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Article

An inquiry into plant-based diet for achieving sustainable goals

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Abstract: This research addresses environmental, ethical, and health concerns related to high meat consumption, and aims to identify key predictors that encourage a shift towards sustainable diets among young adults. A cross-sectional survey involving 340 students from ten Malaysian universities was conducted using a structured questionnaire. The findings indicate that attitudes, subjective norms, perceived behavioral control, and personal norms significantly predict the intention to adopt plant-based diets. These results have practical implications, suggesting that policymakers, educators, and health professionals should create supportive environments and educational programs that emphasize the benefits of plant-based diets and equip students with the necessary knowledge and skills. Theoretically, the study reinforces the TPB framework's applicability in understanding dietary behaviors and underscores the importance of personal and social factors in shaping dietary intentions. Ultimately, promoting plant-based diets among university students necessitates a comprehensive approach and strategy addressing attitudes, social norms, perceived control, and personal values. By leveraging these insights, stakeholders can foster sustainable and healthy eating practices among young adults, contributing to broader environmental and public health objectives for sustainable development.

Keywords: plant-based diets, theory of planned behavior (TPB), sustainable diet, dietary intentions, environmental sustainability

1. Introduction

According to the United Nations Food and Agricultural Organization (FAO, 2017), livestock takes up nearly 80% of global agricultural land and emits 18 % of total greenhouse gas emissions, including methane, that cause 30 times on global warming than carbon dioxide (Grossi et al., 2019). In addition, livestock feed requires significantly more water compared to growing plants for direct human consumption (FoodPrint, 2022) besides polluting water sources as its waste ends up in waterways and causes acid rain resulting from the high concentration of ammonia in the atmosphere it generated (Brown, 2022). It is also worth noting that at least a third of all grains including soybeans and barley are used as livestock feed while on the other hand, more than 820 million people are facing a lack of sufficient food (UNICEF, 2019). The high consumption of animal-based products and the continuing growth of population are threatening the use of natural resources and hence it is critical to consider a more sustainable diet for long-term food security.

In addition, there are ethical objections to using animals for food due to the increase in inhumane conditions for farmed animals to drive economic efficiency

(Singer, 1975). Few global reports have claimed that over 90% of farmed animals not only live their lives in cages but are routinely mutilated without painkillers, and painfully slaughtered (Lymbery and Oakeshott, 2014; Mullee et al., 2017). Meanwhile, there are also concerns about excessive meat consumption with health issues. Numerous studies have shown that there are associations between increased meat intake with high levels of inflammation and increased risk of cardiovascular and chronic diseases as well as mortality (Giromini and Givens, 2022). In view of the negative meat effects of food production on human health, environmental issues, and animal welfare, there is an urgent need for a global shift towards a plant-based diet, a sustainable diet that has a low environmental impact as well as promotes health and well-being (Krizanova et al., 2021).

On the other hand, as the key agents for social change, youth's awareness of climate change is critical as they bear much of the negative impacts of climate change disasters during their lifetimes and whose well-being may be severely affected (Hickman et al., 2021; Léger-Goodes et al., 2022). However, it is rather challenging for youth to change to a climate-friendly food diet (Ojala, 2022) due to their unsustainable social norms and habits despite numerous public campaign programs acknowledging the issues and public promotions such as meat-free Monday (Grønhøj and Thøgersen, 2009; Hyry, 2021).

As in the Malaysian context, the high per capita meat consumption, particularly poultry, presents significant environmental challenges. Malaysians consume approximately 50 kilograms of poultry meat per person annually, which is among the highest rates globally (Siddharta, 2024). This high consumption level contributes substantially to environmental deterioration and greenhouse gas emissions, with livestock farming accounting for 14.5% of human-caused emissions. Despite these pressing issues, there is a notable gap in effective educational policies that promote plant-based diets among young Malaysians. Current strategies lack the necessary depth and reach to foster a significant shift towards sustainable eating habits. This highlights the urgent need for research to explore factors that can effectively encourage young people to adopt plant-based diets (Channel News Asia, 2024). Additionally, there are limited empirical studies for policy development and programs aiming to increase consumption of plant-based diets and limited research on the motivators towards adopting this sustainable diet. Hence, the rationale of this study is to examine antecedents influencing the intentions to adopt a plant-based diet, a climate-friendly diet, among young Malaysians by using the Theory of Planned Behavior (TPB) and extend it to the environment, health as well as ethical reasons in influencing attitudes. Young adults are the target group of this study as this age involves a transitional phase where new habits can emerge by challenging the old habits as most of their values, norms, and identities are yet to be established (Verplanken et al., 2018).

2. Theoretical background and review

2.1. Plant-based diet and theory of planned behaviour

In recent years, many people have increasingly shifted to a plant-based diet due to their potential to improve health and environmental sustainability (Pandey et al.,

2021). According to Hargreaves et al. (2023), a plant-based diet can be defined as "a dietary pattern in which foods of animal origin are totally or mostly excluded".

