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The Impact of Meal Patterns, Food Choices, and Nutritional Knowledge on Academic Performance among Students at UiTM Permatang Pauh, Pulau Pinang

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ABSTRACT

This study investigates the relationship between meal patterns, food choices, nutritional knowledge, and academic performance among Universiti Teknologi MARA (UiTM) Permatang Pauh students. A cross-sectional quantitative survey was conducted with 368 students using a structured questionnaire to assess dietary behaviours, while cumulative grade point average (CGPA) served as the academic performance indicator. Data were analysed with SPSS to examine relationships among the variables. Findings show that students who reported regular meal patterns, balanced food choices, and greater nutritional knowledge tended to achieve higher CGPAs. In contrast, irregular eating habits and poorer dietary practices were associated with lower academic performance. Effect sizes indicated that meal patterns and nutritional knowledge were stronger predictors of CGPA than food choices. As the study relied on a cross-sectional design and self-reported data, the results do not establish causality. Nonetheless, the findings highlight the importance of nutritional education and targeted dietary support within academic environments, contributing to ongoing research on the impact of dietary behaviours on student outcomes.

1. INTRODUCTION

Dietary habits are increasingly recognised as key determinants of not only physical health but also cognitive functioning and academic achievement. University students are a particularly vulnerable group, as they balance academic demands with the challenges of independent living, often resulting in irregular eating patterns and reliance on convenience foods. Prior research has consistently demonstrated that healthier dietary behaviours, including regular meal consumption, balanced food intake, and sufficient nutritional awareness, are associated with improved concentration, memory, and academic outcomes

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(Kim et al., 2016; Reuter et al., 2020; Khan et al., 2022). Conversely, behaviours such as meal skipping, high fast-food intake, and excessive consumption of sugary snacks have been linked to poorer academic performance (Mahfouz et al., 2024; Purtell & Gershoff, 2014). Evidence from international contexts highlights the complexity of these associations. For example, Kim et al. (2016) found that consistent meal consumption, particularly breakfast, combined with fruit, vegetable, and milk intake, predicted better school performance. Reuter et al. (2020), however, reported that while fruit and vegetable consumption alone did not directly influence GPA, breakfast intake showed a significant positive effect, whereas frequent fast-food consumption was negatively associated with performance. Similarly, recent quantitative studies reaffirm that healthier eating habits are positively correlated with academic outcomes, though the strength of associations varies by dietary component (Khan et al., 2022; Resimo et al., 2024).

These findings collectively suggest that meal patterns, food choices, and nutritional knowledge may each exert unique influences on students' learning outcomes. In Malaysia, emerging research also points to concerns about dietary behaviours among youth. Roslim et al. (2024) found that diets high in sugar, sodium, and saturated fats were significantly correlated with lower academic achievement among adolescents, particularly in STEM-related subjects. Nevertheless, despite growing national evidence, little attention has been paid to university students who may face additional dietary challenges due to financial constraints, limited access to healthy food options, and demanding academic schedules. Similarly, Chandravanshi et al. (2024) noted that their study was limited because the data were collected exclusively from a single medical college located in central India, which might restrict its applicability to broader contexts. Within Universiti Teknologi MARA (UiTM) Permatang Pauh, students often live away from home and may lack the skills or resources to maintain balanced dietary practices. To date, a limited number of published studies have examined how meal patterns, food choices, and nutritional knowledge relate to academic outcomes within this campus setting.

To frame this relationship, the present study draws on Social Cognitive Theory (SCT) by Bandura (1986), which emphasizes the interplay between individual factors (e.g., nutritional knowledge), environmental influences (e.g., food availability, peer modelling), and personal behaviours (e.g., meal frequency and food choices). SCT suggests that students' dietary behaviours are shaped not only by knowledge but also by environmental modelling and perceived self-efficacy in maintaining healthy eating practices. Applied to this context, SCT provides a useful lens to examine how dietary behaviours interact with students' ability to perform academically. Taken together, prior research underscores that while diet and academic performance links have been widely explored in global and adolescent populations, localized evidence for Malaysian university students remains scarce. Existing findings cannot be directly generalized to UiTM Permatang Pauh, given the unique cultural, institutional, and environmental influences on students' eating patterns. This lack of evidence creates a gap in understanding how specific dietary behaviours, namely, meal patterns, food choices, and nutritional knowledge, relate to academic performance within this population. Therefore, the current study aims to investigate the relationship between dietary habits and academic performance among UiTM Permatang Pauh students. Specifically, it examines how meal patterns, food choices, and nutritional knowledge are associated with cumulative grade point average (CGPA). By applying Social Cognitive Theory to this context, the study provides a framework for understanding how individual and environmental factors interact to shape dietary behaviours and learning outcomes. The findings are expected to offer actionable insights for university stakeholders to develop nutrition-focused interventions that support both student well-being and academic success.

