A Cross-Sectional Study: Relationship Between Rice-Based Diet and Prevalence of Obesity Among Adults in University of Cyberjaya

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Abstract

Background: It is evidently known that a high-fat and high-sodium dietary pattern and a sedentary lifestyle are one of many major risk factors to metabolic syndrome. However, people often overlook the association between rice-based dietary patterns and high BMI. In many Asian countries, as such in Malaysia, where their daily dietary pattern involves rice-based meals, the prevalence of obesity among adults has increased significantly over the past years. Thus, it is of our concern to investigate the association between rice-based dietary pattern and high BMI.

Objective: This cross-sectional study aimed to study the association between rice-based and rice-dominant dietary patterns and high BMI among the adults in the University of Cyberjaya.

Methodology: 180 participants, comprised of staff and students of University of Cyberjaya aged 18-65 years old were recruited through convenience sampling method. Microsoft forms and physical form questionnaire hand-outs were used to collect and organise the data. Descriptive statistical methods and chi-square were done for data analysis.

Results: No significant association between rice-based dietary pattern and high BMI (P=0.349) found. However, it was observed that rice-dominant dietary pattern had a strong association with high BMI (P=0.006).

Conclusion: While incorporation of rice in daily diet was not significantly associated with risk of high BMI, consuming rice dominantly as part of daily dietary pattern was strongly associated with overweight and obesity among the study population.

Keywords: Rice-based diet, Rice-dominant diet, rice, obesity, overweight, high BMI, dietary pattern

Introduction

Since 1975, there has been a fourfold increase in the frequency of obesity worldwide. According to WHO 2020, the prevalence of obesity among teenagers over the age of 18 has significantly risen from 4% in 1975 to over 18% in 2016. In 2016, there were around 13% of adults worldwide who were obese. In Japan and Taiwan, the prevalence of obesity among older individuals was over 20% in 2012, with 30.5% of men and 21.3% of women being obese.

The prevalence of obesity among adults in Malaysia over the age of 18 was 17.7%, which was higher than the global obesity prevalence of 13% in 2016 (Thin Mon Kyaw, et al. 2022). In Malaysia, the prevalence of obesity among older adults—those over the age of 60—has climbed from 14% in 2006 to 15.1% and 20.5% in 2011 and 2015, respectively (Chan YY, et al. 2017). The prevalence of obesity was much higher in women than in men, with older adults between the ages of 60 and 70 having the highest prevalence (20.5%). According to a different survey, women (57.1%) were more likely than men (50.0%) to be obese. According to the Malaysian Clinical Practice Guideline (CPG), obesity is defined as a multifactorial condition and is characterised by an excess in body fat. Clinically, overweight and obesity can be classified using the Body Mass Index (BMI) scale whereby adults with a BMI of more than 23 kg/m2 and 27.5kg/m2 are classified as overweight and obese respectively (CPG). Through this BMI scale measurement, relative risk for disease can be estimated to compare with normal weight.

Different dietary patterns may be independently associated with obesity and other chronic diseases. In such cases of highly processed meals, which are heavy in saturated fats, sugars (carbohydrates), and salt contribute to obesity and metabolic disease not just through increased caloric intake, but also through systemic effects that cause inflammation and dysregulation of metabolic function (Ryan A. Frieler, et al. 2021).

Methodology

Study population: This study will be performed on adults studying or working at University of Cyberjaya, Selangor, Malaysia. The Kish Formula is used to calculate the sample size. The confidence interval is 95% and prevalence, p, is 86.9% based on prevalence of adults consuming rice twice daily from earlier research by Malaysian Adults Nutrition Survey (MANS) in 2014. The absolute precision required, D, is set at 10% non-respondents. This results in a sample size (n) of 185. An additional 19 is added to account for dropouts and data errors. The final sample size required to conduct the study is 166.

$$n = \left(\frac{z}{m}\right)^2 \times p(1 - P) + 10\% \ non-respondents$$

Table 1: Sample size calculation

	p	1-p	n
Prevalence of adults consuming rice twice daily from earlier research by Malaysian Adults Nutrition Survey (MANS) in 2014	0.869	0.131	n = 185

Study design: A cross-sectional study design is used for conducting this study. Through this descriptive observational study design, the frequency of the prevalence of high BMI (BMI of 25.0kg/m2 or greater) among Malaysian adults (18 years or older) and its association with rice-based diet can be estimated, without introducing interventions to the population. The inclusion criteria were all adults of students/staff at University of Cyberjaya aged 18-65 years old, and both Malaysian and Non-Malaysian. Whereas the

exclusion criteria are individuals who do not wish to give their consent to participate or failed to complete the questionnaire.

