International Journal of Health Systems and Medical Sciences
ISSN: 2833-7433
Volume 05 Number 03 (2026)
Impact Factor: 10.87
SJIF (2023): 3.656

www.inter-publishing.com

Article

Relation Between Body Mass Index and Glucose Level and Academic Performance in Students

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Abstract: The present study aimed to evaluate levels of glucose and body mass index (BMI) and their relation with academic performance in students at the pharmacy college / university of Al-Qadisiyah/Iraq. The study included eighty students at the 5th stage, aged (23-24) years. Glucose level, body weight, and height were measured for each student. Results showed significant differences($p \leq 0.05$) in the three categories of body mass index in both male and female students. Fasting glucose levels were normal in both male and female students. according to academic levels, significant differences($p \leq 0.05$) were found among academic levels for male students, while non significant differences were found among academic levels of female students.Results showed negative correlation(- 0.35) between BMI and academic level while positive correlation(+ 0.26) revealed between glucose and academic level.

Keywords: BMI,glucose level, academic performance, students

Citation: Ibrahim I. R. Relation between body mass index and glucose level and academic performance in students. International Journal of Health Systems and Medical Sciences 2026, 5(3), 16-25.

Received: 10th Apr 2025
Revised: 11th May 2026
Accepted: 11th Jun 2026
Published: 06th Jul 2026

1. Introduction

Body Mass Index (BMI) is a simple widely used indicator for screening individuals into weight categories that may associate with health risks. It is calculated using weight in kilograms divided by the square of their height in meters (kg/m^2) [1]. Providers of healthcare frequently used BMI as primary screening tool because researchers have shown association between higher BMI levels and an elevated risk for certain health issues [2].
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According to WHO [3], there are around 2 billion adults who are overweight and 650 million people who are obese, with an estimated increase to 2.7 billion in 2025 [4]. Studies highlight important variations in the BMI-risk relationship across different ethnicities, indicating that standard BMI cut-offs derived primarily from populations in Europe may not accurately predict disease risk in African, Asian, or other population groups [5]. The current study aimd to evaluate the relationship between body mass index and glucose levels with students' academic performance.

2.Literature Review

2.1 Body mass index and age and geneder

During childhood and –adolescence, BMI tends to elevates due to development and growth.BMI generally elevates with age until middle adulthood ,after which it may stable or lower slightly. In older adults, obesity and underweight are linked to higher risks, however individuals with overweight are not consistently associated with increased mortality, and may even have a protective role in some conditions [6] .In general, men have higher BMI than women across all age groups. However, women tend to maximum elevation in BMI during middle age, particularly after menopause, because shifts in body composition and hormonal changes [7]. Its recorded that gender has critical relation with obesity [8]. Food consumption, gastrointestinal systems and neurotransmitters affected by sex hormones, different levels of sex hormones found in men and women, which affect eating and weight (Schor etal,2018). Androgens are linked to lowered risk of diabetes and obesity in men, but increased risk of diabetes and obesity in women. Estrogens lower appetite and eating and food consumption increased with low levels of estrogen while fat amount and body weight increased with higher estrogen levels [9]. The ability of body to control glucose levels efficiently diminishes with advancing age, and this indicates decline in glucose tolerance, even in individuals without diabetes, mainly due to impaired pancreatic beta-cell function and reduced insulin sensitivity [10].

2.2 BMI and academic level

Many studies have indicated a weak to moderate negative correlation between academic performance and BMI, research on secondary school students in China revealed that higher BMI was linked to poorer academic level, mediated by inhibitory control deficits [11]. High BMI can impair inhibitory control, a cognitive function critical for academic success. Its showed that inhibitory control associates with the relationship between BMI and academic performance. Obese adolescents may face changes in brain regions like the hippocampus and fusiform gyrus, which are related to cognitive functions such as memory and attention, further affecting academic level [12]. Dietary habits and physical activity also affect this relationship. Lower BMI, healthy eating habits, and regular physical activity are positively associated with better academic outcomes [13]. A study on ninth-grade students in Slovakia found that fit and normal-weight students had higher odds of achieving top academic performance compared to unfit or obese peers.. Its also indicated that while BMI alone showed a weak correlation with academic performance, the combination of cardiorespiatory fitness CRF and BMI given a stronger predictive model [14].