The Theory of Planned Behavior (TPB), proposed by Icek Ajzen (1991; 2011), has been widely used in various fields to understand and predict social behavior, especially food-related behaviors including dietary behavior (Pandey et al., 2021). According to this theory, behavioral intentions are the most immediate determinant of behavior, it represents "an individual's motivation to consciously decide to perform a behavior after careful consideration of the available information" (Chen, 2024, Mohd Iza Ney et al., 2022). They are influenced by three main factors: belief-based constructs like attitudes toward the behavior, subjective norms, and behavioral responses like perceived behavioral control (Hagger and Hamilton, 2024). The predictive power of these factors is having an uneven effect in affecting intentions and behavior rather it highly depends on the behavior type and situation's nature (Armitage and Conner 2001).

2.2. Attitudes and intention to shift to plant-based diets

Attitudes refer to an individual's overall positive or negative evaluation of performing a particular behavior that will result in certain outcomes (Chen, 2024; Hagger and Hamilton, 2024). Ajzen (1991) reported that attitudes could predict intentions to perform a particular behavior, especially in the context of adopting a plant-based diet, individuals may tend to evaluate it positively if they perceive it as healthier, more environmentally friendly, or morally right. Numerous studies (Bryant, 2019; Gifford et al., 2024; Nevalainen et al., 2023) have identified a positive relationship between attitudes towards plant-based diets and the intention to shift to such diets. Research by Miki et al. (2020) demonstrated that young people who held more positive attitudes toward plant-based diets were more likely to express intentions to adopt them.

A person's attitude and behavioral tendencies towards plant-based diets will determine whether they choose to follow a vegan lifestyle for ethical reasons or not. Ethical motivations stemming from concerns about animal welfare, environmental sustainability, and global food security are strong drivers for the adoption of plant-based diets. Personal attitudes, influenced by ethical concerns, especially animal rights, play a crucial role in shaping dietary choices (North et al., 2021). Consumers who prioritize self-reliance and ethical concerns in their consumption habits tend to favor healthier and more natural food options, which has led to a shift towards reduced meat consumption and increased plant-based eating. This trend is supported by previous studies (Dhont and Ioannidou, 2024; Graça et al., 2019) that highlight health and ethical reasons as key motivators for adopting plant-based diets.

Next, perceived health is the main factor that it is expected that more Asian consumers will change their dietary patterns and opt for vegan/vegetarian food options in the future (Cisternas et al., 2024). Landry and Ward (2024) found that healthy, vegetarian-style dietary patterns can be adopted for improved health and chronic disease prevention. Those young people who are aware of the health benefits of adopting plant-based diets will have a great positive attitude toward adopting such diets (McInnes et al., 2023; Su et al., 2019). It can be found that vegetarians are

primarily motivated by the perceived health benefits of a plant-based diet. They do not view meat as a necessary or integral part of their daily nutritional needs. Some individuals may choose to limit their consumption of animal products rather than eliminate them from their diet. Promoting health can influence individual's attitudes toward reducing the intake of traditional meat (Alae-Carew et al., 2022).

One of the most significant health crises affecting the world today is climate change, which is closely linked to our eating habits (Landry and Ward, 2024). It has been found that human behavior change in food consumption can have a crucial impact on climate change (Faber et al., 2024; McGrath, 2018), especially in developed countries (Fresán and Sabaté, 2019). According to a study conducted by McInnes et al. in 2023, young individuals are showing a favorable attitude towards adopting a plant-based diet due to their concerns for the environment. Young consumers, particularly Gen Z, prioritize eco-friendly products when purchasing sustainable food due to their high environmental consciousness (Su et al., 2019). Some meat consumers are aware of the environmental sustainability by having such a dietary shift despite their lack of interest in vegan or vegetarian diets (Bryant, 2019). However, the study by Mazdiarmid et al. (2016) revealed the opposing results where Scottish adults lack awareness of food and climate change issues, therefore, they tend to consume more meat instead of a plant-based diet.

2.3. Subjective norms and intention to shift to plant-based diets

Subjective norms refer to an individual's perception of social pressure to perform or not perform a behavior concerning others' influence (Chen, 2024; Hagger, 2019). These norms are usually influenced by the beliefs about whether significant others (such as family, friends, or peers) approve or disapprove of the behavior and the motivation to comply with those perceived norms. In other words, individuals may feel motivated to comply with perceived social norms due to a desire for social approval, avoidance of social disapproval, or the belief that conforming to social norms is the right thing to do. When transitioning to a plant-based diet, people's opinions can be influenced by their social surroundings, such as family, friends, colleagues, or societal norms. Dietary change can be challenging and various studies have shown that the perceived social support for adopting a plant-based diet can significantly impact an individual's intentions to do so. A study by Randall et al. (2024) has found that people who feel greater social support for a plant-based diet are more likely to adopt it. However, the intention to adopt a plant-based diet is negatively affected by the perceived social norm that others would encourage one to reduce meat consumption (Gifford et al., 2024; Onwezen et al., 2021). For instance, the motivation to adopt a plant-based diet is also influenced by imitation. If a popular actor or media personality adopts a vegetarian diet, their fans are likely to follow suit (Fehér et al., 2020). This is supported by a study by Daly et al. (2022), which identified that young people's subjective norms affected how they consume plant-based diets.

