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BRIEF COMMUNICATION

Insulin Resistance and its Correlation with Risk Factors for Developing Diabetes Mellitus in 100 Omani Medical Students

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مقاومة الانسولين وارتباطها مع بعوامل الاختطار لتطور مرض السكري في 100 من طلاب الطب العمانيين

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ABSTRACT: ***Objectives:*** The aim of this study was to assess the prevalence of insulin resistance (IR) in healthy young Omanis and relate this with their body mass index (BMI) and family history (FH) of diabetes mellitus (DM). ***Methods:*** This study was conducted between May 2009 and February 2010 at Sultan Qaboos University, Muscat, Oman. A detailed questionnaire was completed by 50 male and 50 female medical students between 20–25 years old. Fasting blood samples were obtained for serum glucose and insulin measurements. IR was calculated using the homeostasis model assessment-estimated insulin resistance (HOMA-IR) formula (fasting insulin x fasting glucose/22.5) and a value above 2.5 was considered elevated. The results were analysed using the Statistical Package for the Social Sciences (SPSS). ***Results:*** Participants were classified into the following BMI categories: 59% were normal (18.5–24.9 kg/m^2), 26% were overweight or obese (>24.9 kg/m^2) and 15% were underweight (<18.5 kg/m^2). A FH of DM was present in 74%. The HOMA-IR index was elevated in 16% and was directly correlated to the BMI (P = 0.003). There was no correlation between IR and a positive FH of DM. ***Conclusion:*** There is a high prevalence of IR (16%) and obesity (26%) in healthy young Omani medical students. Counselling is recommended for all overweight and obese individuals in an attempt to prevent or delay the onset of DM in the future.

Keywords: Insulin Resistance; Diabetes; Body Mass Index; Obesity; Young Adults; Oman.

الملخص: الهدف: الهدف من هذه الدراسة هو تقييم مدى انتشار مقاومة الأنسولين (IR) عند الشباب العمانيين الأصحاء و علاقة ذلك مع مؤشر كتلة الجسم (BMI) والتاريخ العائلي لديهم بخصوص داء السكري (DM). **الطريقة:** أجريت هذه الدراسة بين مايو 2009 وفبراير 2010 في جامعة السلطان قابوس في مسقط، سلطنة عمان. تم تعبئة استبيان مفصل من قبل 50 من الذكور و 50 من الإناث من طلاب الطب تتراوح أعمارهم 20–25 سنة. تم أخذ عينات من الدم لقياس الجلوكوز و الأنسولين في حالة الصيام. تم حساب مقاومة الأنسولين باستخدام معادلة (HOMA – IR) بصيغة (الجلوكوز X الأنسولين/22.5) فإذا كانت القراءة أعلى من 2.5 فيتم اعتباره مقاوم للأنسولين. وقد تم تحليل النتائج باستخدام برنامج (SPSS). **النتائج:** تم تصنيف المشاركين لفئات حسب معامل كتلة الجسم (BMI) كالتالي: 59% كانت طبيعية (18.5–24.9 كجم/م^2)، و 26% يعانون من زيادة الوزن أو السمنة (> 24.9 كجم/م^2) و 15% يعانون من نقص الوزن (< 18.5 كجم/م^2). وكانت نسبة وجود التاريخ العائلي لمرض السكري عند الأشخاص المشاركين في الدراسة 74%. وكانت نسبة مقاومة الأنسولين 16% وكان له ارتباط مباشر مع مؤشر كتلة الجسم (P = 0.003). لم تكن هناك أي علاقة بين مقاومة الأنسولين ووجود التاريخ العائلي لمرض السكري. **الخلاصة:** هناك ارتفاع في معدل انتشار مقاومة الأنسولين (16%) والبدانة (26%) في شباب طلاب الطب العماني. يوصى بتقديم النصح لجميع الأفراد المصابين بالبدانة في محاولة لمنع أو تأخير ظهور مرض السكري في المستقبل.

مفتاح الكلمات: مقاومة الأنسولين؛ معامل كتلة الجسم؛ البدانة؛ الشباب؛ سلطنة عمان.

In recent decades, diabetes mellitus (DM) has become one of the most challenging medical issues worldwide. The World Health Organization (WHO) estimates a 190% increase in the number of people living with DM in Oman over the next 20 years, from 75,000 in 2000 to 217,000 in 2025.[1] The distribution of chronic diseases and related risk factors among the Omani general population is similar to that of industrialised nations: 12% of the population have diabetes, 30% are overweight, 20% are obese, 41% have high cholesterol and 21% have metabolic syndrome.[1]

Insulin resistance (IR) is a major risk factor for developing metabolic syndrome. In clinical practice, IR refers to a state in which a given concentration of insulin is associated with a subnormal glucose response.[2] In addition, IR is a precursor to the development of overt diabetes. It is therefore necessary to establish the magnitude of this problem in the Omani society and, armed with this knowledge, develop measures to delay or prevent the onset of DM in affected individuals.

