

# An Investigation on the Lifestyle Factors Influencing the Body Mass Index (BMI) of Students in UiTM Melaka using Logistic Regression

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## ARTICLE HISTORY

## ABSTRACT

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*The increasing prevalence of overweight and obesity among adolescents in Malaysia has become a serious concern. Based on researchers' observation, students' lifestyles are unhealthy. They tend to eat fast food and spending most of the time indoor rather than outdoor, which causes most of the students gaining weight. Hence, researchers decided to study on lifestyle of the students. To measure the individual's health, one needs to determine what factors are related to Body Mass Index (BMI). A study was conducted among 360 students of UiTM Malacca Branch whose ages ranging from 20 to 23 with the aim to determine whether lifestyle factor does affect the students' BMIs and to examine the most contributing factor to the students' BMIs. The data were collected using questionnaires that consist of questions concerning general characteristics of individual's eating habits, physical activities, motivation, smoking, and medication. Logistic regression is used to achieve the objectives of the study. The dichotomous dependent variable was identified to find out whether the students have BMIs more than 25. After measuring the body weights and heights of the individuals, the results show 50.80% of the students' BMIs who participated in the study were more than 25. Besides, the findings also show the BMIs of the individuals differed based on eating habits, physical activities, and motivation ( $p < 0.05$ ).*

**Keywords:** *Body Mass Index (BMI); logistic Regression; eating habits; physical activities; motivation*

## 1. INTRODUCTION

Malaysia becomes the country with the highest rate of obesity among the Asian countries. Over 31 million of Malaysians, 4.7 million of Malaysians have been recorded having obesity problem. Obesity rate in Malaysia increases year-to-year among the Asian countries and this was proven by World Health Organization (WHO). Obesity means having too much of body fat. It is different from being overweight, which means weighing too much. The weight may come from muscle, bone, fat, and/or body fluid. Both terms mean that a person's weight is greater than what is considered healthy for his or her height. Obesity occurs over the time when you eat more calories than you use. The balance between calories-in and calories-out differs for each person. Factors that might affect a person's weight include their genetic makeup, overeating, eating high-fat foods, and not being physically active. WHO [1] reported in their latest updates on obesity that the worldwide prevalence of obesity doubled between 1980 and 2014, where 13% of the whole world population (15% of women and 13% of men) is obese.

WHO added 40% of women and 39% of men in the world at the age of 18 years old and above have overweight BMIs. A study done by the Ministry of Health (MOH) of Malaysia stated that Melaka recorded to have the second of the highest percentage of obesity compared to the other states. Nusi [2] has mentioned in their study that over 44.5% of Malaysians were recorded to have their BMIs more than 25 which represent overweight. As cited in Kosmo [3], the minister of health of Malaysia said that the number of obese people in Malaysia will continue arising if they do not take actions to keep fit by practicing healthy lifestyle. Overweight BMI has a tendency to become obese due to the possibilities of the increasing amount of body fat if maintain the same lifestyle as highlighted by Kosmo [3]. Staff [4] has revealed that obesity has certain factors including genetics, family lifestyle, inactivity, unhealthy diet, medical problems, certain medications, social and economic issues, age, pregnancy, quitting smoking, and lack of sleep. Nusi [2] has emphasised on uncontrolled eating habits which can lead Malaysians to become obese. Students who are mostly above 18 years old have the tendency being obese since they are more likely to eat street foods and do not take breakfast, which are bad lifestyle practices.

## 2. METHODOLOGY

This study was proposed to determine whether lifestyle factors do affect the students' BMIs and to examine the most contributing factor to the students' BMIs. The methods used to achieve the objectives are as follows:

### 2.1 Research Population and Sample

The population is taken from UiTM Malacca Branch (UiTM Jasin Campus and UiTM Lendu Campus). The population of diploma students in these campuses is 4950 students. The selected samples are 360 students as supported by Sekaran [8]. Based on the formula used by Sekaran [8], the calculation of sample size is stated as below:

$$S_{\bar{x}} = \frac{S}{\sqrt{n}} \left( \sqrt{\frac{N-n}{N-1}} \right) \quad (1)$$

Since the population is 4950 students, Sekaran [8] suggests that the samples consisting of 360 students should be taken.

### 2.2 Sampling Method

Multistage sampling methods, which include cluster sampling and stratified sampling, were used. Initially, faculties from UiTM Melaka campuses were clustered. As there are seven faculties available among the Melaka campuses, four of them were selected as one cluster using simple random sampling. The clusters include Faculty of Accountancy, Faculty of Business Management, Faculty of Computer and Mathematical Science and Faculty of Plantation and Agrotechnology. Samples from each cluster were selected by using stratified random sampling method. The number of samples from each faculty is proportionate to the number of students in the faculty. The total population number of students from four clusters is 4950; hence, the

suitable proportion used is 7.3% from each faculty. Thus, 360 samples of students were selected in this study.