1.1 Hypotheses

H1: There is a significant relationship between meal patterns and academic performance in UiTM Permatang Pauh.

H2: There is a significant relationship between food choices and academic performance in UiTM Permatang Pauh.

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H3: There is a significant relationship between nutritional knowledge and academic performance in UiTM Permatang Pauh.

1.2 Conceptual Framework

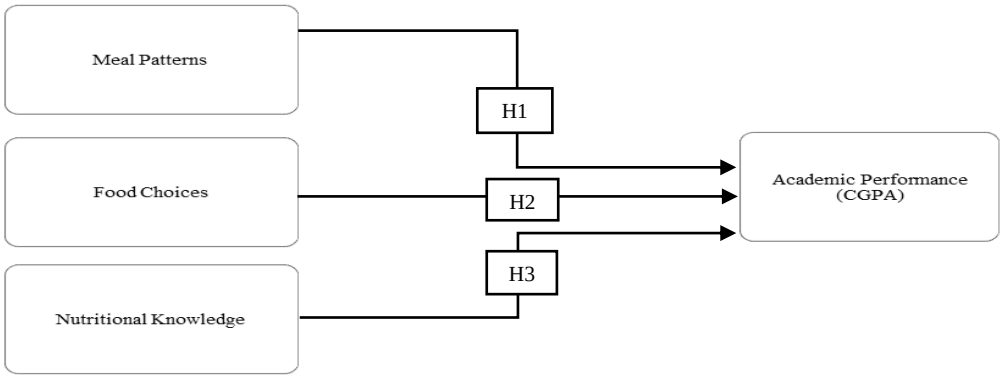

Figure 1. Conceptual Framework adapted from Social Cognitive Theory (Bandura, 1986), and supported by prior studies on the influence of meal patterns, food choices, and nutritional knowledge (Adolphus et al., 2013; Burrows et al., 2017; Bryan et al., 2004; Rampersaud et al., 2005; Do Amaral et al., 2020) on academic performance.

2. LITERATURE REVIEW

The present study is guided by Social Cognitive Theory (SCT) (Bandura, 1986), which emphasizes the interaction of personal factors, environmental influences, and behaviours in shaping outcomes. In this context, SCT provides a useful lens to understand how students' meal patterns, food choices, and nutritional knowledge (personal and behavioural factors), influenced by academic demands, peer norms, and food environment (environmental factors), may impact their academic performance. By applying SCT, this study frames dietary behaviour as not only an individual choice but also a socially and environmentally mediated process that may directly influence cognitive function and academic achievement.

2.1 Global Evidence on Dietary Habits and Student Performance

Globally, research consistently links dietary behaviours with cognitive and academic outcomes. Regular meal consumption, especially breakfast, has been shown to improve attention, memory, and test performance (Adolphus et al., 2019; Haapala et al., 2020). Conversely, meal skipping and irregular eating are associated with fatigue, reduced concentration, and lower grades (Xiao, 2023). Studies also highlight that diets high in processed foods and saturated fats impair memory and learning, while nutrient-rich diets enhance brain function (Gómez-Pinilla, 2008; Nyaradi et al., 2016). A key finding across contexts is that not all dietary components contribute equally: breakfast intake shows the most consistent positive effect, whereas fruit or vegetable intake alone demonstrates weaker or context-dependent associations (Reuter et al., 2021). Moreover, recent evidence emphasizes the role of nutritional knowledge and self-efficacy as mediators of dietary choice (Carter et al., 2022). These findings suggest that both behaviours and underlying knowledge are important to explain variance in academic performance.

2.2 Evidence from Malaysia and Southeast Asia

Malaysian studies echo global concerns. University students report high rates of breakfast skipping, reliance on fast food, and diets rich in sugar, sodium, and saturated fats (Gan et al., 2011; Haizatul et al., 2022). These patterns are linked to weight gain, low energy, and poorer concentration. Roslim et al. (2024) found that adolescents consuming diets high in sugar and saturated fats scored lower in STEM

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subjects, indicating potential cognitive implications of unhealthy diets. However, evidence for Malaysian university students remains limited and fragmented. Most studies focus on adolescent populations (secondary school) or compare general dietary intake without directly linking it to GPA or academic metrics. Furthermore, little is known about how nutritional knowledge, a factor emphasized by SCT, shapes food-related decisions among Malaysian students.