2.3 Glucose and academic level

Glucose is an important energy source for the brain, and changes in glucose levels can significantly affect cognitive functions such as memory, attention and executive functioning. Its found that suboptimal glucose levels have been associated with impaired academic performance on tasks writing fluency, requiring reading fluency, and math calculations [15]. Weak glycemic control has been linked to lower academic level in adolescents with Type 1 diabetes, particularly in tasks that need sustained memory and attention [16]. Breakfast consumption, has been shown to positively affect academic performance in children in terms of cognitive, behavior, and school performance,meals with a lower glycemic index tend to give better cognitive performance by preventing rapid drops and spikes in blood glucose levels [17]. Differences in gender have been shown in the relationship between glucose regulation and academic performance,female students with diabetes are more likely to face challenges in completing high school compared to male students [18]. Present study aimed to Study the distribution of students according to BMI, and evaluatin the relation of BMI and glucose levels with academic level in students.

3. Materials and Method

Current study carried out on eighty students aged (23-24) years in the college of pharmacy / Al-Qadisiyah university/Iraq. The study carried out during the period November 2024 to March 2025. Data about students were obtained by questionnaire form that included gender, age, weight, height, and academic student level.

3.1 Body mass index (BMI)

Body mass index was calculated by the following equation:BMI (kg/m2) = weight (kg) / height (m2) The students divided into three groups depending on BMI(18-24.9 , 25-29.9,>30) kg/m2 respectively.

3.2 Glucose estimation:

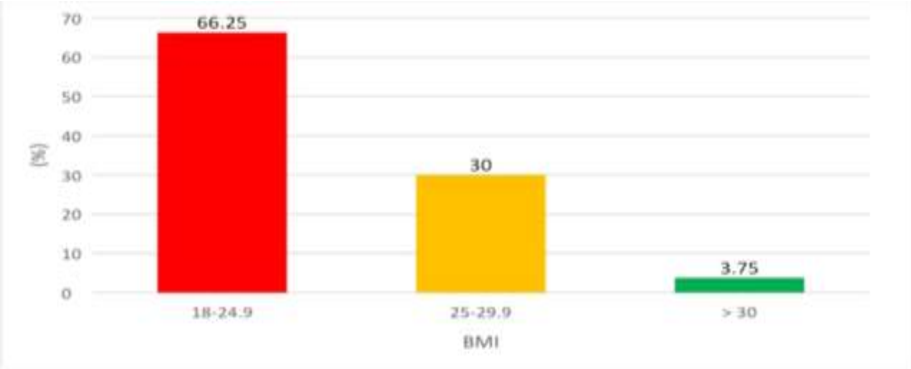
Fasting and random glucose level was measured by using blood glucose meter type (Yuwell check) that produced by (Yuwell) company.

3.3 Statistical analysis

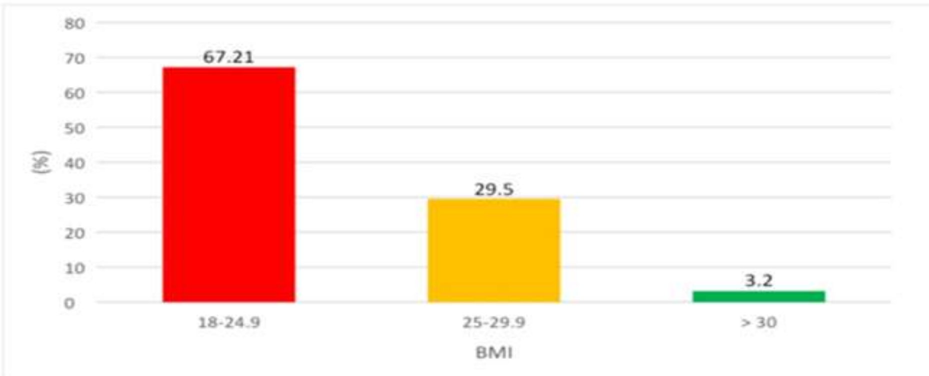
Significant differences among groups were carried out by using the Chi-square test ,alsocorrelation factor yed for evaluation the relation between different availables.