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Table 1: Percentage of the sample of medical students according to insulin resistance, body mass index category and family history of diabetes (N = 100)

Category	Participants %		
	Male n = 50	Female n = 50	Total
IR	10	6	16
Underweight BMI	8	7	15
Normal BMI	27	32	59
Overweight or obese BMI	15	11	26
Family history of DM	37	37	74

IR = insulin resistance; BMI = body mass index; DM = diabetes mellitus.

The aim of this study was to establish the prevalence of IR in a group of healthy, young Omani medical students and to correlate these findings with their body mass index (BMI) and the presence or absence of a positive family history (FH) of diabetes.

Methods

Omani students from the College of Medicine & Health Sciences of Sultan Qaboos University (SQU) in Muscat, Oman, were invited to participate in this study between May 2009 and February 2010. Investigators visited the students' classes and explained the nature, benefits, risks and anticipated outcomes of the study. Smokers, diabetics, those taking regular medications and/or those with other medical problems were excluded from the study leaving 100 participants included in the study.

The study group was comprised of 50 male and 50 female medical students between 20–25 years old in their fourth to sixth year of university and representing different regions of Oman. Most of the participants were from northern Omani governorates (Muscat, Al-Dakhliyah, Al-Batena, Al-Sharqiyah, Al-Dahahira and Musandam). Although, the participants represented the overall population of young Omanis in terms of geographical region, they did not give a fair representation of the overall young Omani population in terms of educational level.

Each student anonymously filled out a questionnaire to determine the following: age; history of DM and other medical problems; regular medications taken; FH of DM with subtypes of first degree (mother, father, brother or sister) or second degree (grandfather, grandmother, uncle or aunt); smoking status, and weight, height and BMI measurements. Participants then underwent investigations to determine their fasting serum insulin and glucose levels. Insulin levels were measured with the Access® 2 Immunoassay System (Beckman Coulter, Inc., Brea, California, USA) using the chemiluminescence immunoassay principle while glucose levels were measured with the COBAS INTEGRA® 800 analyser (Roche Diagnostics Ltd., Basel, Switzerland) using the spectrophotometry principle. The clinical applications regarding the calculation of IR have not yet been standardised. However, the most reliable method to evaluate IR was chosen, the homeostasis model assessment-estimated insulin resistance (HOMA-IR). The HOMA-IR is calculated using the following formula: fasting insulin in μU/mL is multiplied by fasting glucose in mmol/L and divided by 22.5. The cut-off rate for abnormal values is between ≥2.1–2.7.[3] A HOMA-IR level of >2.5 was considered abnormal. This level was decided upon based on the current clinical evidence that suggests using 2.5 as a cutoff point for IR.[4] BMI was calculated by assessing each participant's weight and height. Participants were then classified as either underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2) or overweight/obese (≥25 kg/m^2).

The data from the questionnaires and investigations were collected and analysed using the Statistical Package for the Social Sciences (SPSS),

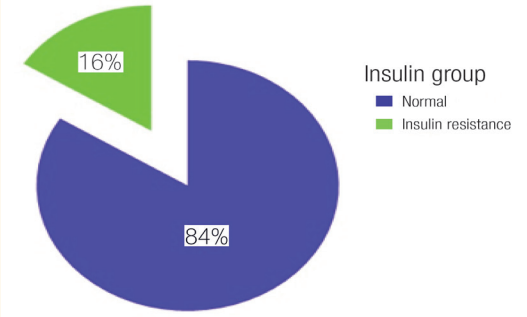

Figure 1: Percentage of the sample of medical students by insulin group (N = 100).

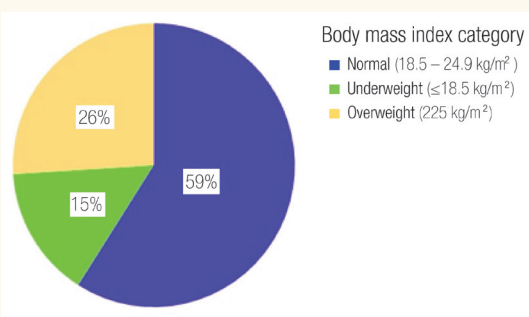

Figure 2: Percentage of the sample of medical students by body mass index category (N = 100).

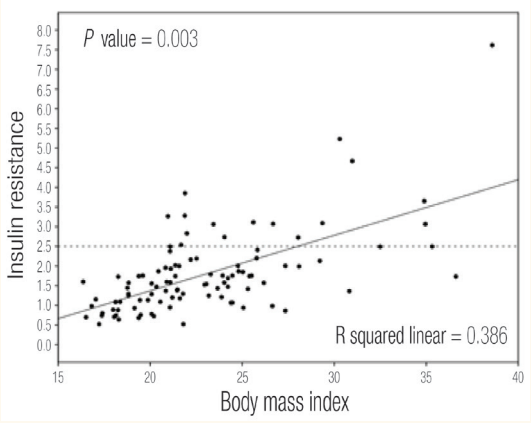

Figure 3: Significant direct correlation between body mass index and insulin resistance among the sample of medical students (N = 100).