2.3 Meal Patterns and Academic Performance

Meal patterns refer to how often, when, and predictably meals are consumed within the course of a day, including breakfast, lunch, and evening meal (Haizatul et al., 2022). Consistent meal patterns, specifically daily consumption of breakfast, provide essential nutrients and energy to facilitate cognitive and learning functions, thus promoting better academic achievement (Reuter et al., 2021; Xiao, 2023). Meanwhile, unhealthy eating patterns and skipping meals correlate with poor dietary quality and academic achievement (Haizatul et al., 2022; Reuter et al., 2021). Regularly eating students show better cognitive function and concentration compared to those with irregular eating habits (Xiao, 2023). Meal timing and frequency are strongly associated with learning outcomes. Studies consistently show that regular breakfast consumption predicts better cognitive functioning, memory, and GPA (Adolphus et al., 2019; Haizatul et al., 2022). In contrast, irregular meal patterns such as skipping breakfast or inconsistent eating schedules are linked to reduced attention and lower academic performance (Reuter et al., 2021; Xiao, 2023). From an SCT perspective, meal patterns are influenced by both personal self-regulation (e.g., planning meals despite busy schedules) and environmental factors (e.g., availability of healthy food near campus). For UiTM Permatang Pauh students, who often manage tight schedules and limited food options, these contextual pressures may increase the likelihood of skipped or irregular meals.

2.4 Food Choices and Academic Performance

Food choices are the types of food and beverages an individual selects and consumes in their daily life (Bryan et al., 2004). Nutritious food choices such as vegetables, fruits, whole grains, and proteins are associated with better cognitive function, memory, and learning (Gómez-Pinilla, 2008; Rampersaud et al., 2005). Conversely, unhealthy food options like fast foods, sugary drinks, and convenience foods have been linked to lower levels of concentration and impaired academic performance (Florence et al., 2008; Sorhaindo & Feinstein, 2006). Beyond timing, the quality of food choices is a critical predictor of cognitive performance. Diets rich in whole grains, lean proteins, fruits, and vegetables are linked to higher attention and memory retention (Bryan et al., 2004; Burrows et al., 2017), while frequent consumption of sugary beverages, instant noodles, and fried foods has negative associations with learning outcomes (Florence et al., 2008; Li & O'Connell, 2012). Recent interventions show that improving food quality at institutional levels (e.g., healthier cafeteria options, nudging strategies) can positively influence both diet and academic performance (Belot & James, 2011; Wansink et al., 2013). Within SCT, food choices are shaped by observational learning (e.g., peer modelling), social norms, and perceived barriers such as cost. At UiTM Permatang Pauh, the dominance of affordable but calorie-dense campus food may skew students toward poor dietary quality, reinforcing unhealthy patterns.

2.5 Nutritional Knowledge and Academic Performance

Nutritional knowledge can be described as an individual's being aware of nutrients, food requirements, and the impacts of consuming foods on health (Guevara et al., 2020). It encompasses knowledge of balanced diets, nutrient-rich foods, and food preparation that promotes mental and physical well-being (Vijay et al., 2020). Individuals with better nutrition knowledge will be more likely to consume healthy foods, consume more fruits and vegetables, and avoid processed or fatty foods (Drewnowski & Hann, 1999; Do Amaral et al., 2020). Frequency and context of family meals also improve nutritional knowledge and healthy food practices in adolescents (Do Amaral et al., 2020).

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While behaviour is central, nutritional knowledge plays an enabling role in dietary decision-making. Research indicates that students with higher nutritional knowledge are more likely to consume balanced meals and less likely to adopt diets high in sugar (Vijay et al., 2020; Carter et al., 2022).

Knowledge enhances self-efficacy, a core construct in SCT, empowering students to resist unhealthy options despite peer or environmental pressures. However, knowledge alone does not guarantee healthier eating. Studies show discrepancies between knowledge and behaviour due to structural and cultural barriers (Kristjánsson et al., 2010). In Malaysia, few studies have directly tested whether students' nutritional knowledge predicts academic performance, leaving a critical gap in understanding how education translates into dietary behaviour and outcomes.

