Metabolic Health Literacy and Lifestyle Determinants among Malaysian University Students

Wardah Mustafa Din[1], Noor Sharizad Rusly[1], Ahmad Firdhaus Arham[1], Muhammad Firdaus Aziz[1], Nur Asmadayana Hasim[1], Nurul Syakirah Nazri[1] and Yusnaini Md Yusoff[1*]

Faculty of Liberal Science, Universiti Kebangsaan Malaysia, Jalan Temuan, 43600 UKM Bangi, Selangor, Malaysia

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ABSTRACT

Obesity and metabolic syndrome are significant global public health concerns, and university students increasingly exhibit early risk behaviors that may contribute to future cardiometabolic complications. This study provides a comprehensive assessment of knowledge, attitudes, practices, and barriers related to obesity and metabolic health among 3,949 university students using a newly developed and psychometrically validated instrument. Exploratory factor analysis confirmed a strong four-factor structure, supported by an excellent Kaiser–Meyer–Olkin value of 0.918, indicating solid construct validity across domains that are not commonly examined together in young adult populations. Although students demonstrated moderate awareness of obesity and metabolic syndrome risks, important misconceptions remained, including simplistic beliefs about obesity causes and limited understanding of newer pharmacological treatments such as GLP-1 receptor agonists. Attitudes were generally positive yet still reflected elements of weight-related stigma and hesitancy toward medical therapy. Health practices were inconsistently carried out, and many students reported difficulty interpreting conflicting online health information, suggesting that digital information overload has become a modern barrier to healthy behavior. Attitudes showed the strongest association with practice, reflected by a correlation of 0.613. Demographic differences were evident, with female students and those at higher academic levels demonstrating better knowledge, more favorable attitudes, and healthier behaviors compared to males and early-year students. These findings provide timely insights into behavioral, therapeutic, and information-related influences on obesity and metabolic syndrome and offer an important evidence base for designing targeted interventions and institutional policies that support healthier lifestyles among university populations.

Keywords: Obesity and metabolic syndrome; KAP-B model; Malaysia university students

INTRODUCTION

Obesity and metabolic syndrome represent major global public health threats, with the World Health Organization reporting a near triple of global obesity rates since 1975 [1]. This upward trajectory is particularly marked among adolescents and young adults, predisposing younger cohorts to long-term cardiometabolic complications. Metabolic syndrome, characterized by central obesity, dyslipidemia, hypertension, and impaired glucose tolerance, substantially elevates the risk of cardiovascular disease, type 2 diabetes, and premature mortality [1]. Although formerly associated with aging populations, recent empirical evidence highlights its rising prevalence among university students, a population vulnerable to lifestyle disruptions including physical inactivity, poor dietary quality, and chronic academic stress [2-5]. University students represent a demographic undergoing a pivotal developmental transition during which lifestyle habits are established and frequently sustained into adulthood [6]. The systemic demands of higher education, including irregular routines, restricted access to nutritious food options, and psychological stress, foster behaviors that compromise health, such as physical inactivity, poor dietary quality, and insufficient sleep [7-11].

Within Southeast Asia, and specifically in Malaysia, this public health challenge is increasingly pronounced.

National epidemiological data from the National Health and Morbidity Survey 2019 revealed that nearly half of Malaysian adults are classified as either overweight or obese, a alarming trajectory that is consistently mirrored within university populations [12]. Despite widespread public health campaigns, there remains a considerable gap between knowledge about obesity and actual behavioral change. Students may be aware of health risks but fail to translate that knowledge into healthier lifestyle practices [13]. Furthermore, social stigma, economic barriers, and lack of institutional support may hinder their ability to adopt sustainable health behaviors. There is therefore a critical need to assess university students' knowledge, attitudes, practices, and perceived barriers (KAP-B) in relation to obesity and MetS. Understanding these dimensions is essential for developing targeted, evidence-based interventions that not only improve individual outcomes but also contribute to long-term public health strategies within educational settings.

The objective of this study is to evaluate the knowledge, attitudes, practices, and perceived barriers (KAP-B) regarding obesity and metabolic syndrome among Malaysian university students. By identifying key knowledge deficits, attitudinal patterns, and structural determinants of health behaviors, the empirical findings will inform the development of student-centered health education frameworks. Ultimately, this work provides evidence-based policy recommendations designed to foster early preventive strategies against chronic lifestyle diseases within higher education populations.

MATERIALS AND METHODS

Study Design and Setting

A quantitative, cross-sectional survey design was employed to evaluate knowledge, attitudes, practices, and perceived barriers (KAP-B) regarding obesity and metabolic syndrome among university students in Malaysia. Data collection was conducted between January and March 2025 across multiple public and private higher education institutions utilizing a secure online survey platform. This methodological approach facilitated efficient, large-scale data acquisition while ensuring respondent anonymity, voluntary participation, and data confidentiality.

