevalence of obesity has doubled since the 1980's. Saudi Arabia is among the fastest growing economies of the world. As a result, there have been significant modifications in

the lifestyle of the population of Saudi Arabia, including changes in eating habits and physical activity (Streib, Forbes report; 2007 & ElMouzan M, 2010 & Al-Malki, 2003 & Al-Rethaiaa, 2010 & Al-Qahtani, 2005 & Horaib, 2013 & Hussain 2014).

When leptin, a hormone released by adipose cells in the small intestine, is released into the circulation, its plasma levels correlate with BMI. Leptin induces proliferation and differentiation of hematopoietic cells. It also stimulates (a) proliferation of monocytes/macrophages; (b) activation of neutrophils by inducing TNF- α and IL-6 production; (c) Th1-type cytokine production. These findings may help explain the fact that obesity is associated with nearly 40% of some malignancies, such as thyroid, colon cancers, multiple myeloma and leukemia. Accordingly, the purpose of the current study was to assess the prevalence and immunological parameters of obesity of Saudi students at the PSAU.

Materials and Methods

Subjects

Characteristic of samples

Data were collected as a questionnaire, which included demographic information and relevance to chronic diseases. This survey that included 500 Saudi students studying at the PSAU, Alkharj region, Saudi Arabia, during the period from Sept 2018 to December 2021.

Characteristic of obese students

A total of 171 of 500 students were classified as obese and undertaken for further immunological investigations. BMI was calculated from measured height and weight and thereby classified as follows: overweight (25–30 kg/m²); and obese (30–35 kg/m²), morbidly obesity (>36 kg/m²).

Measurement of serum CRP level

The sera were separated from thirty obese and thirty healthy controls (aged and sex matched) and were used to assess the concentrations of CRP. All samples were screened to confirm the presence of CRP by using Card-CRP Single Test (Axis-Shield, Norway) according to the manufacturer's instructions. The level of CRP of positive samples was measured by using CRP enzyme-linked immunosorbent assay-ELISA Kit (Abcam, Massachusetts, USA). The normal range of serum level of CRP is less than 8mg/ml, 'positive' samples those who have 9mg/ml or greater

Measurement of serum IL-6

Once the sera were separated from thirty obese and thirty healthy controls (aged and sex matched), they were also used to assess the concentrations of cytokines. Plasma from all groups were collected and stored at -20°C for later analysis. During analysis, an ELISA kit was used for measuring cytokines. Sample duplicates were utilized and the analytic procedure was carried out according to

manufacturer's manual. Luminex kits were used to analyze patients' plasma and was purchased from (Merck Millipore, MILLIPLEX MAP Human) and they were used as per manufacturer's instructions.

LEPTIN measurements

Once the sera were separated from thirty obese and thirty health control (aged and sex matched), they were also used to assess the concentrations of Leptin. Serum leptin was measured by enzyme-linked immunosorbant assay (sandwich method).

Statistical analysis

Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) for Windows, version 10.0.1, 1999. Student t-test, and Mann-Whitney test were applied as appropriate according to the results of Levene test of homogeneity of variances. Pearson correlation coefficients were also calculated.

Results

The mean age of the study population was 20.5 ± 2.5 years for males, and 19.4 ± 5.8 for females. Males;females' ratio was 4: 1. As shown in Fig 1. the prevalence rates of obesity in the PSAU was 34.2%.

Table 1 shows that the majority of the students were between 17-20 years old, although a few of them were >25 years old.

Table 1
Subject distribution according to age

Age	of participants
17-20 years old	56%
21-24 years old	41%
25 and More years old	3%

Table 2, shows that there was a 2:1 preponderance of males in the study group.

Table 2
Subject distribution according to gender

Sex	% of participants
Male	66%
Female	34%

Table 3; shows the distribution of obese students according to their college of study. The highest incidence of obesity was amongst students of engineering, followed by students of CAMS at 56%, then students in their preparatory year at 30%. Students of medicine (3%) were the least obese.

Table 3
Subject distribution according to college of study

College	Number of Obese Participants
Medicine	3
CAMS	56
Pharmacy	14
Engineering	91
Computing	21
Administration	16
Preparatory Year	30

Table 4 also shows which additional chronic diseases were present in obese students. We found that allergy was the most common among these students (75), then asthma (10), and lastly BP and DM at 2 and 1 respectively.

Table 4
Association between obesity and chronic diseases

Diseases	Number of obese participants
blood pressure (BP)	1
Diabetes (DM)	2
Allergy (Eye, Skin, GIT)	75
Asthma	10
Others	5

Table 5 shows we found a significant difference in CRP production between obese and non obese subjects ($p=0.002$)

Table 5
Measurement of CRP

	CRP
CONTROL	1.8±1.0 mg/L
Obese students	17.2 ±0.8mg/L

Table 6 shows we identified a significant difference in IL-6 production in the obese subjects compared to non obese ($p=0.005$)

Table 6
Measurement of Cytokine IL-6

	IL-6
CONTROL	2.5±0.6 pg/mL.
Obese students	6.7±0.5 pg/mL.

Table 7 demonstrates a trend difference in Leptin production in obese subjects compared to non obese ($p=0.2$)

Table 7
Measurement of Leptin

	LEPTIN
CONTROL	11.1±2.4 ng/mL
Obese students	17.2 ±3.1ng/mL

Discussion

According to Forbes, Saudi Arabia ranked number 29 on a 2007 list of the countries in terms of the percentage (6%) of its citizens being overweight (BMI > 25) (Streib, Forbes report, 2007). There are many local published studies that report the relatively high prevalence of obesity in the KSA. First was among college students (21.8%) (ElMouzan, 2010 & Al-Malki, 2003 & Al-Rethaiaa, 2010 (Second; in a study in 2004 over 82% of the subjects were either overweight or obese) (Al-Qahtani, 2005). Third, a study (2009–2011) to measure the prevalence of obesity among military personnel in KSA, it was reported that 40.9% of the participants were overweight, with 29% obese (Horaib, 2013). Fourth; a study on the prevalence rates of obesity in the Hail region (in Baqaa, Ash Shinan and Ghazala were, 64%, 70%, 69%, and 55%, respectively) (Hussain Ahmed, 2014). Internationally, the prevalence of obesity is highest in USA (26%) and lowest in South East Asia (3%) (GHO report, 2013).

In the current study, we showed a weak link between obesity, hypertension, and diabetes, but a statistically significant difference between obesity and allergy reactions ($p=0.001$). At least four papers, some very recent, have previously shown an increase in the CRP in obese subjects compared to non-obese subjects: (Pavela, 2018 & Aronson 2004 & Visser 1999 & Cohen E, 2021) (However, in contrast to this, Hassaein et al provided data that suggested CRP is not affected by obesity) (Hassaein, 2016). Moreover, our results are also agreement with five papers which detected higher serum IL-6 among obese individuals (Gillespie, 2016 & ElKader, 2016 & Roytblat, 2000 & ElByoumy 2017 & ElMikkawy, 2020). Additionally our results are also concordant with two papers which demonstrated higher plasma Leptin levels among obese individuals (Milaneschi, 2012 & Izquierdo, 2019)

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