3. Results and Discussion

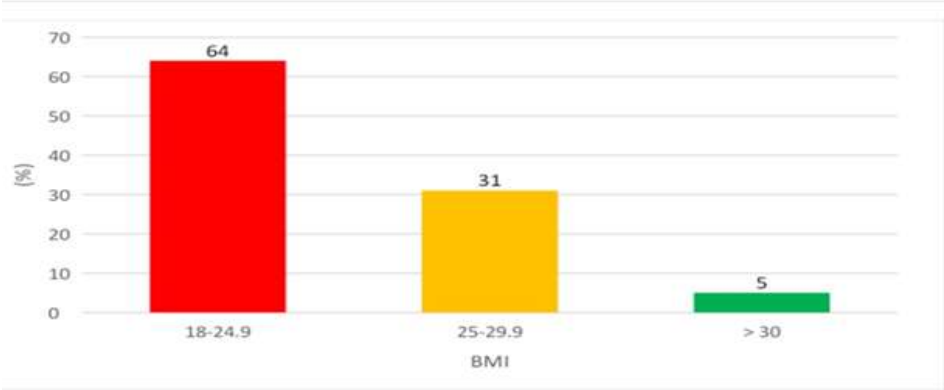
Results showed that the students with normal weight were (66.25%) and students with overweight were (30%) while 3.75% of students in the current study were obese. Results revealed significant differences (P<0.05) among (Fig. 1). According to gender, BMI in male students was (67.26%), having normal weight, and 29.5% were overweight while 3.28% were obese students. On the other hand, 65% of femalestudents have normal weight and 31.58% are overweight, in addition, 5.36% of female students were obese(Fig. 2,3) .



Figuer (1) General Distribution of students according to the BMI



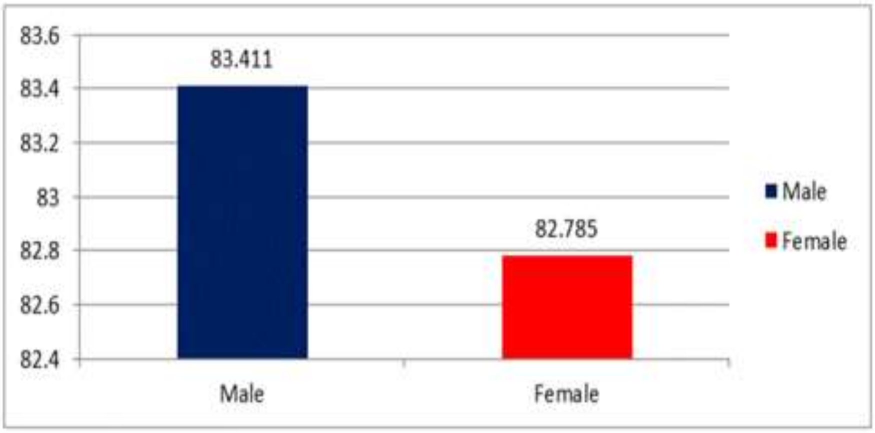
Figuer (2) Distribution of male students according to the BMI



Figuer (3)Distribution of female students according to the BMI

Glucose level

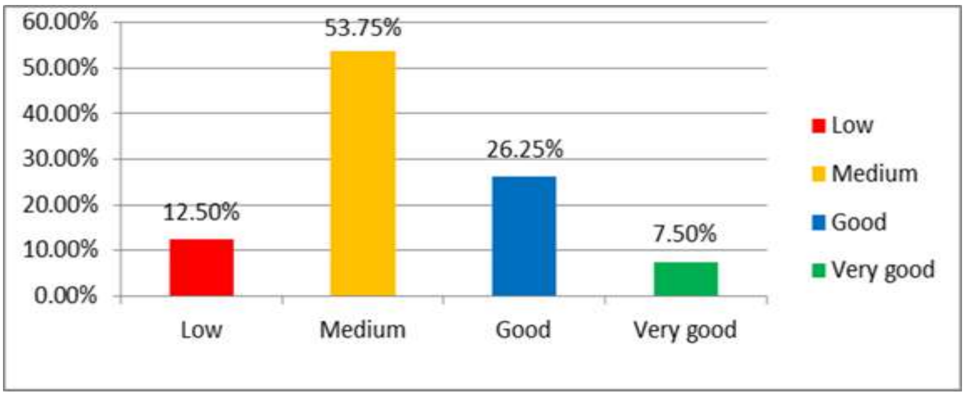
Results of current study indicated non significant differences (P>0.05) in the fasting glucose level between male and female students, while there was nonsignificant increase (P>0.05) in the random glucose level in female students compared with male students(Fig.4).