Instrument Development

A self-administered questionnaire was developed by adapting existing validated knowledge, attitudes, and practices (KAP) frameworks to the contexts of obesity and metabolic syndrome [14-16]. To ensure cultural relevance and linguistic equivalence, the instrument was produced in both English and Malay using a standard back-translation protocol, followed by qualitative review and validation by a public health expert. The finalized survey comprised five distinct sections. Section 1 collected sociodemographic parameters, including gender, educational level, and year of study. Section 2 assessed knowledge using five objective items evaluated via a True, False, or Not Sure response format. Section 3 measured attitudes using five items scored on a 5-point Likert scale. Section 4 evaluated health practices through 5-point Likert scale, and Section 5 quantified perceived barriers across five items measured on 5-point Likert scale.

Sampling Strategy

A non-probability purposive sampling method was used to target undergraduate and postgraduate students from various public and private universities in Malaysia. The minimum sample size was calculated using Cochran's formula, targeting a 95% confidence interval and 5% margin of error [17]. A total of 3,949 valid responses were included in the final analysis, exceeding the minimum requirement and enhancing representativeness.

Data Collection

Data was collected via Google Forms, shared through official university channels, email lists, and student networks. A consent form was embedded on the first page, and only students aged 18 and above were allowed to proceed. The survey was accessible for 6 weeks, and reminders were sent bi-weekly to ensure optimal response rates. This study was conducted in accordance with the Guidelines for Ethical Review of Clinical Research or

Research Involving Human Subjects by Medical Research and Ethics Committee and the International Ethical Guidelines for Health-Related Research Involving Humans 2016 by Council for International Organizations of Medical Sciences [18,19]. The study protocol was determined to be exempt from full ethics review as it involved minimal risk and no collection of identifiable personal information. Therefore, no formal approval number was issued. Participation was entirely voluntary, and verbal informed consent was obtained from all respondents prior to participation.

Data Analysis

Data was exported into IBM SPSS Statistics version 27 for analysis. The following statistical procedures were conducted; Descriptive Statistics (frequency, percentages, mean ± SD) to summarize demographic data and responses to KAP-B items. Reliability Analysis using Cronbach's alpha for each domain (Knowledge, Attitudes, Practices, Barriers). Exploratory Factor Analysis (EFA) with Varimax rotation to confirm construct validity of the questionnaire. Cross-tabulations and Chi-square tests to examine associations between demographic variables and KAP-B domains. Pearson's correlation to explore relationships between knowledge, attitude, and practice scores. Significance was set at $p < 0.05$.

RESULTS

A total of 3,949 university students participated in the study, with a gender distribution of 53.3% female and 46.7% male (**Table 1**). The majority of respondents were pursuing a bachelor's degree (63.8%), followed by those in Diploma (17.9%), Master's (11.5%), PhD (5.1%), and Professional Certificate program (1.7%). In terms of academic standing, the largest proportion were Year 2 students (44.6%), followed by Year 3 (27.0%), Year 1 (17.0%), Year 4 (7.7%), and those studying for more than four years (3.7%). These figures indicate a representative spread across gender and academic levels among Malaysian university students.

Table 1: Sociodemographic profile

Factors		**Frequency (n=3949)**	**Percentage %**
Gender	Female	2105	53.3
	Male	1844	46.7
Level of Education	Professional Certificate	67	1.7
	Diploma	705	17.9
	Bachelor	2519	63.8
	Master	456	11.5
	PhD	202	5.1
Year of Education	Year 1	670	17.0
	Year 2	1762	44.6
	Year 3	1065	27.0
	Year 4	306	7.7
	Above 4 Years	146	3.7

To assess the dimensionality of the instrument, an Exploratory Factor Analysis (EFA) was conducted using Principal Axis Factoring with Varimax rotation (**Table 2**). Preliminary tests confirmed that the dataset was suitable for factor analysis. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.918, indicating an excellent level of common variance among items and demonstrating that the sample was highly appropriate for factor extraction. Additionally, Bartlett's Test of Sphericity was significant ($\chi^2 = 38{,}748.304$, $df = 190$, $p < .001$), confirming that the correlation matrix was not an identity matrix and that sufficient inter-item correlations existed to justify further analysis.

Table 2: Result of the KMO test and Bartlett's sphericity test

Test		Results
KMO		0.918
Bartlett's sphericity test	Chi-square Degree of freedom Significance	38748.304 190 <0.001

KMO=Kaiser-Meyer-Olkin

Factor analysis supported the four-construct KAP-B model (Knowledge, Attitudes, Practices, and Barriers), extracting four factors with eigenvalues greater than 1.0 (**Table 3**). These factors initially accounted for 57.15% of the cumulative variance. Following Varimax rotation, the solution yielded enhanced interpretability and explained 55.14% of the total variance. The proportion of variance explained by each rotated factor was 16.88% for Factor 1 (Attitudes), 14.79% for Factor 2 (Practices), 14.46% for Factor 3 (Barriers), and 9.01% for Factor 4 (Knowledge). These results are consistent with the theoretical structure of the instrument and confirm that the four-factor model provides a meaningful and statistically robust representation of the underlying constructs measured in the survey.