Data collection will be through the survey questionnaires distributed among adults in the Selangor state. Participants will be required to answer all questions provided in the questionnaire anonymously (no sharing of personal information required). The research tool that will be used for this study is the survey questionnaires. The questionnaires inquire about participants' dietary pattern; attained using the 3 day 24-hour dietary recall method (Arab L et al.), body mass index, waist circumference, and sociodemographic background, such as age, gender, race, marital status etc.

A 24-hour dietary recall (24HR) is a systematic interview designed to obtain comprehensive information about all the respondent's food and drink intake over the preceding 24 hours, most frequently from midnight to midnight the day before. When necessary, the respondent is prompted to provide more specific information than was initially supplied, which is a fundamental component of the 24HR. For instance, the preparation technique and bread type would be inquired about from a responder who reported having chicken for dinner or a sandwich for lunch. This open-ended response format is intended to encourage responders to give a thorough and in-depth account of all foods and drinks ingested. The portion quantity of each food and beverage is recorded in addition to additional specific identifiers like the time of day and the food's origin. To aid respondents in judging and reporting portion size and to increase accuracy, visual aids such as food models, photos, and other images may be employed. Typically, questions about dietary supplements are asked last in dietary recalls, with inquiries regarding foods and drinks coming first.

Data analysis: The data obtained was analysed using Jeffrey's Amazing Statistics Program (JASP) version 18, where descriptive analysis was calculated to find the range, mean, standard deviation and frequency percentage. Chi square test will be used to measure the association between rice-based diet and high BMI.

Definitions: Rice-based diet. Participants were categorised into 'rice-based dietary pattern' if they had consumed any meals containing rice at least once in the past 24 hours, or total energy intake of rice of more than 0 kcal in the past 24 hours.

Rice-dominant diet. Participants were categorised into 'rice-dominant dietary pattern' if they had consumed rice of more than 50% of the average total energy intake of Malaysian Adults in the past 24 hours, or intake of rice of more than 775 kcal in the past 24 hours. The value of 50% of the average total energy intake was considered as the cut-off point for the 'rice-dominant' category as any intake of rice that exceeds more than half of their daily dietary pattern indicates that rice is being consumed as a major fraction of their daily meal pattern. The figure 775 kcal was formulated as below:

As recommended by the National Coordinating Committee on Food and Nutrition (NCCFN Malaysia);
• Carbohydrate intake = 50% - 55% total energy intake (TEI)

As stated by Yi Yi Lee, et al (2019);
• Average Malaysian adult energy intake = 1550 kcal / day

$$50\% \ of \ avg \ energy \ intake = 50\% \times 1550 \frac{kcal}{day} = 775 \frac{kcal}{day}$$

Body Mass Index (BMI). The body mass index of the participants were retrieved directly from the respondents through the questionnaires given whereby the formula, and steps on calculating their BMI were thoroughly explained with texts and graphic aids. This study has grouped the different categories of

BMI into two main groups of interest; Normal (BMI of 24.9 kg/m2 or below), and elevated BMI (BMI of 25.0 kg/m2 or above, which includes overweight and obese).

Results

Table 2: Sociodemographic Characteristics of Respondents in this Study

Variables	Frequency (N)	Percentage (%)
Age group		
<20	43	23.89
21-25	106	58.89
26-30	11	6.11
31-35	12	6.67
36-40	7	3.89
>40	1	0.56
Gender		
Male	58	32.22
Female	122	67.78
Nationality		
Malaysian	156	86.67
Non-malaysian	24	13.33
Religion		
Islam	119	66.11
Buddhist	25	13.88
Christian	17	9.44
Hindu	19	10.56
Ethnicity		
Malay	92	51.11
Chinese	38	21.11
Indian	48	26.67
Others	2	1.11
Marital status		
Single	151	83.88
Married	29	16.11
Educational level		
Secondary education	22	12.22
Post secondary	41	22.78
Diploma	22	12.22
Undergraduates degree	90	50.00
Postgraduates degree	5	2.778
Students/staff of UOC		
Student	148	83.15
Staff	30	16.85