2.6 Academic Performance as an Outcome

Academic performance, often measured by Cumulative Grade Point Average (CGPA), is a reliable and widely used indicator of student achievement (Zakaria et al., 2019). Dietary behaviours may affect CGPA both directly, through cognitive function (attention, memory), and indirectly, through psychosocial well-being (attendance, motivation, mood). For example, balanced diets with adequate micronutrients support sustained energy and focus, whereas poor nutrition increases fatigue and stress, which in turn reduces academic engagement (Adolphus et al., 2019). While international and Malaysian studies highlight important associations, little is known that published research has examined the interplay between meal patterns, food choices, nutritional knowledge, and academic performance within UiTM Permatang Pauh. This is critical, given the unique pressures faced by students at this campus, including demanding coursework, limited access to affordable and healthy food, and cultural influences on diet. Guided by Social Cognitive Theory, this study addresses this gap by exploring how these dietary factors collectively influence students' CGPA.

3. METHOD

3.1 Research Design

This study employed a cross-sectional quantitative survey design to investigate the dietary habits of students at Universiti Teknologi MARA (UiTM) Permatang Pauh, with particular attention to meal patterns, food choices, and nutritional knowledge. The aim was to examine the correlation between these dietary patterns and the academic performance of students measured using Cumulative Grade Point Average (CGPA)**.** This design was chosen as it allows the identification of statistical associations among variables at a single point in time without implying causality. Additionally, the study sought to identify specific dietary behaviours such as breakfast consumption and the number of daily meals that may positively or negatively influence academic outcomes.

3.2 Population and Sampling

The target population comprised all Diploma and Degree students at UiTM Permatang Pauh, totalling 4,171 students, as per the official data retrieved from the University's Academic Affairs Department webpage (as of 2 October 2024). The rationale in investigating these two groups was primarily due to the parallels in their academic and lifestyle conditions, which would allow for consideration of dietary practices that affected academic performance. The population consisted of 2,232 Diploma students, 1,596 Degree students, and 343 Master's students. However, only Diploma and Degree students were included in the sampling frame, as the study specifically focused on undergraduate dietary patterns. Moreover, the majority of undergraduate students were full-time students, making them a suitable group for assessing dietary habits within a structured living environment. The sample size was calculated using the Raosoft sample size calculator, which determined that a minimum of 352 respondents was required to achieve a 95% confidence level with an acceptable margin of error. This confidence level indicates that in repeated samples, 95% of the results would reflect the true population parameters, a standard threshold in social science research. A convenience sampling strategy was employed due to practical constraints related to

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time and resource availability. Participants were selected based on their accessibility and willingness to participate, typically students encountered on campus during data collection periods. While convenience sampling does introduce potential sampling bias, its effectiveness in exploratory and educational research contexts has been supported in the literature (Etikan, Musa, & Alkassim, 2016). Furthermore, the relatively large sample size helped mitigate the limitations commonly associated with non-probability sampling and enhanced the reliability of the observed trends.

3.3 Research Instrument

A total of 368 students took part in the study, which is more than the minimum required sample size of 352, as calculated by the Raosoft sample size calculator with a 5% margin of error and a 95% confidence level. Due to time and accessibility constraints, a convenience sampling technique was used, enabling students who satisfied the inclusion criteria to voluntarily participate. Full-time Diploma or Degree students at UiTM Permatang Pauh who voluntarily participated and self-reported their CGPA were eligible participants; postgraduate students and those with missing or incorrect answers were not. The sample size obtained was adequate for statistical analysis and fairly representative of the target population, despite the possibility that convenience sampling may limit the findings' generalizability. Data were collected using a self-administered questionnaire, which was adapted and refined to suit the specific context of this study. The instrument was designed to capture students' dietary habits and their perceived academic performance, and all items were developed to align closely with the study's objectives. The questionnaire consisted of items structured around three primary components: meal patterns, food choices, and nutritional knowledge, as they relate to academic outcomes. A Likert-scale format employing a five-point scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) was used. This format was chosen based on its established use in behavioural and social science research for measuring opinion intensity and behavioural frequency (Parmjit et al., 2006).