Table 3: Factor characteristic value and variance contribution rate

Factors	Characteristics	Variance contribution rate (%)	Cumulative contribution rate (%)
Factor 1	3.375	16.876	16.876
Factor 2	2.959	14.793	31.668
Factor 3	2.892	14.461	46.129
Factor 4	1.802	9.011	55.140

The rotated factor matrix (**Table 4**) showed a clear and distinct pattern of factor loadings, with all items loading on their respective theoretical domains and exceeding the minimum acceptable threshold of 0.40. Items assessing Attitudes (A1–A5) loaded strongly on Factor 1, with loadings ranging from 0.687 to 0.798, indicating excellent internal cohesion. Items representing Practices (P1–P5) loaded on Factor 2 with loadings between 0.660 and 0.730. Barriers items (B1–B5) loaded highly on Factor 3, with loadings from 0.699 to 0.752, demonstrating a strong and coherent behavioral barrier construct. Items measuring Knowledge (K1–K5) loaded on Factor 4, with loadings from 0.488 to 0.676, suggesting acceptable to strong item contributions within the knowledge domain. Importantly, no cross-loadings were observed across the four factors, reflecting excellent discriminant validity of the instrument. Each item loaded strongly on a single factor, confirming the conceptual clarity and structural soundness of the measurement model.

Table 4: Results of factor loading

Items	Factor			
	1	2	3	4
K1	0.676			
K2	0.607			
K3	0.488			
K4	0.488			
K5	0.672			
A1		0.687		
A2		0.775		
A3		0.750		
A4		0.785		

A5		0.798		
P1			0.660	
P2			0.662	
P3			0.730	
P4			0.710	
P5			0.713	
B1				0.721
B2				0.726
B3				0.752
B4				0.699
B5				0.713

Overall, the EFA supports a well-defined four-factor solution, consistent with the conceptual basis of the survey. The strong KMO value, significant Bartlett's test, meaningful proportion of explained variance, and clear factor loadings collectively demonstrate that the instrument possesses strong construct validity and is suitable for assessing obesity-related knowledge, attitudes, practices, and behavioral barriers among university students.

The reliability analysis revealed strong internal consistency across all four domains of the KAP-B questionnaire (**Table 5**). Cronbach's alpha values were 0.721 for knowledge, 0.918 for attitudes, 0.872 for practices, and 0.868 for barriers. Item-deletion diagnostics confirmed that all subscales maintained acceptable reliability, affirming the stability and internal coherence of the instrument (**Table 6**).

Table 5: The results of 'Cronbach's Alpha value

Dimensions	**Number of items**	**Cronbach's Alpha**
Knowledge	5	0.721
Attitudes	5	0.918
Practices	5	0.872
Barriers	5	0.868

Table 6: Results of 'Cronbach's Alpha value if deleting items

Items	**Cronbach's Alpha value if deleting items**
General knowledge about obesity	
K1	0.882
K2	0.883
K3	0.885
K4	0.886
K5	0.882
Attitude towards better lifestyle	
A1	0.867
A2	0.866
A3	0.866
A4	0.865
A5	0.865
Practices in preventing obesity	
P1	0.870
P2	0.871
P3	0.868
P4	0.868

P5	0.869
Barriers to stay healthy	
B1	0.873
B2	0.876
B3	0.875
B4	0.873
B5	0.873

The findings from **Table 7** show that students demonstrated moderate but uneven knowledge regarding obesity, with strong understanding in some areas but notable gaps in others. A large majority recognized that obesity increases the risk of type 2 diabetes and cardiovascular diseases (72.5%), and that sustainable food choices may support weight and metabolic health (66.4%). Knowledge of the gut microbiome's influence on weight was also relatively high (62.8%), although over one-fifth of students were uncertain. However, misconceptions were evident: nearly half of the students (44.9%) incorrectly believed that obesity is solely caused by overeating and lack of exercise, while 37.4% correctly rejected this oversimplified view, indicating persistent misunderstanding about the multifactorial nature of obesity. Knowledge about GLP-1 receptor agonists (e.g., semaglutide) was particularly limited, with only 48.9% identifying the statement as true and 32.7% reporting uncertainty, suggesting low awareness of modern pharmacological treatments. Overall, while students possess foundational knowledge about obesity risks and dietary strategies, substantial gaps remain regarding biological mechanisms and contemporary medical therapies.