### **2.3 Research Instrument**

Data were collected by using face-to-face interview and self-administered questionnaires. Face-to-face interview was done to make it easier for the respondents to understand the questions and to record the weights and heights of the students. Questionnaires were constructed by using public questionnaires to fulfil the objectives of the study. Academic questionnaires from IRCM Lifestyle Questionnaires and Intermountain Healthcare were used as the basis of studying the tendency of obesity based on the lifestyle factors. The questionnaire was adapted based on the research interest to fulfil its objectives.

The questionnaires consist of six sections. The researcher noted the respondents' heights in centimetre (cm) and weights in kilogram (kg) to calculate their BMIs. Asil [5] mentions that the respondents' body weights calculated without shoes by a portable bathroom scale are sensitive till 0.1 kg. According to Asil [5], for height measurements, individuals have to stand with their feet side-by-side, together with their heads, hips and heels touching the wall. The measurement was taken by using a measuring tape. The body mass index of individuals were evaluated according to the World Health Organization's (WHO) classifications: below 18.5 is underweight, 18.5-24.99 is normal, 25.0-29.99 is overweight; and 30.0 and above is considered obese. In section A, the respondent's demographic profile such as age, gender, UiTM branch, and faculty are needed. Section B, C, D, E, and F contain the questions that focuses on eating habits, physical activities, motivation, smoking, and medication respectively.

### **2.4 Reliability Analysis**

Reliability analysis is the analysis used to measure the validity of the questionnaire. Pilot study was done to make sure error-free and no misunderstandings of the items; thus, this can enhance the accuracy of the evaluations. Cronbach alpha was used to measure the reliability, which should be more than 0.7 as suggested by Tavakol [6]. The high value for Cronbach Alpha implies high correlation between the items used in the study.

### **2.5 Logistic Regression Analysis**

This study is to determine the factors that affect students' BMIs. After the data were collected from 360 students, a full main model possessing all the factors and covariates was run. However, the relationship between the respondent variables and the predictor variables must be analysed as mentioned by Luguterah [7]. The study's contents is the dependent variable, BMI is categorical, while the independent variables are eating habits, physical activity, motivation, smoking, and medication. Since the data of dependent variable, BMI, is dichotomous, logistic regression was used in this research.

The final model only needs to include the significant predictor variables. The model was tested by using Wald test to see whether the parameters associated with the independent variables are

significant or not to predict the dependent variable. The hypotheses for the Wald test are as follows:

H<sub>0</sub>: The independent variable is not significant.

H<sub>1</sub>: The independent variable is significant.

The decision rule for Wald Test is to reject H<sub>0</sub> if the p-value is less than or equal to its significance value. If the null hypothesis is rejected, then the variable is significant. The odd ratios of each significant variable can be interpreted.

Equation (2) and equation (3) below are the general equations for logistic regression. Equation (3) is derived from equation (2). Logistic regression calculates the log odds of the dependent variables. The odds of obese subjects are equal to the probabilities of BMI more and equal 25 divided by the probabilities of BMI that is less than 25. The odds ratio is calculated to estimate the changes in the odds of membership in target variable, BMI. The p values on log transformation help to build a normal regression equation, which is called as log distribution, logit (p). It is noticeable that p is BMI with more and equal 25.

$$\text{logit}(p) = \log\left(\frac{p}{1-p}\right) = a + b_1x_1 + b_2x_2 + \dots + b_nx_n \quad (2)$$

$$p = \frac{e^{a+b_1x_1+b_2x_2+\dots+b_nx_n}}{1 + e^{a+b_1x_1+b_2x_2+\dots+b_nx_n}} \quad (3)$$

where:

p = The probability of BMI more and equal 25

e = The base of natural algorithms

a = The slope of the equation

b = The coefficient of the predictor variables

### 3. RESULTS AND DISCUSSION

#### 3.1 Reliability Analysis

Table 1 shows the Cronbach's Alpha value for the data recorded from the samples. Generally, the Cronbach's Alpha value of less than 0.6 is considered to be poor and those in the range of 0.7 and greater than 0.8 are considered to be good. From Table 1, the Cronbach's Alpha value for the items in relation to eating habits is 0.791, which implies that the items are good. The Cronbach's Alpha value for section C is 0.862, which means that the items of physical activities are placed correctly with their variables. Next, the reliability analysis of the items in the motivation and medication section shows the Cronbach's Alpha value as 0.863 and 0.911 respectively. Hence, the items included in both sections are good in representing their variables. Lastly, 0.897 of Cronbach's Alpha value is recorded for items included in section F, which is considered to be good in representing the corresponding variables.

Table 1: Cronbach's Alpha

Sections	Variables	Number of Items	Cronbach's Alpha
B	Eating Habits	7	0.791
C	Physical Activities	7	0.862
D	Motivation	7	0.863
E	Smoking	7	0.911
F	Medication	7	0.897

### 3.2 Logistic Regression Analysis

The analysis using Wald test statistic is shown in Table 2. The null hypothesis of the individual independent variables related to the BMI results was tested.