3.4 Data Collection and Analysis

A total of 368 valid responses were collected and included in the final analysis. The quantitative data were analysed using Statistical Package for the Social Sciences (SPSS) to determine the relationships between dietary variables and academic performance, in line with the research objectives. Descriptive statistics were used to summarize respondent demographics, while inferential statistics, such as correlation analysis, were employed to examine the strength and direction of associations among the key variables. Structured self-administered questionnaire, designed from existing studies' guidance (Rampersaud et al., 2005; Florence et al., 2008; Burrows et al., 2017), that was the tool used for gathering data. There were two sections in the tool, and the first one collected demographic data like the gender, the age, the household income, the level of study, and the living arrangement, while the second one consisted of 12 items which were categorized into 3 constructs: meal patterns, food choices, and nutritional knowledge. Each item was rated using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) to maintain consistency among the variables. Representation items were: "I always have breakfast before going to school" (Meal Patterns), "I eat fruits and vegetables every day" (Food Choices), and "I am familiar with the nutritional value of the food I eat" (Nutritional Knowledge). The validation of the questionnaire was conducted through an assessment by two academic specialists in nutrition and behavioural sciences to ensure content validity and clarity of the items. Subsequently, a pilot study involving 30 students was carried out to evaluate the reliability, practicality, and clarity of the questionnaire. The feedback obtained from the pilot study was used to make necessary improvements before the actual data collection phase.

Table 1. Research Instruments

Research Instruments	Questions	Authors
Meal Patterns	I always have breakfast before attending classes. I consume my meals at consistent times each day. Missing meals does affect my concentration in class.	Rampersaud et al., (2005), Phillips et al., (2004), Basch,

	I often nibble or snack between meals.	Bruening et al., (2011)
Food Choices	I take fruits and veggies daily. I am choosing whole grains (brown rice) over refined grains (white rice) in my meals. I prefer more on sugary drinks over water or natural juices. I often prefer fried foods and more to high-fat in my diet.	Haapala et al., Burrows et al., (2017) O'Neil et al., (2009), Florence et al., (2008)
Nutritional Knowledge	I consume milk, cheese, or yogurt every day. I frequently eat foods with high-protein (meat, fish, eggs, or beans) in daily diet. I often include fiber-rich foods like whole grain bread in my diet. I frequently consume sweets and desserts.	Murakami et al., (2010) Neumark-Sztainer et al., (1996), Jenkins et al., (2002), Øverby et al., (2004), Do Amaral et al., 2020

To fulfil the research objectives, data were collected through an online survey using Google Forms (G-Form). Before accessing the questionnaire, participants were presented with a disclaimer on the first page, outlining the purpose of the study and emphasizing voluntary participation. This step was crucial in ensuring ethical standards and addressing any concerns related to the privacy of demographic data, particularly questions about academic performance. Data were collected between October and December 2024 using an online Google Form**.** The questionnaire link was distributed via multiple social media platforms, including WhatsApp and Telegram, to facilitate a wide and convenient reach among the target respondents. Participants were instructed to complete the survey within approximately ten minutes. Upon submission, responses were automatically recorded and stored in the administrative account managed by the research team.

The first page of the survey had an introduction, study purpose, confidentiality notice, and informed consent form. Ethical clearance was provided by the Faculty Research Committee, and confidentiality and voluntary participation were guaranteed to the participants. Data were stored in a password-protected file that was accessible only by the researchers. The instrument consisted of two main sections. Section A comprised demographic items, including age, gender, and education level, alongside a filtering question: "My Cumulative Grade Point Average (CGPA) is...". This filter ensured that responses reflected actual student performance data relevant to the study's aims. Section B addressed the three core research objectives, with items grouped into the following areas: meal patterns, food choices, and nutritional knowledge. Respondents rated their agreement with each statement using a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). In total, 12 items were included in this section, all aligned to assess the relationship between dietary habits and academic performance. The data collected were analysed using the Statistical Package for the Social Sciences (SPSS). The analysis incorporated both descriptive statistics to provide an overview of the sample characteristics and inferential statistics to explore the relationships among key variables. This approach ensured that the data were systematically interpreted in accordance with the research objectives, offering both depth and relevance to the findings.

4. RESULTS

A total of 368 students participated in the study. The majority were male (62.2%), with females comprising 37.8%. Most respondents were aged 21–25 years (89.1%), followed by 18–20 years (6.5%) and ≥26 years (4.3%). Degree students represented 62.2% of the sample, while 37.8% were diploma students. Regarding the living status, 58.4% of them lived off-campus and 41.6% in hostels. More than half (52.9%) had a monthly household income of less than RM3,000, which represented a middle-to-lower-income group, were reported in Table 1. These variables were later considered as covariates to control for potential confounding.