Figuer (4) Fasting glucose level in students according to the geneder

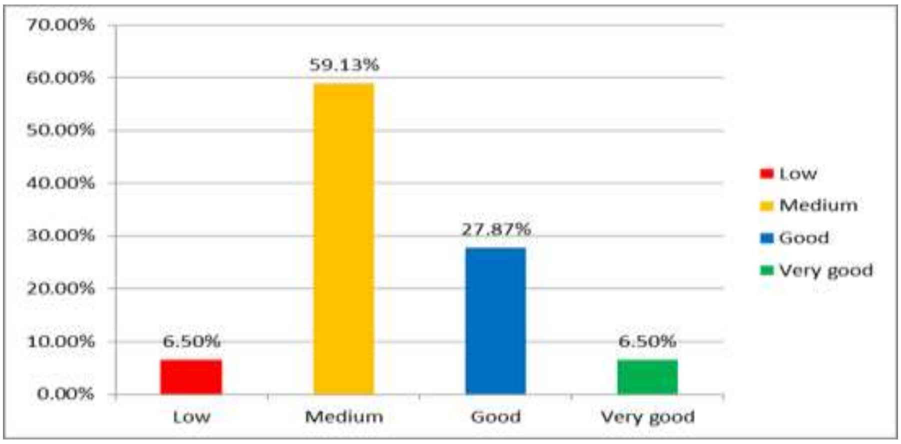
Academic level

Results in Fig (5) showed significant differences (P<0.05) among academic levels. Students with a low level were(12.50%),(53.75%) had a medium level,(26.25%) had a good level, and 7.50% had a very good level.

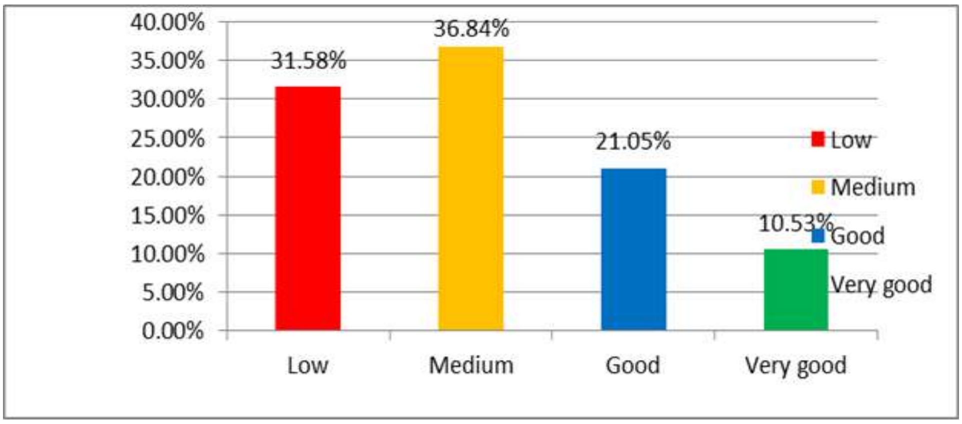


Figuer (5) Distribution students according to academic level

According to gender, there were significant differences among student levels in male students: 6.50% had a low level, 59.02% had a medium level, 27.86% had a good level, and 6.50% had a very good level. On the other hand, there were non-significant differences (P>0.05) among female student levels: 31.58% had a low level, 36.84% had a medium level, 21.05% had a good level, and 10.53% had a very good level(Fig 6,7).According to correlation coefficient ,results showed negative correlation(- 0.35) between BMI and academic level while positive correlation(+ 0.26) revealed between glucose and academic level (Fig. 8,9).