Table 7: Knowledge of students regarding obesity

Items	True (%)	False (%)	Not sure (%)
Obesity increases the risk of developing type 2 diabetes and cardiovascular diseases [K1]	2864 (72.5)	485 (12.3)	600 (15.2)
The gut microbiome can influence weight gain and fat storage [K2]	2478 (62.8)	637 (16.1)	834 (21.1)
All obesity is caused solely by overeating and lack of exercise [K3]	1775 (44.9)	1475 (37.4)	699 (17.7)
GLP-1 receptor agonists (e.g., semaglutide) are approved medications for treating obesity [K4]	1931 (48.9)	728 (18.4)	1290 (32.7)
Sustainable food choices (e.g., plant-based diets) may help in managing weight and metabolic syndrome [K5]	2623 (66.4)	669 (16.9)	657 (16.6)

The findings indicate that students demonstrated moderately positive but still divided attitudes toward obesity and its management (**Table 8**). Nearly half of the respondents agreed or strongly agreed that obesity should be treated as a medical condition rather than a personal failure (42.4%), suggesting growing recognition of obesity as a complex health issue; however, 36.9% disagreed or strongly disagreed, reflecting the continued presence of stigma and individual blame perceptions. Comfort in discussing weight-related health concerns with healthcare providers was relatively moderate, with 44.5% expressing agreement, although a considerable proportion remained neutral or uncomfortable, indicating persistent hesitation in seeking professional support. Students also showed mixed attitudes toward obesity medications, with 41.4% agreeing that such treatments are as valid as lifestyle modification, while a similar proportion expressed disagreement or uncertainty, suggesting limited confidence in pharmacological interventions and possible lack of therapeutic awareness. Awareness of obesity-related social stigma was relatively strong, as 45.3% acknowledged that individuals with obesity experience unfair treatment in society. Furthermore, almost half of the respondents believed that obesity prevention should be a shared responsibility between individuals and society, indicating increasing recognition of environmental and societal influences on health behaviors. Overall, the findings suggest that although students are becoming more receptive toward medical and social perspectives of obesity, substantial misconceptions, stigma-related attitudes, and uncertainty toward treatment approaches remain evident.

Table 8: Attitudes of students regarding obesity

Items	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
I believe obesity should be treated as a medical condition rather than a personal failure [A1]	724 (18.3)	951 (24.1)	817 (20.7)	616 (15.6)	841 (21.3)
I feel comfortable discussing weight-related health issues with healthcare providers [A2]	724 (18.3)	1035 (26.2)	860 (21.8)	573 (14.5)	757 (19.2)
Obesity medications are just as valid as lifestyle changes for long-term weight management [A3]	678 (17.2)	955 (24.2)	912 (23.1)	622 (15.8)	782 (19.8)
People with obesity often face unfair social stigma [A4]	745 (18.9)	1041 (26.4)	878 (22.2)	573 (14.5)	712 (18.0)
I believe that preventing obesity is a shared responsibility between individuals and society [A5]	899 (22.8)	992 (25.1)	771 (19.5)	538 (13.6)	749 (19.0)

The findings demonstrate that students exhibited moderate but inconsistent engagement in obesity prevention practices (**Table 9**). Regular physical activity was relatively limited, with only 32.2% of respondents reporting that they always or often exercised for at least 30 minutes three times per week, while over one-third rarely or never engaged in such activity, indicating insufficient adherence to recommended exercise behaviors. The use of mobile health applications for fitness or health monitoring was similarly modest, with approximately one-third reporting regular usage, suggesting that digital health tools remain underutilized despite their accessibility among young adults. Dietary practices appeared slightly more favorable, as 39.1% consistently reduced their intake of sugary drinks and processed foods; however, many students only practiced this behavior occasionally, reflecting inconsistent dietary self-regulation. Information-seeking behavior also varied, with 38.5% frequently consulting credible online or academic sources about obesity and health, while a considerable proportion reported limited engagement with reliable health information. Likewise, regular monitoring of body weight, waist circumference, or BMI was practiced consistently by only 37.1% of respondents. Overall, these findings suggest that although students demonstrate some awareness and intention toward healthy lifestyle practices, sustained behavioral implementation remains suboptimal, highlighting a persistent gap between health awareness and daily practice.

Table 9: Practices of students regarding obesity

Items	Always (%)	Often (%)	Sometimes (%)	Rarely (%)	Never (%)
I engage in physical activity for at least 30 minutes, 3 times a week [P1]	502 (12.7)	770 (19.5)	1242 (31.5)	850 (21.5)	585 (14.8)
I use mobile apps or wearables (e.g., Fitbit, Apple Health) to track my fitness or health data [P2]	486 (12.3)	871 (22.1)	1098 (27.8)	841 (21.3)	653 (16.5)
I consciously reduce my intake of sugary drinks and processed foods [P3]	614 (15.5)	933 (23.6)	1187 (30.1)	704 (17.8)	511 (12.9)
I seek credible online or academic sources to learn about obesity or health [P4]	564 (14.3)	955 (24.2)	1124 (28.5)	760 (19.2)	546 (13.8)
I regularly assess my weight, waist circumference, or BMI [P5]	577 (14.6)	888 (22.5)	1141 (28.9)	770 (19.5)	573 (14.5)

The data presented in **Table 10** indicates that students encounter a range of systemic and informational barriers to maintaining a healthy lifestyle, with the most prevalent obstacles appearing at a moderate intensity. Conflicting online health advice and a lack of trust in commercial weight loss programs represent the most significant concerns, as approximately 30 percent of respondents reported being moderately affected by these factors. While academic stress and financial limitations are frequently discussed in student welfare contexts, this

study reveals that only a minority of the population considers these to be extreme impediments. Instead, most of the cohort identifies factors such as social discomfort regarding weight-related issues and time constraints as slight or moderate barriers. These findings suggest that while multifaceted challenges exist, the primary necessity for student health intervention lies in providing more transparent and credible health information to mitigate the confusion caused by digital sources.