Estimated income per month		
<RM2,500	122	67.78
RM 2,500-RM 3,169	19	100.56
RM 3,170-RM 3,969	21	11.63
RM 3,970-RM 4,849	7	3.89
>RM 4, 850	11	6.11
Area of residence		
Urban	144	80.00
Rural	36	20.00
Body Mass Index		
Underweight	25	13.89
Healthy (Normal)	103	57.22
Overweight	33	18.33
Obese	13	7.22
Extremely obese	6	3.33
Any medical illnesses		
Yes	170	94.44
No	10	5.56

Table 3: Association Between Rice-based Dietary Pattern and High BMI among Adults in University of Cyberjaya

Body Mass Index					
Variables	**Normal, N(%)**	**Overweight/Obese, N(%)**	**Chi square, x^2**	**df**	**p-value**
Rice-based	82(45.56)	39(21.67)	0.875	1	0.349
Non rice-based	44(24.44)	15(8.33)			
Total	126(70.00)	54(30.00)			

Interpretation: Table 3 presents the association between rice-based dietary patterns and high BMI among adults at the University of Cyberjaya in Malaysia. The table includes the frequency and percentage of respondents categorised by their body mass index (BMI) and their dietary pattern. The chi-square test is used to measure the association, and the results are presented in the table with the degrees of freedom (df) and p-values.

The table shows that for the rice-based dietary pattern, 82 individuals were categorised as having a normal BMI, while 39 individuals were classified as overweight or obese. For the non-rice-based dietary pattern, 44 individuals were categorised as having a normal BMI, and 15 individuals were classified as overweight or obese.

The chi-square test results in a p-value of 0.349, indicating that there is no significant association between the rice-based dietary pattern and high BMI among the adults at the University of Cyberjaya.

Table 4: Association Between Rice-dominant Dietary Pattern and High BMI among Adults in University of Cyberjaya

Body Mass Index					
Variables	Normal, N(%)	Overweight/Obese, N(%)	Chi square, x^2	df	p-value
Rice-dominant	11(6.11)	13(7.22)	7.701	1	0.006
Non rice-dominant	115(63.89)	41(22.77)			
Total	126(70.00)	54(30.00)			

Interpretation: Table 4 presents the association between rice-dominant dietary patterns and high BMI among adults at the University of Cyberjaya in Malaysia. The table includes the frequency and percentage of respondents categorised by their body mass index (BMI) and their dietary pattern. The chi-square test is used to measure the association, and the results are presented in the table with the degrees of freedom (df) and p-values.

The table shows that for the rice-dominant dietary pattern, 11 individuals were categorised as having a normal BMI, while 13 individuals were classified as overweight or obese. For the non-rice-dominant dietary pattern, 115 individuals were categorised as having a normal BMI, and 41 individuals were classified as overweight or obese.

The chi-square test results in a p-value of 0.006, indicating that there is a significant association between the rice-dominant dietary pattern and high BMI among the adults at the University of Cyberjaya.

Table 5: Association Between Age and High BMI among Adults in University of Cyberjaya

Body Mass Index					
Variables	Normal, N(%)	Overweight/Obese, N(%)	Chi square, x^2	df	p-value
Age group					
<20	32(17.78)	11(6.11)	2.145	5	0.829
21-25	72(40.00)	34(18.88)			
26-30	7(3.89)	4(2.22)			
31-35	8(4.44)	4(2.22)			
36-40	6(3.33)	1(0.56)			
>40	1(0.56)	0(0.00)			

Total	126(70.00)	54(30.00)			

Table 6: Association Between Gender and High BMI among Adults in University of Cyberjaya

Body Mass Index					
Variables	Normal, N(%)	Overweight/Obese, N(%)	Chi square, x^2	df	p-value
Gender					
Male	39(21.67)	19(10.56)	0.310	1	0.578
Female	87(48.33)	35(19.44)			
Total	126(70.00))	54(30.00)			

Table 7: Association Between Ethnicity and High BMI among Adults in University of Cyberjaya

Body Mass Index					
Variables	Normal, N(%)	Overweight/Obese, N(%)	Chi square, x^2	df	p-value
Ethnicity					
Malay	63(35.00)	29(16.11)	4.670	3	0.198
Chinese	31(17.22)	7(3.89)			
Indian	30(16.67)	18(10.00)			
Others	2(1.11)	0(0.00)			
Total	126(70.00)	54(30.00)			

Table 8: Association Between Monthly and High BMI among Adults in University of Cyberjaya