2.4. Perceived behavioral control and intention to shift to plant-based diets

Perceived behavioral control refers to an individual's belief in their ability to perform a behavior (Conner and Sparks, 2015). It includes everything that might help or impede the conduct, both internal and external. Perceived behavioral control in the context of switching to a plant-based diet might include things like having access to plant-based food alternatives, knowing how to cook, and being knowledgeable about nutrition. Research has shown that people are more likely to have stronger intentions to switch to a plant-based diet if they feel they have more behavioral control over doing so (Mustapa et al., 2024). Hardin-Fanning and Ricks (2017), for instance, discovered that people were more likely to declare their plans to switch to a plant-based diet if they felt competent in preparing and obtaining plant-based meals. Stronger intents were correlated with higher perceived behavioral control (Drolet-Labelle et al., 2023; Gifford et al., 2024). For instance, research has shown that perceived behavioral control plays a significant role in influencing individuals' intentions to transition to plant-based yogurt alternatives. Based on a study by Pandey et al. (2021), this factor is crucial in determining their willingness to adopt these healthier and more sustainable options. The study highlights that individuals who believe they can easily access and incorporate plant-based yogurt into their diets are more likely to consider making the switch from traditional dairy yogurt. Conversely, Chen (2024) discloses that perceived behavioral control is not a determinant for an individual to adopt plant-based diets.

2.5. Subjective norms to personal norms

Subjective norms and personal norms are two interrelated concepts that collectively shape people's actions and ways of thinking. Personal norms serve as internalized moral principles and values and are vital in guiding conduct because they connect behaviors with internalized standards of good and wrong (Schwartz, 1977), whereas subjective norms reflect external societal influences (Gavrilets et al., 2024). Based on empirical data, it appears that both conceptions are important in determining how people behave, with personal norms driving pro-social conduct and subjective norms frequently affecting adherence to societal standards. Research has shown that there are interacting effects between personal norms and subjective norms, indicating that the influence of personal norms on conduct may be tempered by the intensity of subjective standards (Ajzen, 2016). Subjective standards are frequently less powerful when people have stronger personal norms, especially when they feel strongly about moral responsibility or conviction. Intentions to switch to a plant-based diet can be influenced by personal norms that are established by social identity and a sense of belonging within particular groups or communities. People may switch to plant-based diets in order to follow the beliefs and lifestyles of like-minded people or to comply with the nutritional standards that are common in their social groups. Their need to preserve social approval and coherence within their social networks shapes their norms.

2.6. Personal norms for intention to shift to plant-based diets

People may switch to plant-based diets due to personal values on animal welfare and ethical treatment of animals. People who have a strong internalization of compassion and minimizing animal suffering could feel ethically obliged to cut back on or give up eating animal products (Aaltola, 2012). They have a higher desire to embrace plant-based diets since their standards mandate that doing so is consistent with their ethical convictions. Intentions to switch to a plant-based diet might also be influenced by personal standards on environmental sustainability. Plant-based diets may be seen as a more environmentally friendly choice than diets high in animal products by those who place a high priority on environmental sustainability and conservation (Schultz et al., 1995). Their desire to switch to plant-based diets is increased when they make dietary decisions that reduce their influence on the environment because of their norms. It is proven that personal norms did have strong significant that affecting individuals' plant-based eating and other sustainable eating behaviours (Wang and Scrimgeour, 2021).

2.7. Personal norms mediate between subjective norms and intention to shift to plant-based diets

Subjective norms can significantly influence personal norms. When individuals perceive social approval for plant-based diets, they are more likely to internalize these norms and feel morally obligated to follow the same dietary patterns (Randall et al., 2024). Studies have shown that individuals often adopt behaviors that align with their social circles, which then become part of their personal value system (Fishbein and Ajzen, 2010).

Personal norms, rooted in individuals' personal values and moral principles, play a crucial role in mediating the influence of subjective norms on intentions (Kim and Seock, 2019). If individuals' personal norms align with the perceived subjective norms regarding plant-based diets, they are more likely to form intentions to shift to plant-based diets as a way of adhering to their internalized standards of conduct. If individuals strongly internalize the normative belief that adopting a plant-based diet is morally right or socially desirable, they are more likely to form intentions to align their dietary choices with these personal norms.

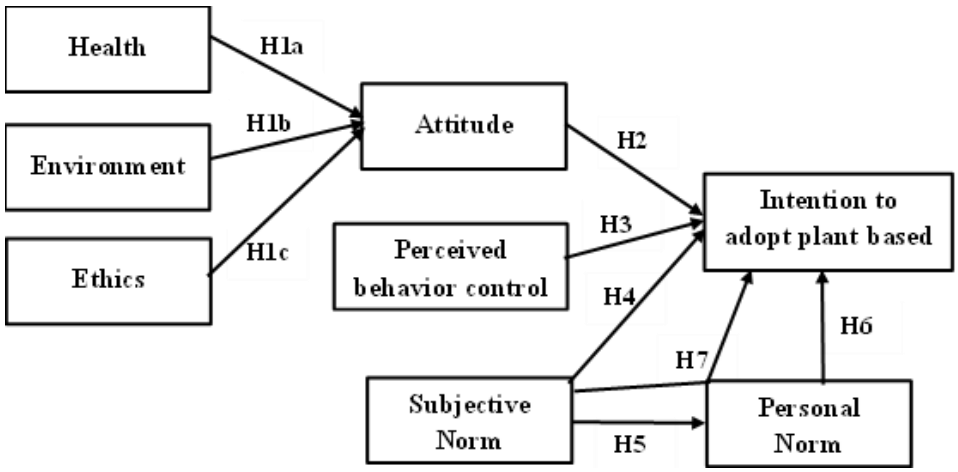

Figure 1. Research framework.