Table 10: Barriers of students regarding healthy lifestyle

Items	Extremely (%)	Very much (%)	Moderately (%)	Slightly (%)	Not at all (%)
I lack time to focus on healthy eating and exercise due to academic stress [B1]	356 (9.0)	565 (14.3)	1148 (29.1)	1034 (26.2)	846 (21.4)
I cannot afford healthier food options or fitness programs [B2]	281 (7.1)	575 (14.6)	1075 (27.2)	1087 (27.5)	931 (23.6)
I feel judged or uncomfortable seeking help for weight-related issues [B3]	296 (7.5)	561 (14.2)	1097 (27.8)	1042 (26.4)	953 (24.1)
I don't trust commercial weight-loss programs or supplements [B4]	416 (10.5)	637 (16.1)	1163 (29.5)	956 (24.2)	777 (19.7)
I find conflicting health advice online confusing and overwhelming [B5]	406 (10.3)	672 (17.0)	1189 (30.1)	919 (23.3)	763 (19.3)

A total of 3,949 university students participated in the survey (**Table 11**). Descriptive statistics for the four composite domains which are Knowledge, Attitudes, Practices, and Barriers are presented in Table 8. The mean score for Knowledge was 0.6155 (SD = 0.54488), indicating low obesity-related knowledge across the sample. In contrast, Attitudes (M = 1.9033, SD = 1.20521) and Practices (M = 1.9877, SD = 1.01443) showed moderate levels, suggesting that although students generally hold favorable views towards healthy lifestyle behaviors, these attitudes do not consistently translate into actionable practices. Barriers recorded the highest mean score (M = 2.3575, SD = 0.98797), indicating that students experience considerable challenges such as academic stress, time constraints, cost, and environmental limitations that impede healthy behaviors adoption.

Table 11: Descriptive analysis

Variable	N	Mean Score	Std. Deviation
Knowledge	3949	0.6155	0.545
Attitude	3949	1.903	1.205
Practice	3949	1.988	1.014
Barrier	3949	2.358	0.988

Chi-square tests (**Table 12**) were conducted to examine associations between individual questionnaire items and demographic variables (gender, level of education, and year of study). Results showed significant demographic differences across most items. Knowledge items (K1, K2, K4, K5) showed highly significant associations with all demographic variables ($p < .001$), indicating that knowledge levels differ substantially by gender, education level, and year of study. This suggests that certain demographic groups possess more accurate or extensive knowledge of obesity risks. Most attitude items (A1–A5) were significantly associated with gender ($p < .001$) and academic progression ($p < .05$), suggesting that females and senior-year students exhibit more positive attitudes towards healthy behaviors. Practice items (P1, P3, P4, P5) showed significant associations with all demographic variables ($p < .05$), indicating variability in obesity-preventive behaviors across groups. The single item without gender difference (P2, $p = .143$) suggests that some behavioral practices are universally adopted regardless of sex. Most barrier items (B1, B3, B4, B5) showed strong associations with demographic variables ($p < .05$), indicating that perceptions of obstacles vary significantly across gender, education level, and academic year. Only B2 showed no significant association with gender ($p = .604$), implying that some barriers are universally experienced regardless of demographic background.

Table 12: Pearson Chi-Square

	Pearson Chi-Square (p value)		
Items	**Gender**	**Level of Education**	**Year of Education**
General knowledge about obesity			
K1	< 0.001	< 0.001	< 0.001
K2	< 0.001	< 0.001	0.417
K3	0.020	< 0.001	0.480
K4	< 0.001	< 0.001	0.067
K5	< 0.001	< 0.001	0.600
Attitude towards better lifestyle			
A1	< 0.001	0.054	< 0.001
A2	< 0.001	< 0.001	< 0.001
A3	0.002	0.003	< 0.001
A4	< 0.001	< 0.001	< 0.001
A5	< 0.001	< 0.001	0.052
Practices in preventing obesity			
P1	< 0.001	< 0.001	0.010
P2	0.143	< 0.001	0.010
P3	< 0.001	< 0.001	< 0.001
P4	< 0.001	< 0.001	0.006
P5	< 0.001	0.006	0.082
Barriers to stay healthy			
B1	< 0.001	< 0.001	< 0.001
B2	0.604	0.006	< 0.001
B3	0.054	0.002	< 0.001
B4	0.031	< 0.001	< 0.001
B5	< 0.001	< 0.001	< 0.001