Figuer (6) Academic level in male students



Figuer (7) Academic level in female students

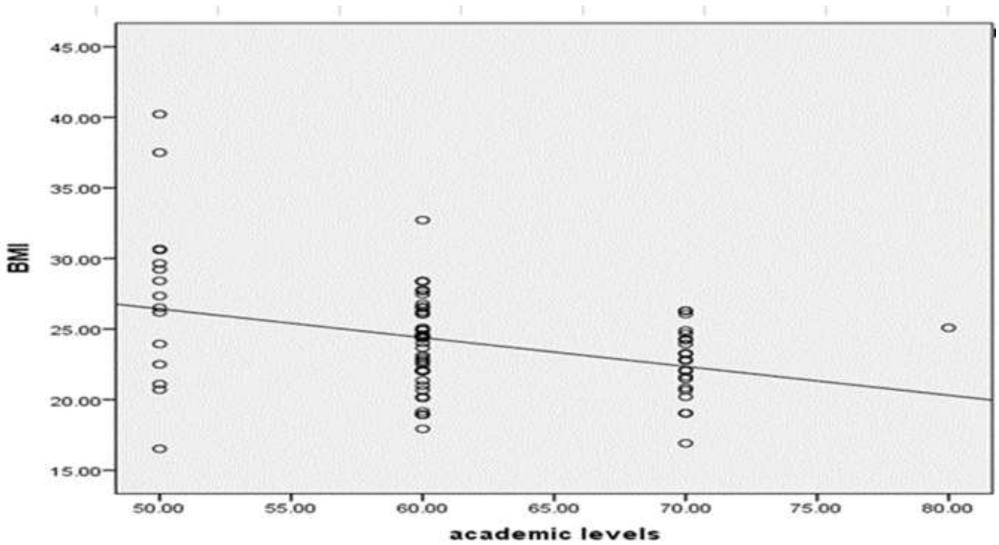
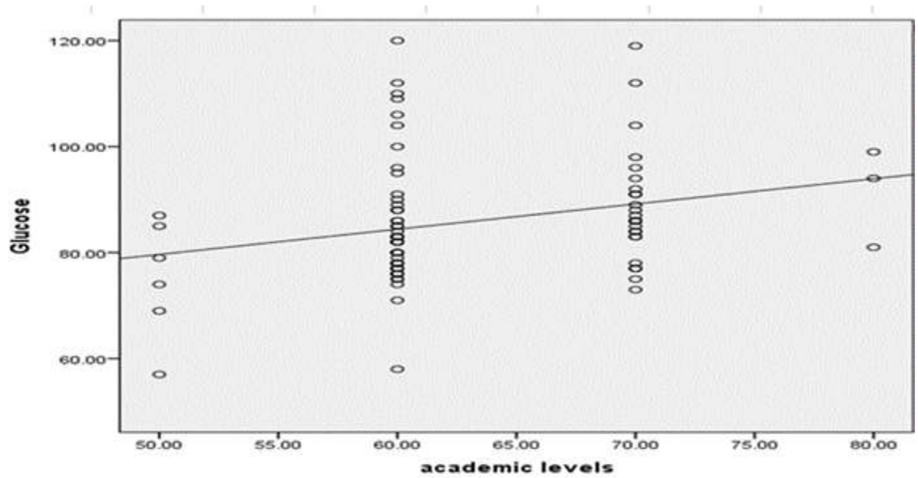


Figure (8):correlation between BMI and academic level



Figure(9): correlation between glucose and academic level

The Results showed that students with normal weight was higher than overweight and obese.The relationship between age and body mass index (BMI) is complex and can vary across life stages and different populations .BMI typically elevates with age during childhood and adolescence due to growth and development.Age and geneder can affect the relation between BMI and body fatness.in older there is low correlation between fatness and BMI [19] In many populations, BMI tends to elevate with age during early and middle adulthood. This is often attributed to changes in metabolism. a decline in physical activity and lifestyle factors [20]. Sudents involved in present study at age 23_24 years and have high physical activity during study period and and this may expain high percentage of students with normal weight.Prevalence of obesity depending on age elevated in women from 1990-2-22 [21].Women tend to have higher BMI than men in many populations, and the relationship between age and BMI may differ by gender.Total adipose tissue in women is about 10% greater than men [22] .

4.1 The relationship between body mass index and gender

Relationship between body mass index and gender is influenced by hormonal, biological and sociocultural factors. In general, higher body fat in women in comparison with men, even at the same BMI. This is due to differences in muscle mass fat distribution and [23]. Estrogen promotes fat storage in women, on the other hand testosterone in men promotes fat storage in the abdominal region and muscle mass [24]. weight gain and changes in fat distribution during menopause due to declining estrogen levels, which can lead to higher BMI and increased abdominal fat [25]. Many variables affect obesity development such as steroid hormones,genetic variables and gut microbiota [26]. Men are generally involved in vigorous physical activity, which can help maintain lower BMI levels. Women in certain cultures,may have fewer physical activity due to responsibilities and societal roles [27].

4.2 BMI and academic performance

Obesity has increased dramatically during past few decades [28]. Obesity is closely correlated with various physical and psychological health risks and lower health-related quality of life [29]. In addition to harmful effects of obesity on health and mortality , obesity has also been associated with poor academic performance. Some studies have indicated that individuals with obesity have lower intelligence quotient (IQ), attention, memory and motor skills compared to normal weight peers [30]. Males and females with overweight or underweight perceptions were involved to achieve higher grades [31]. Studies have indicated the risk of abnormal BMI leading to cognitive impairment. However, the relative risk of underweight or overweight on cognitive function is obscure [32]. Some studies suggest that higher BMI may be linked to reduced cognitive function, particularly in areas such as memory, attention and executive function, which are crucial for academic performance [33].In some cases, a higher BMI may provide students with more energy reserves, which could be beneficial for academic activities, especially in demanding courses or during exam periods [34].