Table 2. Socio-demographic Characteristics of Respondents (N = 368)

Variable	n	%
Gender: Male	229	62.2
Gender: Female	139	37.8
Age: 18–20	24	6.5

Age: 21–25	328	89.1
Age: ≥26	16	4.3
Programme: Diploma	139	37.8
Programme: Degree	229	62.2
Living on campus	153	41.6
Household income < RM3,000	195	52.9
Household income ≥ RM3,000	172	47.1

4.1 Reliability and Validity

Cronbach's alpha was computed for each subscale across the full sample. Results indicated good internal consistency: meal patterns (α = 0.82, 95% CI [0.79, 0.85]), food choices (α = 0.84, 95% CI [0.81, 0.86]), and nutritional knowledge (α = 0.80, 95% CI [0.77, 0.83]). These values exceed the recommended threshold of 0.70, confirming acceptable reliability. Content validity was ensured through expert review of questionnaire items.

Table 3. Reliability Analysis

Construct	No. of Items	Cronbach's Alpha (α)	95% Confidence Interval	Interpretation
Meal Patterns	4	0.82	[0.79, 0.85]	Good Reliability
Food Choices	4	0.84	[0.81, 0.86]	Good Reliability
Nutritional Knowledge	4	0.80	[0.77, 0.83]	Acceptable Reliability

4.2 Descriptive Statistics

Table 4 presents means and standard deviations for the key variables. Respondents reported moderate adherence to healthy meal patterns (M = 3.12, SD = 0.84), moderate food choices (M = 2.97, SD = 0.78), and moderate nutritional knowledge (M = 3.25, SD = 0.81). Average self-reported CGPA was 3.18 (SD = 0.42).

Table 4. Descriptive Statistics of Key Variables (N = 368)

Variable	Min	Max	Mean	SD
CGPA	2.10	4.00	3.18	0.42
Meal Patterns	1.00	5.00	3.12	0.84
Food Choices	1.00	5.00	2.97	0.78
Nutritional Knowledge	1.00	5.00	3.25	0.81

The descriptive statistics summarize the mean (standard deviation) dietary habits of the two groups. Students with a CGPA < 3.5 probably have non-steady meal behaviours, including lower mean scores of healthy eating practices, and experiences that include regular breakfast eating or selection of nutrient-dense foods. In this group, we would expect even higher mean values for unhealthy behaviours, such as high frequency of fast food, sugar-sweetened beverages, or ultra-processed snack food consumption. Alternatively, students whose CGPA is currently above 3.5 probably have a mean score of more beneficial eating habits. This group might eat three balanced, nutritious meals every day, have fruits and vegetables, and never skip breakfast. These descriptive stats make it clear that there is an inverse tendency between dietary profile and academic performance, suggesting that the better a student eats, the better he does at university.

4.4 Correlation Analysis

Pearson's correlation analysis was conducted to examine the relationships between dietary habits (meal patterns, food choices, and nutritional knowledge) and students' academic performance (CGPA). The analysis was further divided into two groups based on academic achievement: students with a CGPA below 3.50 and those with a CGPA of 3.50 and above**.** Pearson's correlations indicated significant positive associations between all dietary variables and CGPA (Table 3). However, high intercorrelations

among predictors (r = 0.70–0.85) suggest possible multicollinearity. Variance inflation factors (VIF) were examined in regression models to address this.

Table 5. Correlations Among Key Variables (*Correlations for below 3.5)*

Variable	Meal Patterns	Food Choices	Nutritional Knowledge	CGPA
Meal Patterns	1.00	0.68**	0.61**	0.52**
Food Choices		1.00	0.66**	0.41**
Nutritional Knowledge			1.00	0.47**
CGPA				1.00

**. Correlation is significant at the 0.01 level (2-tailed).

Among the lower-achieving students with a CGPA of less than 3.50, Meal Patterns and General Nutrition Knowledge had the strongest correlations with CGPA (r = 0.52 and r = 0.47, respectively). This indicates that maintaining good eating habits consistently and having general knowledge of nutrition are linked with modestly better academic performances even among lower achievers.