Correlation analysis revealed several significant associations between the four domains (**Table 13**). Knowledge showed no significant relationship with attitudes ($r = .015$, $p = .352$), indicating that higher levels of obesity-related knowledge did not necessarily translate into more positive attitudes toward prevention. A very weak but significant relationship was found between knowledge and practice ($r = .035$, $p = .026$), suggesting that knowledge alone contributes minimally to behavioral engagement. Knowledge demonstrated a weak negative correlation with perceived barriers ($r = –.164$, $p < .001$), indicating that students with greater knowledge tended to report slightly fewer obstacles to healthy behavior. In contrast, attitudes exhibited a strong positive correlation with practice ($r = .613$, $p < .001$), showing that favorable attitudes were strongly associated with healthier behavioral patterns. Attitudes also correlated moderately with perceived barriers ($r = .385$, $p < .001$), implying that students with positive attitudes were more aware of environmental and personal barriers. Practices were moderately correlated with barriers ($r = .371$, $p < .001$), suggesting that students who attempted to adopt healthier behaviors were more likely to encounter or recognize barriers. Overall, the strongest determinant of practice was attitude rather than knowledge.

Table 13: Correlation

Variables	**Knowledge**	**Attitudes**	**Practices**	**Barriers**
Knowledge	1	0.015	0.035*	-0.164**
Attitudes	0.015	1	0.613**	0.385**
Practices	0.035*	0.613**	1	0.371**
Barriers	-0.164**	0.385**	0.371**	1

Values represent Pearson correlation coefficients (r)= *p < 0.05, ** p < 0.01

DISCUSSION

This study offers a comprehensive examination of university students' knowledge, attitudes, practices, and perceived barriers related to obesity, providing insights into how these factors interact within a large and diverse student population. Although previous research has examined specific elements of obesity-related awareness and lifestyle behaviors among young adults [20-22], the present work addresses a key gap in the literature by integrating multiple contemporary dimensions into a single empirical framework. Specifically, the incorporation of emerging therapeutic knowledge, psychosocial barriers, and digital health behaviors within a unified assessment instrument distinguishes this study from earlier investigations. By consolidating these multidimensional aspects, the findings contribute timely and meaningful perspectives to the broader understanding of obesity management among young adults.

In line with previous findings, students in this study exhibited moderate but uneven obesity knowledge. While participants clearly recognized the link between obesity and cardiometabolic diseases, reflecting broad awareness of general health risks among young adults [23-25], misconceptions regarding its etiology persisted. Specifically, the view that obesity is caused exclusively by overeating and inactivity echoes documented global patterns of oversimplified causal beliefs [26-28]. Crucially, this study expands existing literature by evaluating awareness of modern pharmacotherapies, including GLP-1 receptor agonists. The observed low familiarity highlights a critical knowledge gap regarding clinical innovations in obesity management, an area previously unexamined within student populations.

Students in the present study exhibited positive yet contradictory attitudes toward obesity. Although nearly half of the participants endorsed viewing obesity as a formal medical condition, aligning with broader shifts in public perception and social health research [29], a substantial proportion continued to attribute the condition to individual moral failure. This duality suggests that while public health campaigns aimed at reducing weight stigma have achieved measurable progress, stigmatizing attributions remain widespread. Additionally, high participant awareness regarding weight-related stigma corroborates prior empirical work establishing that young adults possess a heightened sensitivity to social discrimination and peer devaluation [30]. Beyond general stigma awareness, the widespread uncertainty and skepticism observed regarding anti-obesity medications represent a novel attitudinal barrier that has not been widely documented in earlier university-based literature. Notably, the robust positive correlation between participant attitudes and self-reported health practices ($r = .613$) aligns with foundational behavioral paradigms, such as the Theory of Planned Behavior [31], which positions attitudinal constructs as central determinants of health behavior adoption. Taken together, these findings highlight the necessity of targeted attitudinal interventions to optimize both clinical engagement and health outcomes in higher education settings.

In line with previous investigations, students in this study exhibited moderate but inconsistently sustained health behaviors. Consistent with earlier work by Elmahgoub et al. [32] and Rákó et al. [33], only one-third of participants engaged in regular physical activity, highlighting the persistent difficulty of integrating health practices into academically demanding routines. Dietary improvements and self-monitoring practices displayed comparable patterns, supporting prior evidence that intentions to adopt healthy behaviors often fail to translate into sustained routines. Crucially, this study expands existing scholarship by assessing digital health engagement within this demographic. The finding that only one-third of students routinely utilize mobile health applications complements emerging literature, suggesting that high technological proficiency among young adults does not automatically drive health app adoption in the absence of perceived personal value or institutional endorsement.

