



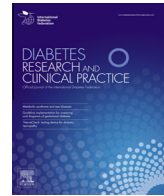
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Prevalence of prediabetes and its association with obesity among college students in Kuwait: A cross-sectional study

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ABSTRACT

This cross-sectional study sought to estimate the prevalence of prediabetes and assess its association with obesity among young adults in Kuwait; a country with a high prevalence of obesity and diabetes. The estimated prevalence of prediabetes was 6.3% (95% CI: 4.8–8.1) and obesity was associated with elevated prediabetes prevalence.

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1. Introduction

Prediabetes, defined as blood glucose levels higher than normal, but lower than diabetes thresholds, is a high risk state for developing future diabetes. It also predisposes affected individuals to early forms of micro- and macrovascular complications [1,2]. Increasing trends of prediabetes prevalence in the general population and more specifically among youth is highly alarming since up to 70% may eventually develop diabetes [1,3,4]. The simultaneous increase in childhood obesity and prediabetes is thought to be linked and that obesity is a major risk factor for prediabetes

development [3,5]. In addition, prior studies have suggested that lifestyle interventions, such as dietary modifications and increased physical activity that aim to reduce weight, are highly effective in reducing the progression risk from prediabetes to diabetes [2]. In Kuwait, more than half of the adults are affected by overweight and obesity [6] and 23.1% of the general population by diabetes [7]. Therefore, early screening, identification, and intervention may be cost-effective and necessary strategy. To this end, the current investigation sought to estimate the prevalence of prediabetes and assess its association with obesity among young adults in Kuwait.

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2. Methods

2.1. Study design and participants

In a cross-sectional study 934 college students aged ≥ 18 years with no prior doctor-diagnosed diabetes attending Kuwait University (KU) or the Public Authority for Applied Education and Training (PAAET), representing the two largest public higher-education institutions in Kuwait, were enrolled. Study participants were recruited using a convenience sample. The study was approved by the Ethical Committee of the Health Sciences Center at KU. Written informed consent was obtained from all study participants.

2.2. Questionnaire and measurements

Study participants were asked to self-complete a questionnaire that captures demographic characteristics. Moreover, study nurses measured weight in kilograms and height in centimeters. Capillary blood samples were collected by pricking the skin of the finger and the point-of-care A1CNow[®]+ system was used to measure glycated hemoglobin (HbA1c) according to the manufacturer's recommended procedure.

2.3. Variables and definitions

Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. BMI was categorized as: underweight ($\text{BMI} < 18.5$), normal ($18.5 \leq \text{BMI} \leq 24.9$), overweight ($25.0 \leq \text{BMI} \leq 29.9$), and obese ($\text{BMI} \geq 30.0$). The underweight group was analyzed with the normal group due to its small proportion (5.7%, $n = 53$). Study participants were considered to have undiagnosed diabetes if they reported no previous history of doctor-diagnosed diabetes and their measured HbA1c is $\geq 6.5\%$ (≥ 48 mmol/mol). Individuals with no prior history of diabetes and HbA1c levels between 5.7% and 6.4% (39–46 mmol/mol) were considered to have prediabetes [8]. At the analysis level, individuals with undiagnosed diabetes ($n = 7$) were excluded from the analytical study sample.

2.4. Statistical analysis

Descriptive analyses were conducted to estimate proportions and means and standard deviations (SD). To assess associations between BMI groups and prediabetes, the prevalence ratio (PR) and its 95% confidence intervals (CI) was estimated by applying the modified Poisson regression with robust variance estimation using the GENMOD procedure in SAS 9.4 (SAS, Cary, N.C., USA) [9]. Statistical significance level was set at $\alpha = 0.05$.

3. Results

After excluding seven individuals with undiagnosed diabetes, the analytical study sample included data from 927 participants. The age of study participants ranged between 18 and 36 years with a mean age of 20.9 (SD: ± 2.6) years. The prevalence of overweight and obesity were estimated to be 27.8%

Table 1 – Characteristics of study population (N = 927).

Variable	% (n)
Sex	
Male	25.1 (233)
Female	74.9 (694)
Enrollment venue	
Kuwait University	78.6 (729)
PAAET	21.4 (198)
Smoking status	
Never	84.6 (780)
Current	14.2 (131)
Former	1.2 (11)
Missing, n	5
Family history of diabetes	
Yes	49.0 (453)
No	51.0 (471)
Missing, n	3
Body mass index groups (kg/m ²)	
Normal (≤ 24.9) [†]	51.6 (477)
Overweight (25.0–29.9)	27.8 (257)
Obese (≥ 30.0)	20.6 (190)
Missing, n	3
Prediabetes [‡]	
Yes	6.3 (58)
No	93.7 (865)
Missing, n	4

PAAET: Public Authority for Applied Education and Training, HbA1c: glycated hemoglobin.

[†] The underweight group ($\text{BMI} < 18.5$) was combined with the normal group ($18.5 \leq \text{BMI} \leq 24.9$).

[‡] Prediabetes was defined as $5.7\% \leq \text{HbA1c} \leq 6.4\%$ (39–46 mmol/mol).

and 20.6%, respectively (Table 1). The mean HbA1c was 5.1% (32 mmol/mol; SD: ± 0.4). The prevalence of prediabetes was estimated to be 6.3% (95% CI: 4.8–8.1; Table 1). In unadjusted regression model, the association between obesity and prediabetes prevalence did not demonstrate statistical significance (PR = 1.61, 95% CI: 0.88–2.94; Table 2). However, after adjusting for potential confounders, this association gained statistical significance (PR = 1.84, 95% CI: 1.01–3.33).

4. Discussion

Findings of this cross-sectional study indicate that prediabetes is prevalent (6.3%) among young adults aged 18–36 years in Kuwait and showed that obesity is a major predisposing factor for prediabetes. The estimated prevalence of prediabetes in the current study is similar to estimates of previous studies conducted in Kuwait, which showed that prediabetes affect around 9.0% of participants aged between 17 and 24 years [10,11]. Similarly, a study from Qatar, also a country with high diabetes prevalence (22.9%) [7], showed that prediabetes affect 6.0% of those aged between 20 and 29 years [12]. Data from the National Health and Nutrition Examination Surveys in the USA estimated the prevalence of prediabetes to be 9.9% among adults aged 18–44 years in 2007–2010 [4]. Although the magnitude of prediabetes can differ across

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