Personal norms, therefore, mediate the relationship between subjective norms and intentions to shift to plant-based diets by translating perceived social pressures into internalized standards of conduct. Individuals' intentions are influenced not only by their perceptions of social expectations but also by their personal beliefs about what is morally right or wrong in relation to dietary choices. **Figure 1** shows these relationships.

3. Methodology

3.1. Sample and data collection

A cross-sectional survey was conducted with university students, both from public and private universities, and a convenience sampling technique was utilized. Academic staff from 5 public universities and 5 private universities who were readily accessible and willing to assist in distributing the online questionnaire were approached. University students who were willing to participate in this research comprised the sample for this study, and hence the unit of analysis was individual students. Participants were asked for their consent regarding participation in the survey and informed all responses remained anonymous. Data was collected from Feb 2024 to April 2024. A total of 340 responses were collected.

Based on Cohen's (1988) recommendations (i.e., effect size (f^2) = 0.15 and α = 0.05 and power of 0.80), the required sample size was computed using the G* power software. The suggested minimum sample size of 92 is below the collected responses, i.e., 340 used in the analysis, fulfilling the requirement for sample size.

3.2. Survey measures

The first section consists of 8 questions on social-demographic characteristics with nominal scaling and these include gender, age, nationality, ethics, education level, type of university, current diet practice, and meat consumption frequency. The second section consists of the TPB theoretical model constructs and items. It comes with 3 questions on attitude (Pang et al., 2021), 5 questions on subjective norms (Pang et al., 2021), 4 questions on perceived behavioral control (Savari et al., 2023), and 4 questions on intention to practice plant-based diet (adapted from Carfora et al., 2017; D'Souza et al., 2022). 4 items measuring personal norms were adapted from Han (2014) and the three additional constructs influencing attitudes, i.e. ethics (6 items), health (5 items), and environment (5 items) were adapted from Tarraga et al. (2020). All these items in the second section were measured on a 5-point Likert scale ranging from 1 ('strongly disagree') to 5 ('strongly agree').

Pre-test was performed with 3 academic experts to check the suitability and the validity of the items. Improvements on some of the wordings were made. A pilot test with 30 university students was administered and all the items scored Cronbach alpha value above 0.7 (**Table 2**). Hence, all the items are deemed reliable.

Table 2. Pilot study cronbach alpha.

Health	Environment	Ethics	Attitude	Perceived behavioural control	Subjective norm	Personal norm	Intention to adopt plant-based diet
0.744	0.700	0.876	0.910	0.886	0.881	0.831	0.907

4. Data analysis

The partial least squares (PLS) structural equation modeling (SEM) technique was employed in testing the hypothesized relationships. PLS is a variance-based method for generating estimates of both true composites and factors, with the measurement error fully accounted for. According to Peng and Lai (2021), PLS offers predictive capability by enabling the researchers to evaluate the predictive validity of the exogenous variables. Thus, it has found wide application in analyzing models with complex relationships, as in the case of the present study. Our model proposes new relationships to the conceptualization of TPB by clarifying the underlying factors of attitude and the indirect effect of subjective norm on intention through the personal norm, thereby making the PLS an appropriate tool for data analysis. Based on the two-stage approach, the measurement model (i.e., construct reliability and validity) was first assessed, followed by the structural model used in testing the hypothesized relationships (Ojo, 2022; Peng and Lai, 2012).

4.1. Measurement model

The reliability of the measurement scale was assessed using the Cronbach alpha and composite reliability values for each variable. As shown in **Table 3**, all the generated values were above the recommended cutoff of 0.700 for both Cronbach alpha and composite reliability values (Hair et al., 2017). Thus, the measurement scale's internal consistency and reliability conditions have been met.

Table 3. Measurement scales, reliability, and validity.

Variables and Items	Factor Loading
Health (α = 0.779; CR = 0.851; AVE = 0.596)	
A diet with lots of meat can be harmful to health.	0.703
Eating meat in excess harms health.	0.574
If I ate less meat, my health would improve.	0.864
Eating less meat is good for my health.	0.902
Environment (α = 0.842; CR = 0.894; AVE = 0.679)	
Eating meat harms the environment.	0.855
To eat meat is disrespectful towards life and the environment.	0.855
By eating meat, I am also responsible for the problem associated with its production.	0.811
By eating meat, I support an industry that is responsible for environmental damage.	0.772
Ethics (α = 0.869; CR = 0.905; AVE = 0.658)	
When I think about eating meat I feel guilty.	0.817
I feel bad when I think about eating meat because of the animal suffering.	0.890
Eating meat reminds me of the death and suffering of the animals.	0.879
If I saw an animal being killed, I would have no problems eating it.	0.800