Perceived barriers served as a critical determinant of health practices in this sample, reinforcing established global findings that contextual and psychosocial constraints often exert a stronger influence on behavior than knowledge alone [34-36]. Academic stress and financial limitations were identified as the primary impediments, mirroring previous evidence that university routines, financial strain, and transitional pressures substantially restrict healthy lifestyle adoption. Concurrently, emotional barriers, specifically fear of social judgment and hesitancy to access clinical support, underscore the enduring burden of weight stigma within young adult

demographics [37,38]. Crucially, this study advances existing literature by revealing that informational barriers present a major challenge, as over half of the cohort struggled to reconcile conflicting digital health claims. This outcome highlights modern public health vulnerabilities in an era dominated by algorithm-driven content and variable information quality, demonstrating that information overload has become a key structural barrier for contemporary university students.

Demographic disparities further contextualize the empirical findings of this investigation. Significant variations observed across gender and educational level corroborate previous reports establishing that female students and individuals with higher educational attainment demonstrate greater health consciousness and increased engagement in preventive behaviors [39,40]. Crucially, the inclusion of year of study as a core analytical variable offers an original contribution to literature by capturing progressive shifts in health knowledge and attitudes as students advance academically. This developmental nuance, rarely examined in comparable university-based scholarship, indicates that academic progression itself may serve as an important facilitator of enhanced health literacy and positive behavioral attributions.

The strong psychometric properties of the newly developed KAP-B instrument, evidenced by a robust factor structure and high internal validity indicators, confirm its structural reliability and construct validity in assessing obesity-related perceptions and behaviors among university students. Whereas conventional instruments typically measure knowledge or attitudes as isolated domains, the KAP-B framework incorporates contemporary therapeutic awareness, weight-stigma dynamics, and digital health behaviors. This integrative design establishes the instrument as a novel and methodologically rigorous tool, uniquely suited to evaluate the complex, multidimensional nature of obesity in contemporary academic populations.

In summary, while this study confirms several established empirical trends regarding obesity-related perceptions and behaviors, it advances the literature by offering novel insights into young adults' awareness of modern pharmacotherapies, digital health engagement, and informational barriers. By examining these dynamics within an increasingly complex digital media ecosystem, the findings provide a timely framework for understanding how contemporary university students navigate health information and clinical innovations. Consequently, these results highlight the necessity of multi-component institutional interventions. Effective health promotion within higher education settings requires a integrated approach that pairs traditional educational initiatives with targeted stigma-reduction strategies, digital health literacy support, and structural environmental modifications to foster sustainable, long-term health behaviors among student populations.

CONCLUSION

In conclusion, this study provides timely empirical evidence regarding university students' obesity-related knowledge, attitudes, practices, and perceived barriers. The results demonstrate persistent knowledge gaps, inconsistencies between attitudes and behaviors, and prominent structural, informational, and emotional challenges to health maintenance. Universities should implement integrated health strategies that combine education, stigma reduction, affordable nutrition, physical activity, and digital literacy while embedding obesity prevention into student healthcare. Key strengths of this study include its large sample size and the validation of a tool measuring emerging factors like digital health use and modern treatment awareness. Despite limitations from a self-reported, cross-sectional design in a single population, the study provides a strong foundation for targeted campus health policies and interventions.

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Ethics Approval And Consent To Participate

This study was conducted in accordance with the Guidelines for Ethical Review of Clinical Research or Research Involving Human Subjects (Medical Research and Ethics Committee [MREC], 2006) and the CIOMS International Ethical Guidelines for Health-Related Research Involving Humans (2016). The study protocol was determined to be exempt from full ethics review as it involved minimal risk and no collection of identifiable personal information. Therefore, no formal approval number was issued. Participation was entirely voluntary, and verbal informed consent was obtained from all respondents prior to participation.

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Conflict Of Interest

The authors have no conflicts of interest to declare.

Availability Of Data And Materials

All data generated or analysed during this study are included in this published article. For other data, these maybe requested through the corresponding author.

Authors' Contributions

Conceptualization: YMY, WMD; Data curation: YMY, NSR, MFA; Formal analysis: YMY, AFA, NAH; Funding acquisition: YMY; Investigation: YMY, WMD; Methodology: YMY, NSR, AFA ; Project administration: YMY, WMD; Resources: YMY, WMD, NSR; Software: YMY, MFA, NAH; Supervision: YMY; Validation: YMY, WMD; Visualization: YMY; Writing–original draft: YMY, WMD, NSR, AFA, MFAM, NAH, NSN; Writing–review & editing: all authors.