Table 6. Correlations Among Key Variables (*Correlations for above 3.5)*

Variables	Meal Patterns	Food Choices	Nutritional Knowledge	CGPA
Meal Patterns	1.00	0.71**	0.75**	0.64**
Food Choices		1.00	0.72**	0.53**
Nutritional Knowledge			1.00	0.61**
CGPA				1.00

**. Correlation is significant at the 0.01 level (2-tailed).

In the higher CGPA group of students with CGPA 3.50 and above, the relationships were more robust than in the lower group. Meal Patterns (r = 0.64) and Nutritional Knowledge (r = 0.61) once again showed the most robust positive correlations with CGPA, which suggests that dieting discipline on a regular basis and increased nutritional knowledge are stronger in high-performing students. The correlation analysis quantifies how strong and in which ways dietary habits are related to academic performance for each group. For the students whose CGPA was below 3.5, it is most likely that negative correlations exist between skipping meals or consumption of unhealthy or junk foods (e.g., fast foods or sugary beverages) and their academic performances. This might mean that those behaviours negatively affect attention, cognitive ability, and overall school performance.

Students with a CGPA>3.50 are likely to possess better academic performance owing to the consumption of healthy dietary patterns such as regular meal consumption and balanced meal intake. Among them, the associations between some nutritional elements and intelligence test scores indicate the importance of nutrition in both cognitive ability and learning efficiency. The findings are in keeping with previous research, which highlights the advantages of nutrient-dense diets and regular eating patterns for academic performance.

4.5 Regression Analysis

A multiple regression analysis was conducted to determine which dietary behaviour variables best predicted CGPA. The model was statistically significant, $F(3, 364) = 59.82$, $p < 0.001$, explaining 32% of the variance in CGPA (Adjusted $R^2 = 0.32$).

Table 7. Regression Results Predicting CGPA

Predictor	B	SE	β	t	p
Constant	1.52	0.18	—	8.44	<.001
Meal Patterns	0.25	0.06	0.31	4.32	<.001
Food Choices	0.09	0.05	0.11	1.78	.075
Nutritional Knowledge	0.22	0.07	0.27	3.14	.002

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Meal Patterns and Nutritional Knowledge were strong predictors of CGPA, while Food Choices could not attain significance. This would mean that habitual meal patterns and nutrient knowledge are more important to students' academic achievement than some foods alone. Regression analysis determines which of the dietary habits are more predictive of academic performance (CGPA). On the other hand, for students with a CGPA below 3.5, the regression model might show a lower prediction power, suggesting that, whereas dietary habits are a factor in academic performance, for this group of students, other information, like time management or study habits, might play a more decisive role. Regression analysis for students with a CGPA above 3.5 will probably show that meal patterns, food choices, and nutritional knowledge are major contributors to students achieving higher CGPA. One of the best predictors may be simply eating breakfast regularly, along with a balanced diet. Their stronger association with dietary factors indicates that more health-adherent eating is important to maintaining cognitive efficiency and academic excellence in this more intellectually able group.

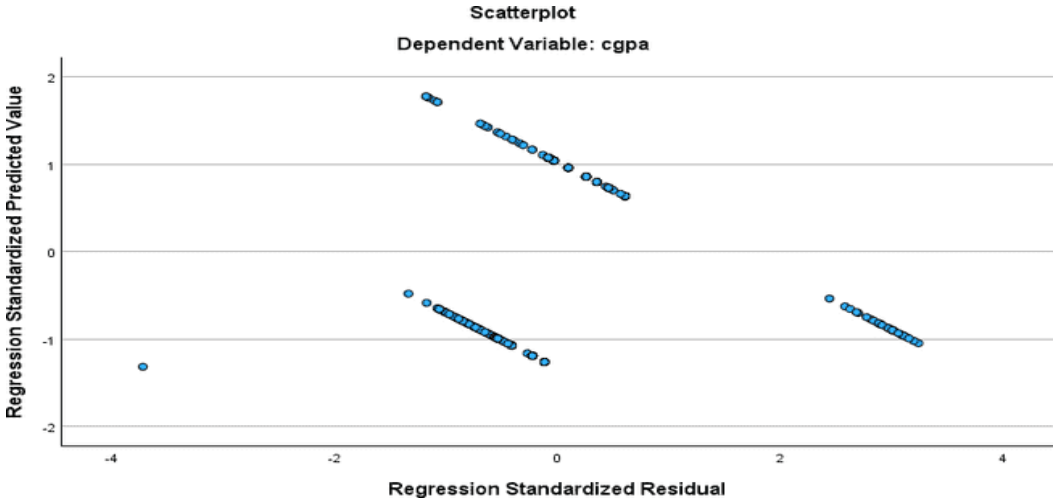

Figure 2. Scatterplot of Standardised Residuals Against Standardized Predicted Values for the Regression Model Predicting CGPA