Body Mass Index					
Variables	Normal, N(%)	Overweight/Obese, N(%)	Chi square, x^2	df	p-value
Income per month					
<RM2,500	85(47.22)	37(20.56)	2.009	4	0.734

RM 2,500-RM 3,169	15(8.33)	4(2.22)			
RM 3,170-RM 3,969	15(8.33)	6(6.33)			
RM 3,970-RM 4,849	5(2.78)	2(1.11)			
>RM 4, 850	6(3.33)	5(2.78)			
Total	12(70.00)	54(30.00)			

Table 9: Association Between Educational Level and High BMI among Adults in University of Cyberjaya

Body Mass Index					
Variables	Normal, N(%)	Overweight/Obese, N(%)	Chi square, x^2	df	p-value
Educational level					
Secondary education	16(8.89)	6(3.33)	6.245	4	0.182
Post secondary	33(18.33)	8(4.44)			
Diploma	17(9.44)	5(2.78)			
Undergraduates degree	58(32.22)	32(17.78)			
Postgraduates degree	2(1.11)	3(1.67)			
Total	126(70.00))	54(30.00)			

Table 10: Association Between Age and Rice-based Diet among Adults in University of Cyberjaya

Rice-based diet					
Variables	**Rice-based , N(%)**	**Non rice-based, N(%)**	**Chi square, x^2**	**df**	**p-value**
Age group					
<20	23(12.78)	20(11.11)			
21-25	86(47.78)	20(11.11)			
26-30	4(2.22)	7(3.89)			
31-35	6(3.33)	6(3.33)	28.748	5	<0.001
36-40	1(0.56)	6(3.33)			
>40	1(0.56)	0			
Total	121(67.22)	59(32.78)			

Table 11: Association Between Gender and Rice-based Diet among Adults in University of Cyberjaya

Rice-based diet					
Variables	**Rice-based , N(%)**	**Non-rice based, N(%)**	**Chi square, x^2**	**df**	**p-value**
Gender					
Male	38(21.11)	20(11.11)			
Female	83(46.11)	39(21.67)	0.113	1	0.737
Total	121(67.22)	59(32.78)			

Table 12: Association Between Ethnicity and Rice-based Diet among Adults in University of Cyberjaya

Rice-based diet					
Variables	**Rice based, N(%)**	**Non-rice based, N(%)**	**Chi square, x^2**	**df**	**p-value**
Ethnicity					

Malay	73(40.56)	19(10.56			
Chinese	16(8.89)	22(12.22)			
Indian	31(17.22)	17(9.44)	17.44	3	<0.001
Others	1(0.556)	1(0.556)			
Total	121(67.22)	59(32.778)			

Table 13: Association Between Income Per Month and Rice-based Diet among Adults in University of Cyberjaya

Rice-based diet					
Variables	Rice-based, N(%)	Non rice-based, N(%)	Chi square, x^2	df	p-value
Income per month					
<RM2,500	97(53.89)	25(13.89)			
RM 2,500-RM 3,169	7(3.89)	12(6.67)			
RM 3,170-RM 3,969	5(2.78)	16(8.89)	34.75	4	<0.001
RM 3,970-RM 4,849	4(2.22)	3(1.67)			
>RM 4, 850	8(4.44)	3(1.67)			
Total	121(67.22)	59(32.78)			

Table 14: Association Between Educational Level And Rice-based Diet among Adults in University of Cyberjaya

Rice-based diet					
Variables	Rice-based, N(%)	Non rice-based, N(%)	Chi square, x^2	df	p-value
Educational level					

Secondary education	8(4.44)	14(7.78)			
Post secondary	24(13.33)	17(9.44)			
Diploma	9(5.00)	13(7.22)			
Undergraduates degree	78(43.33)	12(6.67)	34.95	4	<0.001
Postgraduates degree	2(1.11)	3(1.67)			
Total	121(67.22)	59(32.778)			

Discussion

The discussion aims to explore the ramifications of our study findings on the relationship between rice-based dietary patterns and BMI among individuals in the University of Cyberjaya. The study population in this study comprised a diverse range of data in terms of age, ethnicity, religion, and nationality. The said diverse range of data had rendered this study ideal as a wide range of participants from different age groups participated, as well as an almost similar percentage of ethnicity distribution to that of the Malaysian population. These data were ideal in representing the entire Malaysian population.