Orcid

Yusnaini Md Yusoff: https://orcid.org/0000-0002-2460-439X

Wardah Mustafa Din: https://orcid.org/0000-0002-4763-3441

Noor Sharizad Rusly: https://orcid.org/0000-0002-6576-463X

Ahmad Firdhaus Arham: https://orcid.org/0000-0002-6740-2077

Muhammad Firdaus Aziz: https://orcid.org/0000-0002-2090-4336

Nur Asmadayana Hasim: https://orcid.org/0000-0002-7427-1685

Nurul Syakirah Nazri: https://orcid.org/0000-0003-3097-7544

Supplementary document

Complete Questionnaire

KNOWLEDGE, ATTITUDES, PRACTICES, AND BARRIERS ON OBESITY AND METABOLIC SYNDROME

Research Survey Questionnaire (English Version)

Study Purpose & Informed Consent:

You are invited to participate in this research study entitled "Knowledge, Attitudes, Practices, and Barriers on Obesity and Metabolic Syndrome Among University Students." The purpose of this study is to explore university students' understanding and behaviours related to obesity and metabolic syndrome. Participation in this study is entirely voluntary, anonymous, and strictly confidential for academic purposes. By continuing, you confirm that you are at least 18 years old and give your informed consent to participate.

Contact: Research Team via yusnaini@ukm.edu.my

Demographics & Administration

Administrative items and participant demographic background.

No.	Item / Question	Format	Response Options
1	SET Philosophy and Current Issue (ask your enumerator)	Dropdown	23, 34, 36
2	Group (ask your enumerator)	Dropdown	1, 2, 3, 4, 5, 6, 7, 8
3	Gender	Multiple Choice	Male, Female
4	Level of Education	Multiple Choice	Diploma, Bachelor, Master, PhD, Professional Certificate
5	Year of Education	Multiple Choice	Year 1, Year 2, Year 3, Year 4, Above 4 Years

Section A: Knowledge

Instructions: Indicate whether each statement is True, False, or Not Sure.

No.	Item Statement	Response Options
K1 (1)	Obesity increases the risk of developing type 2 diabetes and cardiovascular diseases.	[ ] True [ ] False [ ] Not Sure
K2 (2)	The gut microbiome can influence weight gain and fat storage.	[ ] True [ ] False [ ] Not Sure
K3 (3)	All obesity is caused solely by overeating and lack of exercise.	[ ] True [ ] False [ ] Not Sure
K4 (4)	GLP-1 receptor agonists (e.g., semaglutide) are approved medications for treating obesity.	[ ] True [ ] False [ ] Not Sure

K5 (5)	Sustainable dietary habits (e.g., plant-based diets) may help in managing weight and metabolic syndrome.	[ ] True [ ] False [ ] Not Sure

Section B: Attitudes

Instructions: Please indicate how strongly you agree or disagree with the following statements (5-point Likert scale).

No.	Item Statement	Response Scale
A1 (6)	I believe obesity should be treated as a medical condition rather than a personal failure.	1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
A2 (7)	I feel comfortable discussing weight-related health issues with healthcare providers.	1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
A3 (8)	Obesity medications are just as valid as lifestyle changes for long-term weight management.	1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
A4 (9)	People with obesity often face unfair social stigma.	1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree
A5 (10)	I believe that preventing obesity is a shared responsibility between individuals and society.	1. Strongly Disagree 2. Disagree 3. Neutral 4. Agree 5. Strongly Agree

Section C: Practices

Instructions: How often do you engage in the following behaviors? (5-point frequency scale).

No.	Item Statement	Response Scale
P1 (11)	I engage in physical activity for at least 30 minutes, 3 times a week.	1. Never 2. Rarely 3. Sometimes 4. Often 5. Always
P2 (12)	I use mobile apps or wearables (e.g., Fitbit, Apple Health) to track my fitness or health data.	1. Never 2. Rarely 3. Sometimes 4. Often 5. Always
P3	I consciously reduce my intake of sugary drinks and processed foods.	1. Never

(13)		2. Rarely 3. Sometimes 4. Often 5. Always
P4 (14)	I seek credible online or academic sources to learn about obesity or health.	1. Never 2. Rarely 3. Sometimes 4. Often 5. Always
P5 (15)	I regularly assess my weight, waist circumference, or BMI.	1. Never 2. Rarely 3. Sometimes 4. Often 5. Always

Section D: Barriers

Instructions: Please rate how strongly these barriers apply to you personally (5-point scale).

No.	Item Statement	Response Scale
B1 (16)	I lack time to focus on healthy eating and exercise due to academic stress.	1. Not at all 2. Slightly 3. Moderately 4. Very much 5. Extremely
B2 (17)	I cannot afford healthier food options or fitness programs.	1. Not at all 2. Slightly 3. Moderately 4. Very much 5. Extremely
B3 (18)	I feel judged or uncomfortable seeking help for weight-related issues.	1. Not at all 2. Slightly 3. Moderately 4. Very much 5. Extremely
B4 (19)	I don't trust commercial weight-loss programs or supplements.	1. Not at all 2. Slightly 3. Moderately 4. Very much 5. Extremely
B5 (20)	I find conflicting health advice online confusing and overwhelming.	1. Not at all 2. Slightly 3. Moderately 4. Very much 5. Extremely