The charts in the SPSS output likely depict key trends that visually illustrate the relationship between dietary habits and academic performance among students with a CGPA above and below. For instance, a line graph may show a clear upward trend in CGPA for students who regularly consume breakfast, reinforcing the idea that breakfast consumption plays a critical role in cognitive performance and academic success. Conversely, students who frequently skip breakfast may cluster in the lower CGPA range, highlighting the negative impact of this habit. Bar charts comparing food choices between the two groups may reveal that students with a CGPA above 3.5 are more likely to consume fruits, vegetables, and whole grains, while students CGPA below 3.5 exhibit higher consumption rates of fast food, sugary drinks, and processed snacks. This visual representation emphasizes the stark differences in dietary patterns between high and low-performing students and suggests that healthy eating contributes positively to academic outcomes.

5. DISCUSSION

The findings confirm that healthier dietary habits are positively associated with academic performance. Specifically, meal patterns and nutritional knowledge emerged as stronger predictors of cumulative grade point average (CGPA) than food choices. This suggests that consistency in eating routines (e.g., regular breakfast consumption) and awareness of nutrition exert greater influence on cognitive performance and academic outcomes than isolated food preferences. This result aligns with Kim et al. (2016) and Reuter et al. (2020), who found that regular meal intake contributes to stable glucose levels and improved cognitive alertness, leading to enhanced learning capacity and concentration.

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The regression analysis also demonstrated that students with higher nutritional knowledge tend to maintain regular meal patterns and make more balanced food choices. This interrelationship supports the Social Cognitive Theory (Bandura, 1986), which proposes that individuals' health-related behaviours are influenced by self-efficacy and environmental factors. Students who possess better nutritional awareness are more capable of applying that knowledge in daily practice, thereby reinforcing positive dietary habits that enhance academic performance. In contrast, students with irregular meal patterns or poor dietary practices recorded lower CGPAs. This finding is consistent with Adolphus et al. (2016) and Rampersaud et al. (2005), who emphasized that skipping meals particularly breakfast, can impair cognitive processes such as memory, attention, and problem-solving. Interestingly, the relatively weaker predictive power of food choices found in this study suggests that occasional indulgence in less healthy foods may not necessarily reduce academic performance if students maintain overall meal regularity and nutritional balance.

The results also contribute to the growing evidence linking dietary behaviour and academic achievement among university students in Malaysia, where such relationships remain underexplored. The findings underscore the importance of promoting nutritional education and developing campus-based health initiatives that encourage regular, balanced eating patterns. Initiatives such as nutrition literacy programs or "healthy campus" campaigns could enhance students' dietary self-regulation and improve both well-being and academic outcomes.

5. CONCLUSION

This study examined the relationship between meal patterns, food choices, nutritional knowledge, and academic performance among 369 students at Universiti Teknologi MARA (UiTM) Permatang Pauh. The results revealed a positive association between healthy dietary behaviours and academic achievement, with meal patterns and nutritional knowledge being the strongest predictors of higher CGPA. Students who regularly consumed balanced meals, fruits, and vegetables, and maintained a consistent breakfast routine generally achieved better academic outcomes compared to those with erratic eating patterns and frequent consumption of processed or sugary foods. These findings are in line with previous research indicating that nutrient-rich diets support cognitive function and concentration (Adolphus et al., 2016; Burrows et al., 2017). The study reinforces the importance of healthy eating behaviours as part of holistic student development within higher education. However, several limitations must be acknowledged. The use of convenience sampling may limit the representativeness of the sample, while self-reported CGPA and dietary data may be subject to recall or social desirability bias. Moreover, the cross-sectional design prevents establishing causality between nutritional practices and academic performance. Future studies should adopt longitudinal or mixed-method approaches, include larger and more diverse samples, and consider objective measures of academic records and nutrition. Qualitative studies, such as interviews or focus groups, could also provide deeper insights into the motivations and challenges behind students' eating behaviours. Overall, this study emphasizes the crucial role of dietary habits in academic success. The evidence can inform the development of targeted nutritional education and institutional interventions to foster healthier lifestyles and improved academic performance among university students.

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CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts, and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Anas and Azri carried out the research, wrote the article. Najua Ali conceptualised the central research idea and provided the conceptual framework. Dian Aszyanti Atirah designed the study, supervised research progress, anchored the review and revisions, and approved the article submission.

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