It would be difficult for me to watch an animal being killed for food purposes.	0.716
A diet with lots of meat can be harmful to health.	0.738
Attitude (α = 0.916; CR = 0.947; AVE = 0.856)	
I like the idea of shifting to plant-based diet.	0.940
Shifting to plant-based diet is a good idea.	0.938
I have a favorable attitude toward shifting to plant-based diet.	0.898
Subjective Norm (α = 0.939; CR = 0.954; AVE = 0.805)	
Most people who are important to me think I should shift to plant-based diet.	0.913
Most people who are important to me would want me to shift to plant-based diet.	0.908
People whose opinions I value would prefer that I shift to plant-based diet.	0.927
My friend's positive opinion influences me to shift to plant-based diet.	0.887
Society expects me to adopt plant-based diet.	0.850
Perceived behavioural control (α = 0.905; CR = 0.934; AVE = 0.778)	
I believe I can adopt plant-based diet.	0.875
I have the knowledge and skills to adopt plant-based diet.	0.901
I believe I can adopt plant-based diet if I want to.	0.891
I know how to adopt plant-based diet.	0.862
Personal Norm (α = 0.902; CR = 0.939; AVE = 0.837)	
I feel an obligation to shift to plant-based diet.	0.895
I feel that it is important to shift to plant-based diet.	0.922
Regardless of what other people do, because of my values/principles, I feel that I should shift to plant-based diet.	0.927
Intention (α = 0.951; CR = 0.965; AVE = 0.873)	
I am willing to shift to plant-based diet.	0.913
I intend to shift to plant-based diet by reducing heavy reliance on meat-based food and relying more on plant-based food.	0.940
I plan to shift to plant-based diet by reducing heavy reliance on meat-based food and relying more on plant-based food.	0.949
I want to shift to plant-based diet by reducing heavy reliance on meat-based food and relying more on plant-based food.	0.935

Furthermore, we assessed the convergent and discriminant validity for each variable. Consistent with guidelines (Fawcett et al., 2014), we deleted one item each from health, environment, and ethics to ensure that all the items loading are above 0.500 on their associated constructs and the average variance extracted for each construct is greater than 0.500 (see **Table 4**). Thus, each latent construct accounts for a minimum of 50% of the variance in the underlying items, indicating the convergent validity of the model.

According to Fornell Larcker (1981), discriminant validity can be established when the square root of each construct AVE is of greater value than all the inter-construct correlations. As shown in **Table 4**, the AVE values in Bold are higher than the off-diagonal inter-construct correlation values, indicating the model's discriminant validity.

Table 4. Results of Discriminant validity.

	ATT	ENV	ETH	HTH	INT	PBC	PRN	SBN
ATT	**0.925**							
ENV	0.498	**0.824**						
ETH	0.545	0.671	**0.811**					
HTH	0.45	0.558	0.465	**0.772**				
INT	0.777	0.556	0.607	0.454	**0.934**			
PBC	0.711	0.45	0.488	0.335	0.771	**0.882**		
PRN	0.756	0.515	0.539	0.407	0.857	0.733	**0.915**	
SBN	0.664	0.513	0.464	0.379	0.705	0.593	0.737	**0.897**

Note: ATT-Attitude, ENV-Environment, ETH-Ethics, HET-Health, INT-Intention, PBC-Perceived behavioral control, PRN-Personal norm, SBN-Subjective norm.

4.2. Structural model

The hypothesized relationships were tested using the values of the path coefficients and their significance levels generated from the bootstrap procedure with a resampling size of 1000. Also, we examined the value of the coefficient of determination (R^2) to assess the amount of variance explained by the independent variables. As presented in **Table 5**, health (β = 0.199, p < 0.001), environment (β = 0.173, p < 0.01), and ethics (β = 0.335, p < 0.001) were significant predictors of attitude. Hence, H1a, H1b, and H1c were supported, with the R^2 value of 0.360 for attitude suggesting that health, environment, and ethics could explain a 36% change in people's attitude towards a plant-based diet. As hypothesized in H2, H3, and H4, intention to adopt a plant-based diet was significantly predicted by attitude (β = 0.194, p < 0.001), perceived behavioral control (β = 0.234, p < 0.001) and subjective norm (β = 0.088, p < 0.001). Also, the subjective norm was significantly related to personal (β = 0.737, p < 0.001), while the personal norm was a significant predictor of intention (β = 0.474, p < 0.001). Thus, H5 and H6 were supported. According to the R^2 value (i.e., 0.543), subjective norm accounted for 54.3% variance in personal norm, with the overall model R^2 value explaining 79.9% of the variance in intention to adopt plant-based diet.

Table 5. Results of hypotheses testing.