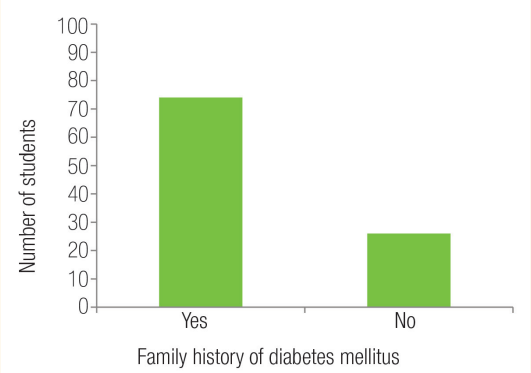

Figure 4: Number of students with and without a family history of diabetes (N = 100).

Version 16 (IBM Corp., Chicago, Illinois, USA), using the Pearson's Chi-squared test, Student's t-test and Pearson product-moment correlation coefficient. A *P* value of <0.05 was considered statistically significant and a 95% confidence interval (CI) was used.

Fully informed written consent was obtained from each participant. The study was approved by the Medical Research & Ethics Committee of the College of Medicine & Health Sciences at SQU.

Results

The data showed a high prevalence of IR (16%) among the 100 healthy subjects [Table 1 and Figure 1]. The 95% CI for the IR of the students was 2.99–4.19 and the mean was 3.59. There was a high prevalence of obesity (26%) among the sample, while 59% of the participants had a normal BMI and 15% were underweight [Figure 2]. IR was significantly associated with a high BMI (*P* = 0.003). Obesity was the main determinant of the degree of IR, while all subjects with a BMI of ≤21Kg/m^2 had no IR [Figure 3]. A large majority students (74%) had a positive FH of DM at either the first degree, second degree or both [Figure 4]. The results showed no correlation between IR and a positive FH of DM (*P* = 0.771).

Discussion

The current study found a high prevalence (26%) of obese and overweight Omani students. This finding strongly supports a recent study conducted among 202 Omani students of both genders which found that approximately 28% were overweight or obese.[5] In addition, 16% of the subjects was found to have IR. The association between IR and BMI was statistically significant and no student with a BMI of ≤21 kg/m^2 had a raised IR.[5] This finding is consistent with previous studies demonstrating that obesity is one of the most important risk factors for developing IR.[6,7]

Out of the 16 students with IR and a mean BMI of 28.02 kg/m^2, 10 were male and six were female. However, the significant association between IR and high BMI in terms of gender was biased due to the small sample size.

A positive FH for DM is a controversial contributing risk factor for developing IR and DM. Some research has demonstrated a significant association between a positive FH of DM and IR,[8] whereas other studies strongly disagree.[9,10] In the current study, 74% of participants had a FH of DM at either the first degree, second degree or both. However, the association between IR and a FH of DM was not statistically significant. It is difficult to conclude either the presence or absence of an association between IR and a positive FH of DM from the current study as almost two-thirds of the sample had a positive FH. This may have masked the significant association between these risk factors.

Awareness of IR and the associated risk of developing DM, as well as the strong association of these variables with obesity, will help improve Oman's healthcare and patient outcomes. The primary prevention of DM should occur through lifestyle modifications, including improvements in diet and levels of physical exercise. The data in this study underscore the need for public education and awareness of these issues.

A genetic predisposition for type 2 (T2) DM is a very important contributing risk factor; there are increasing reports of several mutations associated with the development of T2DM, such as the *PPARG* and *CAPN10* genes.[11,12] However, certain ethnic groups have specific genes that increase the risk of developing T2DM. For example, the Chinese population exhibits

the presence of the *TCF7L2* gene, which puts them at increased risk for DM.[13] However, further studies with larger samples are needed, including studies to evaluate other factors like genetic determinants, especially in those who test positive for IR.

The IR-positive individuals among the study population will continue to be followed-up in the coming years so as to measure the true likelihood of them developing DM. All of the volunteers' data and contact detils have been preserved for future longitudinal studies. Such studies would help healthcare professionals in the early identification and treatment of patients who are at risk of developing DM.

Conclusion

The prevalence of IR in healthy Omani medical students was found to be quite high in this study. Obesity was also prevalent and there was a direct correlation between BMI and IR. Significant IR was not seen in those with a BMI of 21 or less. The authors recommend efforts to reduce the prevalence of obesity, especially among young people, by promoting a healthy diet and physical exercise. This will reduce the prevalence of IR and the future risk of DM.

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