4.3 Relationship between Glucose and age

Results showed that normal fasting glucose level in student at age 23_24 years.Both fasting and postprandial blood glucose levels tend to elevate as people age. Studies showed that fasting blood glucose may increase by 1 to 2 mg/dL per decade and postprandial blood glucose by up to 15 mg/dL per decade [35]. As individuals age, their bodies may become less active at regulating glucose levels. This can result in higher blood sugar levels and an elevated risk of developing type 2 diabetes [36].studies have shown that glycated hemoglobin (HbA1c) levels, which are a measure of average blood sugar levels over time, tend elevate with age [37][38]. Before puberty,there's increased growth in cells that produce insulin, but after that, the growth of these cells is very slow. A few cells reach the end of their life span and die, and a few other cells are created this cause that pancreas may produce less insulin with age [39]

4.4 Relationship between Glucose and gender

Women tend to have lower fasting plasma glucose levels but higher 2-hour plasma glucose levels after an oral glucose tolerance test (OGTT) In the study, including Australians aged ≥25 years, women had a higher 2 h plasma glucose following an OGTT than in men [40]. Impaired fasting glucose (IFG) is more common in men, while impaired glucose tolerance (IGT) is more prevalent in women [41]. Women also tend to have enhanced postprandial insulin and C-peptide concentrations after a meal test [42]. Women have higher plasma FFA concentrations during fasting, suggesting increased lipolysis [43]. Estrogen appears to play a significant role in glucose homeostasis in women. Menopausal estrogen therapy can decrease fasting glucose but may impair glucose tolerance. Estrogen deficiency is linked to an elevated risk of diabetes in women [44]. Hormonal fluctuations, during menstruation, menopause, and pregnancy, can make it more challenging for women to maintain proper blood glucose levels. Changes in hormones can affect insulin sensitivity and metabolism of glucose [45]. Both testosterone excess and deficiency in women, and testosterone deficiency in men, are linked to a predisposition to type 2 diabetes [46].

4.5 Relationship between glucose and academic performance.

Since the central nervous system (CNS) is dependent on a supply of glucose for normal neural functioning, reduced glucose concentrations may result in temporary and/or enduring impairments in CNS function. CNS dysregulation may have negative effects on neuropsychological aspects, such as impaired attention, memory and motor skills [47]. Thus, the brain is reliant on a continuous glucose supply. Only about 30% of glucose is required for direct energy production; much of the remainder is used for the synthesis of amino acids, nucleic acids peptides, , and lipids. Thus, a source of glucose is necessoryfor the synthesis of physiologically active amines such as noradrenaline, serotonin and acetylcholine [48]. Hyperglycemia may have more deleterious effects on the brain than hypoglycemia [49]. Frequent changes in blood glucose levels have been diagnosid as an important risk factor for cognitive deficits. Studies in adults have found chronic hyperglycemia to be correlated with decreased verbal skills and severe hypoglycemia to be associated with problems in motor skills and memory [50]. Certain elements of university life have been identified to achieving appropriate glucose level in this population. These elements include social issues, smoking, alcohol consumption, drug abuse, eating disorders, lack of time, irregular schedules and routines, emotional and psychological barriers , and financial issues [51][52][53].

5. Conclusion

In conclusion, this study shows that health-related factors such as body mass index and glucose level are relevant to the academic performance of pharmacy students in Al-

Qadisiyah University. The results showed that the vast majority of students were classified as having a normative BMI in this age range, with overweight and obesity shown to be only present in small proportions within a sample of apparently healthy young adults. Both males and females had fasting glucose levels in the normal range, and there were no statistically significant differences between genders. Despite these satisfying statistics, academic performance varied by the characteristics of students and the most frequent category was medium academic level. It was also important to note a negative correlation between BMI and academic level, indicating an increase in BMI based on lower academic performance, while the positive association of glucose significance with the progression of knowledge acquisition indicates that its appropriate availability might be crucial for cognitive and learning achievement. These results suggest that nutrition awareness, body mass index assessment, the encouragement of physical activity and regular metabolic screening may be important adjunctive strategies offered to enhance student well-being and promote successful academic outcomes in the context of university health promotion programs. Larger and more heterogeneous student populations, inclusion of lifestyle covariates (diet, physical activity, sleep, stress demographics), the use of longitudinal designs to delineate temporality among proposed confounders/mediators/outcomes are needed in future research to elucidate causal relationships between metabolic health and academic performance.

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