Hypothesis	Path	Beta	*t*-Value	f^2	Decision
H1a	HTH → ATT	0.199	3.769***	0.042	Supported
H1b	ENV → ATT	0.173	2.511**	0.022	Supported
H1c	ETH → ATT	0.335	5.408***	0.093	Supported
H2	ATT → INT	0.194	3.856***	0.067	Supported
H3	PBC → INT	0.234	4.647***	0.110	Supported
H4	SBN → INT	0.088	1.978*	0.017	Supported
H5	SBN → PRN	0.737	22.435***	1.187	Supported
H6	PRN → INT	0.474	7.981***	0.319	Supported

Note: p < 0.001***, p < 0.05*, HTH-Health, ATT-Attitude, ENV-Environment, ETH-Ethics, PBC-Perceived behavioral control, SBN-Subjective Norm, PRN- Personal Norm, INT-Intention.

Furthermore, we assessed the effect size of the hypothesized relationships as small, medium, large, and very large using the values of 0.2, 0.5, 0.8, and 1.3, respectively, as Cohen (1990) recommended. As shown in **Table 4**, the effect size of the subjective norm on the personal norm is considerably large, while the personal norm had a relatively medium effect on intention. All the other variables had relatively small effect sizes. Nonetheless, Chin et al. (2003) argued that the independent variables' influence on the dependent variable allows even the most minor strength of effect size to be considered. Also, the model's predictive capability was assessed using the Stone- Geiser's (Q^2). The Q^2 values for attitude, 0.288, and intention to adopt a plant-based diet, 0.653, are greater than zero, indicating that the model has acceptable predictive relevance (Peng and Lai, 2012).

4.3. Mediating model

The mediating model employed the bootstrapping technique (i.e., 5000 bootstrap samples) in testing the indirect paths from the subjective norm to the intention to adopt a plant-based diet through personal norm (Hair et al., 2017; Preacher and Hayes, 2008). As revealed in **Table 6**, the path estimate coefficient of 0.349 was significant at $p < 0.001$, with the bias-corrected confidence intervals (i.e., 0.272 to 0.433) not within zero. Thus, personal norm significantly mediates the relationship between subjective norm and intention ($\beta = 0.349$, $p < 0.001$).

Table 6. Results of mediation testing.

Hypothesis	Path	Beta	95% Confidence Interval	t-Value	Decision
H5	SBN → PRN → INT	0.349	0.272–0.433	7.354***	Supported

Note: $p < 0.001$***, SBN—Subjective Norm, PRN—Personal Norm, INT—Intentions.

4.4. Common method bias (CMB)

The use of cross-sectional data collected from a single respondent makes the present study susceptible to CMB. As a result, procedural and statistical guidelines were considered to minimise this issue (Guide and Ketokivi, 2015). At the procedural level, a cover letter was enclosed with the questionnaire, starting the study's purpose and promising to maintain the respondents' anonymity. Also, Harman's single-factor test was performed to assess the potential statistical impact of CMB. The result reveals that the most significant single factor accounts for 48.506 percent of the variance, which is lower than the suggested value of 50 percent (Podsakoff et al., 2003). Thus, CMB has not significantly impacted the self-reported data.

5. Discussions

In the last two decades, there is a growing shift toward plant-based diets, particularly among younger populations in developed countries, driven by health, environmental, and ethical considerations. Studies from Europe, the United States, and Asia indicates similar motivators factors, such as sustainability awareness and personal health benefits. However, in various region, adopting these diets presents unique problems due to cultural and economic issues. By placing the findings in the

context of global trends, this study enhances our knowledge of dietary changes around the world by highlighting both common and particular obstacles, enriching the understanding of dietary shifts worldwide.

This study investigates the factors influencing young Malaysian university students' intention to adopt a plant-based diet, using an extended Theory of Planned Behavior (TPB) model. The results indicate that health, environmental, and ethical considerations significantly shape attitudes towards plant-based diets. Additionally, perceived behavioral control and subjective norms are crucial in forming intentions for plant-based diets. The study also reveals that personal norms, derived from subjective norms, substantially mediate the relationship between subjective norms and the intention to adopt a plant-based diet. Overall, the extended TPB model explains 79.9% of the variance in the intention to adopt a plant-based diet, highlighting the critical roles of attitudes, perceived behavioral control, subjective norms, and personal norms.

The shift to plant-based diets among university students in Malaysia is an important matter, considering the substantial negative effects that heavy meat consumption has on the environment, human health, and ethical standards. Land and water use, greenhouse gas emissions, and environmental degradation are all significantly impacted by livestock production (FAO, 2017; Grossi et al., 2019). Moreover, the growing awareness of animal welfare and the health benefits of plant-based diets further underscores the importance of understanding the factors that influence dietary choices among young adults. This research utilizes the Theory of Planned Behavior (TPB) to explore these factors, aiming to inform effective strategies to promote sustainable eating habits in Malaysia.

In fact, promoting plant-based diets among Malaysian university students is often met with resistance due to cultural preferences for meat and the economic significance of the livestock industry. Additionally, there are concerns about the nutritional adequacy of plant-based diets for young adults. These concerns are legitimate but can be effectively addressed with empirical evidence and current trends. Below are the concerns in promoting a plant-based diet in the education setting.