Table 2: Wald Test

Variable	Coefficient	p-value	Conclusion
Eating Habits	0.211	0.00	Significant
Physical Activity	0.252	0.00	Significant
Motivation	0.258	0.00	Significant
Smoking	0.045	0.229	Not Significant
Medication	-0.009	0.810	Not Significant
Constant	-10.77	0.00	

From the obtained results, eating habits, physical activity, and motivation were significant since their p-values for these variables are less than  $\alpha=0.05$ . Smoking and medication were found not significant since their p-values are 0.229 and 0.81 respectively, which are more than  $\alpha=0.05$ .

The final model is,

$$\text{Logit}[P(Y = 1)] = -10.77 + 0.211x_1 + 0.252x_2 + 0.258x_3 \quad (4)$$

where

$Y$  = Body Mass Index

$x_1$  = Eating Habits

$x_2$  = Physical Activities

$x_3$  = Motivation

#### 3.2.1 Hosmer-Lemeshow Goodness-of-Fit

Hosmer-Lemeshow Goodness-of-Fit test was conducted to the data of this study. Table 3 shows the result of the test.

Table 3: Hosmer-Lemeshow Test

Chi-Square	P-value
9.178	0.328

From the result, the p-value of 0.328 shows the null hypothesis is failed to be rejected; hence, the data fits with the model.

### 3.2.2 R-Square

The variations of dependent variables are explained by the independent variable, which is tested by using Cox & Snell and Nagelkerke R-Square. As shown in Table 4, the value of Cox & Snell R-Square as 0.365 implies that there is 36.5% of total variations in BMI, which are explained by the independent variables in the study.

Table 4: Pseudo R-Square

Cox & Snell R-Square	Nagelkerke R-Square
0.365	0.486

The Nagelkerke R-Square value of 0.486 shows that there are 48.6% of variations in the dependent variable, BMI, which are explained by the independent variable included in the study including eating habits, physical activities, motivation, smoking, and medication.

### 3.2.3 Odds Ratio

Odds ratio was calculated and shown in Table 4. There are three significant predictor variables including eating habits, physical activity and motivation.

Table 5: Odds Ratio

Variable	$\beta$	Odd Ratio ( $e^\beta$ )	$e^\beta - 1$	% change in odds
Eating Habits	0.211	1.2349	0.234912	23.49
Physical Activity	0.252	1.2866	0.286596	28.66
Motivation	0.258	1.2943	0.294339	29.43

The odds ratio for eating habits is 1.2349 with the represented percentage of odds ratio as 23.49. Therefore, one score increases in eating habits will increase the odds ratio of BMI by 23.49%. With 1.2866 odds ratio, the percentage changes in odds for physical activity is 28.66. One score increases in physical activity will increase the odds of BMI by 28.66%. The odds ratio for

motivation is 1.2943, while the percentage change in odds is 29.43. Therefore, odds of BMI will increase by 29.43% if one score in motivation increases.

#### 4. CONCLUSION

In this study, there are two objectives to be achieved. The first objective is to determine whether lifestyle factors do affect the students' BMIs, while the second objective is to examine the most contributing factor to the students' BMIs. The methods used for data analysis is logistic regression model. There are five independent variables, which are eating habit, physical activity, motivation, smoking and medication.

Analyses used to achieve these objectives are Wald Statistics and Odds Ratio. The Wald Test shows that eating habits, physical activity, and motivation are significant and affect the students' BMIs. Odds ratio explains the changes in BMI for each significant independent variable. Thus, motivation is the most contributing factor to the student's BMIs as it has the highest odds ratio and estimates value.

#### REFERENCES

- [1] WHO, W. H. O. (2015). Obesity and overweight.
- [2] Nusi, N. H., Adlan, M. A., & Ahmad, M. H. (2015). 1 daripada 3 orang Malaysia gemuk, *Kosmo!* p. 2.
- [3] Kosmo. (2013). Makan berlebihan dan kurang bersenam punca masalah obesiti, *Kosmo!* Retrieved from [http://www.kosmo.com.my/kosmo/content.asp?y=2013&dt=0908&pub=Kosmo&sec=Terkini&pg=bt\\_18.htm](http://www.kosmo.com.my/kosmo/content.asp?y=2013&dt=0908&pub=Kosmo&sec=Terkini&pg=bt_18.htm)
- [4] Staff, M. C. (2001). Risk factors. 9th. from <http://www.mayoclinic.org/diseases-conditions/obesity/basics/risk-factors/con-20014834>
- [5] Asil, E., Surucuoglu, M. S., Cakiroglu, F. P., Ucar, A., Ozcelik, A. O., Yilmaz, M. V., & Akan, L. S. (2014). Factors That Affect Body Mass Index of Adults. *Pakistan Journal of Nutrition*, 13(5), 255-260.
- [6] Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha
- [7] Luguterah, A., & Apam, B. (2013). Predicting Student Completion Status Using Logistic Regression Analysis. 9.
- [8] Sekaran, U., & Bougie, R. (2013). *Research Method for Business* (Sixth Edition ed., pp. 423). UK: John Wiley & Sons Ltd