Given the prevalence of rice-based dietary habits in many Asian countries, including Malaysia, where we conducted our study, our analysis reveals a notable finding: there is no discernible correlation between the study population's consumption of rice-based diet and BMI levels. This result corresponds to a previous study conducted by Kolahdouzan M. et al (2013) where no association was found between frequency of rice consumption per week and BMI (P = 0.353). This suggests that a dietary pattern involving rice does not affect one's BMI on its own, rather, the aetiology of elevated BMI is multifaceted and multifactorial which ranges from genetic predisposition to external environmental factors. It was found that specific dietary patterns, which include the white rice, kimchi, high-fat and high-sodium, high sugar, and coffee patterns, may be independently associated with obesity in Korean adults (Jihye Kim, et al, 2012). This previous study had shown that consumption of different dietary patterns aside from rice-based, may be strongly associated with elevated BMI. Thus, further studies investigating the relationship between the different dietary pattern of Malaysian adults must be made to deduce more comprehensive and robust results and in due time, improve and optimise the National Dietary Guidelines.

However, upon further analysis, our data highlights a notable finding, with a strong correlation found between a dietary pattern that is rice-dominant and elevated BMI among participants of the study. The contrast between the two results suggests that the frequency of rice consumption alone does insignificant implication towards the risk for elevated BMI, rather the daily amount of rice (carbohydrate) intake, measured by one's total energy intake (TEI) in calories yields a more robust and significant correlation towards elevated BMI. It was found that consumption of carbohydrates at the optimum value was associated with reducing chronic disease risk, including obesity (Chambers, Bryne & Frost, 2019). A study observed that high intake of carbohydrate of more than 60% of TEI was associated with significant

implications towards total mortality and non-cardiovascular disease as compared to moderate consumption of 50-55% of TEI (Dehghen et al. 2017). In light of the mentioned studies' results, the Malaysian Dietary Guidelines 2020 had formulated that the recommended amount of carbohydrate intake is 50-55% of TEI. According to Yi Yi Lee, et al (2019), the average energy intake of an adult Malaysian is around 1550 kcal daily, which quantifies the recommended carbohydrate intake to 775 - 852.5 kcal daily.

The results in this study evidently shows that excessive consumption of rice of more than the recommended value impacts one's health negatively. It is vital to understand that the consumption and intake of different micro and macronutrients must be monitored in order to reduce the risk of chronic diseases, namely obesity (G. Roman, et al, 2019). Thus, in a population where rice is a staple food, as such in Malaysia, it is ever more important that adherence to the national dietary guidelines plays a vital role in establishing a healthier and less morbid population.

Conclusion

This cross-sectional research at the University of Cyberjaya investigated the association between rice-based and rice-dominant dietary patterns and BMI among people. The study found no significant association between rice eating frequency and BMI. However, a strong association was found between rice-dominant dietary patterns and higher BMI. This suggests that, while rice consumption frequency may not have a major influence on BMI, the overall amount of rice consumed, assessed as a proportion of total energy intake (TEI), is important. High carbohydrate intake above 60% of TEI has serious consequences for BMI and overall health, emphasizing the significance of consuming carbs in moderation within suggested limits.

Limitations and Recommendations
Limitations

- The study's cross-sectional design: It excludes its ability to show causation between rice-dominant eating patterns and increased BMI.
- Self-Reported Data: The study relied on self-reported dietary consumption, which is susceptible to reporting bias and inaccuracy.
- Sample Size and Demographics: The study was done among individuals at a single institution, therefore the results may not be typical of the Malaysian or regional population.
- Lack of Comprehensive Dietary Analysis: The study concentrated solely on rice and carbohydrate intake, ignoring other dietary components and lifestyle variables that may impact BMI.
- Short-Term Assessment: The study lacked to include long-term food habits and their possible cumulative impact on BMI and general health.

Recommendations

- Dietary Education: Implement educational initiatives to raise knowledge of balanced dietary patterns, with a focus on moderate carbohydrate consumption within the recommended range of 50-55% of TEI.
- Nutritional Guidelines: Encourage people to follow the Malaysian Dietary Guidelines 2020, which prescribe a daily carbohydrate consumption of 775-852.5 kcal for adults and an average calorie intake of 1550 kcal.

- Dietary Monitoring: Establish routine dietary monitoring and counselling services at the University of Cyberjaya to assist individuals in better managing their carbohydrate consumption and overall diet.
- Further Research: Longitudinal studies should be conducted to better understand the long-term influence of rice-dominant diets on BMI and other health outcomes.

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