5.1. Cultural preferences

Cultural norms in Malaysia and many other countries strongly favor meat consumption. However, global trends show a growing shift in dietary preferences among younger generations towards more sustainable and health-conscious eating habits, including plant-based diets. Educational programs and awareness campaigns can play a pivotal role in gradually changing cultural attitudes. For instance, studies have shown that exposure to information about the environmental and health benefits of plant-based diets can significantly influence dietary choices (Verplanken et al., 2018). By integrating sustainability and nutrition education into university curriculums, students can develop a more informed perspective on their dietary choices, which can lead to a gradual cultural shift.

5.2. Nutritional adequacy

There is a common misconception that plant-based diets may not provide adequate nutrition, especially for young adults. However, numerous studies have demonstrated that well-planned plant-based diets can meet all essential nutrient requirements and offer significant health benefits. For example, research has shown that plant-based diets are associated with a lower risk of chronic diseases such as cardiovascular disease, type 2 diabetes, and certain cancers (Krizanova et al., 2021). The key is ensuring a balanced intake of various plant-based foods to obtain all necessary nutrients. Educational initiatives can help students understand how to plan their diets effectively to maintain optimal health.

5.3. Environmental sustainability

The research confirms that high meat consumption significantly contributes to greenhouse gas emissions and environmental degradation. Livestock farming is a major source of methane, a potent greenhouse gas, and requires extensive land and water resources (Channel News Asia, 2024; FAO, 2017). By adopting plant-based diets, students can reduce their ecological footprint, conserve natural resources, and help mitigate climate change. This shift is crucial for creating a more sustainable future, as the current levels of meat consumption are not environmentally viable in the long term.

5.4. Health benefits

The findings align with existing literature linking high consumption of animal products to various health issues, such as cardiovascular diseases, diabetes, and cancer. Plant-based diets, which are rich in fruits, vegetables, legumes, and whole grains, can improve overall health and reduce the prevalence of these diseases (International Agency for Research on Cancer, 2018; Krizanova et al., 2021). Promoting these diets among university students can lead to healthier lifestyle choices and reduce the burden of chronic diseases on the healthcare system.

5.5. Ethical considerations

The study highlights significant ethical concerns regarding the treatment of animals in the livestock industry. Many farmed animals are kept in inhumane conditions, leading to ethical objections from various quarters (Lymbery and Oakeshott, 2014; Mullee et al., 2017). A shift towards plant-based diets aligns with growing societal values around animal welfare and ethical consumption. By adopting these diets, students can make a stand against the mistreatment of animals and support more humane food production practices.

5.6. Educational influence

The research demonstrates that educational exposure significantly impacts students' attitudes toward plant-based diets. Incorporating sustainability and nutrition education into university curriculums can foster positive attitudes and encourage dietary shifts (Verplanken et al., 2018). Educational institutions have a crucial role in shaping the values and behaviors of young adults, and by emphasizing

the benefits of plant-based diets, they can lead the way in promoting more sustainable and ethical eating habits.

6. Implications

6.1. Theoretical implications

The integration of health, environmental, and ethical factors into the TPB highlights the importance of these dimensions in shaping attitudes toward plant-based diets. The significant impact of these factors on attitudes suggests that individuals' decisions to adopt plant-based diets are not solely influenced by general attitudes but are also strongly driven by specific beliefs about health benefits, environmental sustainability, and ethical concerns regarding animal welfare. This extended TPB model thus provides a more nuanced understanding of the attitudinal influences on dietary behavior.

The findings underscore the critical role of subjective norms and personal norms in influencing dietary intentions. The strong relationship between subjective norms and personal norms, and the significant mediation effect of personal norms on the relationship between subjective norms and intention, emphasize the importance of social influences and internalized moral standards in dietary decision-making. This highlights the dynamic interplay between external social pressures and internal personal values, suggesting that interventions aimed at promoting plant-based diets should consider both social and personal normative influences.

Moreover, the study demonstrates the substantial predictive power of the extended TPB model, explaining a significant proportion of the variance in the intention to adopt a plant-based diet. This indicates that the model is robust and capable of capturing the complexity of dietary behavior, providing a valuable theoretical framework for future research in this area.

6.2. Practical implications

The findings of this research with student contact offer valuable insights for practical applications in policymaking, education, healthcare, and social perspective and this preliminary study can serve as a foundation and provide actionable insights for broader public and community contexts. Details of implications and possible interventions are discussed below:

6.2.1. Policy implications

Promoting plant-based diet as a policy measure to mitigate climate change requires a comprehensive, multi-faceted approach. Policymakers must implement strategies that address awareness, accessibility and affordability. For example, Economic policies such as providing subsidies for plant-based food producers and tax incentives for businesses offering plant-based options, can make them more accessible and affordable; invest in infrastructure to streamline the supply chain for plant-based products can help to enhance the availability and distribution of plant-based food; introduce carbon taxes on high-emission food products like red meat and dairy and hold food companies to disclose the environmental impact of their products to create a supportive policy framework for the promotion of plant-based

food. It is also important to enhance public awareness through national media campaigns using social media, TV, newspapers to highlight the environmental impact of animal agriculture. Lastly, supporting research and innovation in plant-based foods including incentives for sustainable farming and public campaigns about the ecological benefits of plant-based diets can drive market growth and consumer acceptance. These measures can collectively foster a supportive environment for adopting plant-based diets, enhancing public health, environmental sustainability, and ethical food practices.

6.2.2. Educational implications

To promote plant-based diet information into educational curricula, educators and curriculum developers should integrate the values and content on the health, environmental, and ethical benefits of plant-based eating within subjects especially health and environmental science course to raise the awareness from a young age. This also can be done through multimedia content or incorporating interactive lessons, such as hands-on cooking classes, teaches students to prepare simple, tasty plant-based meals. This is important as students can act as catalysts for societal change as they often influence family and community behaviors. Schools can also implement initiatives like “Meatless Mondays” to encourage practical application and reinforce learning. Collaborations with nutrition experts or environmental NGOs to develop educational materials and awareness campaigns can provide additional insights and inspiration. Surveys and feedback sessions with students, and community can be conducted to measure changes in dietary habits and awareness levels through pre- and post-program evaluations. Publication of success stories and case studies can be shared to inspire further adoption of plant-based diet. These strategies will help students and community to develop positive attitudes toward plant-based diets and equip them with the skills necessary to make informed dietary choices.

6.2.3. Health implications

It is important to incorporate the plant-based diets into Public Health Guideline by updating dietary guidelines and to develop public health materials that provide guidance on balanced plant-based diets, emphasizing protein, iron, calcium, and vitamin B12 sources. Healthcare professionals can contribute in promoting plant-based diets by developing support programs that assist students and community in transitioning. Not only in school, offering plant-based options in hospital and other institutional settings may help to highlight the health benefits of these meals, such as lower cholesterol, improved heart health, and reduced risk of diabetes. Schools may personalize counselling or community may offer nutrition counselling service to address individual challenges, provide tailored advice, and emphasize the health benefits of plant-based eating. They can highlight and promote evidence linking plant-based diets as a strategy for preventing and managing chronic diseases. These strategies can effectively encourage lasting dietary changes and improve overall health outcomes, not only for students but also for general public health.

6.2.4. Community and social implications

This study highlights the crucial role social norms play in shaping our eating

habits. In the first place, community leaders and influencers should be educated on the benefits of a plant-based diet. Leaders could connect this notion by creating a buzz around plant-based diets, making them the new norm. Imagine peer-led initiatives, viral social media challenges, and community events that celebrate plant-based eating—these could shift perceptions and behaviors on a large scale. Collaborate with hospitals, and volunteer organizations like Tzu Chi and Fo Guang Buddhist Association to normalize the notion.

In summary, this research shows that promoting plant-based diets among university students requires a multifaceted approach, involving policy changes, educational efforts, health support, and community engagement. By addressing the various factors that influence dietary choices, we can make sustainable and healthy eating the norm rather than the exception.

7. Conclusion, limitation, and future research

This study highlights the critical need to promote plant-based diets among Malaysian university students to address significant environmental, health, and ethical concerns. Despite these findings, the deeply entrenched cultural preference for meat in Malaysia, embedded in traditional dietary practices, poses a significant barrier. However, global trends show a shift in dietary preferences among younger generations towards more sustainable eating habits. Educational programs and awareness campaigns have shown potential to change these cultural attitudes (Verplanken et al., 2018), but the pace of change is slow and faces resistance due to long-standing cultural norms and the economic significance of the livestock industry.

Building on the TPB, our study validated the significance of health, environment and ethics in influence consumer's attitude towards plant-based diet. We also found that intention towards plant-based diet is shaped by attitude, perceived behavioural control and subjective norm, while subjective norm is a significant determinant of personal norm. Further to the influence of personal norm on intention towards plant-based diet, the former significantly mediate the influence of subjective norm on the later. Hence, our findings offer a strong basis for creating focused programs that appeal to young adults and help Malaysia have a more sustainable and healthy future. However, to overcome ingrained preferences and economic dependencies, this change will require persistent efforts throughout the domains of education, culture, and policy. In short, by leveraging the findings of this study, stakeholders can develop targeted initiatives that resonate with young adults, fostering a broader cultural shift towards sustainable dietary practices.

There are certain limitations that should be mentioned. The use of convenience sampling in the collection of data from ten public and private universities could limit the generalizability of our findings. Another limitation is the choice of cross-sectional design in the collection of data. However, several procedural and statistical techniques have been followed to demonstrate the minimal effect of common method bias. Hence, future studies are encouraged to adopt probability sampling technique to enhance the chance of selecting respondents from diverse backgrounds, or different demographic groups to see the differences. Also, the longitudinal survey design could be adopted in future research to demonstrate how students' intention

and behaviour towards plant-based diet evolve over time.

Future research should consider a bigger sample size from various university sites throughout different regions in order to improve the accuracy and generalizability of the results. It should also take into account additional factors that could contribute to the rise in variance, such as personality traits, moral disengagement, threat, and coping appraisals. In order to identify the right target audiences, it is also possible to correlate the respondents' demographic profiles (gender, age, religion, etc.) with the factors influencing their intentions toward plant-based diets. Finding the discrepancies between food consumers' expectations and the plant-based diets they really adopt would be another potential topic of focus for a gap analysis.

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