

Correlation between Body Mass Index (BMI) and Blood Pressure among Malaysian Adults Age 40-60

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ABSTRACT

Background: Body mass index (BMI) is a guide to measure the general health of a person based on the weight and height ratio. Via this index, a person can be aware of their body status and also can avert from a risk disease such as hypertension, obesity or other heart related diseases. Meanwhile, blood pressure test (comprised of systolic and diastolic blood pressures) measures the pressure of the blood in the circulatory system.

Aim: To find out whether there was correlation between BMI and blood pressure among the middle age group in Malaysia (40 – 60 years old) according to age, gender and race.

Methodology: In this study, we included 167 participants of age group 40-60 with 74 males (42 Malays, 18 Chinese and 14 Indians) and 93 females (55 Malays, 22 Chinese and 16 Indians), after seeking ethical approval from the ethical review board of SEGi University, Kota Damansara. Participants were randomly selected in this cross-sectional study. The weighing machine and stadiometer were used to measure the weight and height of participants' respectively. The BMI was calculated using the formula $BMI = \text{Weight}/\text{Height}^2$ (kg/m²).

Results: Our results showed that, Malay males and females had the highest BMI value, followed by Chinese and Indians in males, but in females, it was followed by Indians and Chinese. Our results also showed that in both genders, Indians had the highest mean value of systolic blood pressure followed by Malays and Chinese respectively. Our results even showed that, Indian males and Chinese females had the highest mean value of diastolic blood pressure. Malay and Chinese males had same mean value. Malay and Indian females also had the same mean value.

Conclusion: The statistically significant correlation which was observed in our study between BMI and blood pressure could be used by middle age group in acknowledging their health care awareness by improving their lifestyle via maintaining body weight and having suitable blood pressure so that to avoid getting obesity related diseases.

Keywords: BMI, blood pressure,

INTRODUCTION

Body mass index (BMI) is an index which is used as a measurement for indicating an individual's body fatness; it is measured as person's weight in kilograms divided by the square of the person's height in meters (kg/m²). The standard weight status categories related with BMI ranges for adults are: BMI Weight Status below 18.5 kg/m² - Underweight, (18.5–24.9kg/m²)-Normal, (25.0–29.9kg/m²) - Overweight; and (30.0kg/m² and above) is considered Obese¹.

An advantage of the BMI system is that it gives an idea to the physicians on an individual's risk of contracting certain diseases. In addition, it is widely used in determining public health policies. It is also an inexpensive method of measuring body fat¹.

Despite the advantages, the clinical limitations of BMI should also be considered. Firstly, BMI is a measure of excess weight rather than excess body fat. Furthermore,

many factors such as gender, age, ethnicity, and muscle mass can influence the relationship between BMI and body fat. Also, BMI cannot differentiate between skeletal weight, excess fat, or muscle mass and it does not provide any indication of the distribution of fat among individuals².

A study was conducted to assess data on Malaysian adults' body weights and association of ethnic differences in overweight and obesity. The national survey data revealed that in adults, 20.7% were overweight and 5.8% were obese; and the prevalence of obesity was much greater in women than in men. In the view of ethnicity, the highest prevalence of obesity was detected in Indians followed by Malays and Chinese³.

Blood pressure (BP) is defined as how hard blood pushes against the walls of arteries, and the unit of measurement called millimeters of mercury (mmHg) is used to measure the pressure in the blood vessels. Blood pressure can be measured using two readings; the first reading is systolic blood pressure (SBP), which measures

the blood pressure in the blood vessels when the heart beats by pumping blood throughout the whole body. The second reading is diastolic blood pressure (DBP), which measures the blood pressure in the blood vessels when the heart rests between beats. The normal blood pressure reading is 120mmHg systolic blood pressure and 80mmHg diastolic blood pressure. If the blood pressure flows at higher rate than normal pressure, it can lead to slightly higher levels (between 120/80 and 139/89 mmHg); which is a condition called pre-hypertension. This condition can still be prevented but if it worsens the person will most probably get hypertension⁴⁻⁶.

Hypertension is when the blood pressure is higher than 140/90 mmHg, this means that the blood pressure applies too much force against the walls of the blood vessels⁴. High blood pressure usually has no warning signs or symptoms, and many patients do not know they have it. Hypertension is a major risk factor of death globally due to the increased risk of getting heart diseases⁷. The problem of hypertension has been constantly increasing over the past decades, driven by reduced physical activity, unhealthy diet, and obesity. Increase in blood pressure is less common in children than in adults. Age, gender, ethnicity, existing health conditions, being overweight or obese, as well as alcohol and tobacco use are a few factors that contribute to hypertension⁸.

In comparison, hypotension is when the blood pressure is lower than that of normal blood pressure. This condition can be very lethal due to the fact that severe low blood pressure can deprive the body of enough oxygen to carry out normal functions leading to damages to the heart and brain. On the other hand moderate forms of blood pressure are associated with fainting, dizziness, weakness and a risk of injury from a fall. Major medical conditions that cause low blood pressure include pregnancy, heart problems, blood loss, septicaemia and dehydration⁹.

A study was conducted in a rural community in northern Malaysia to study the trends of blood pressure. The patterns of blood pressure for both males and females were similar. The data also showed that age highly influenced the blood pressure reading, where the mean blood pressure mostly increased in the 41 to 50 years age group¹⁰.

There was a study on the findings of blood pressure screening which was done in Malaysia (South-East Asia) and Australasia. It reported that roughly one third (32.4%) of 4116 participants had hypertension. 63.9% of those with hypertension were on antihypertensive treatment and 59.5% of them had controlled blood pressure which showed a rather high blood pressure (BP) control rate in Malaysia¹¹. Yet, there has not been much research reported in Malaysia on blood pressure pattern according to race.

Studies have shown that increased amount of body fat can result in weight-related diseases. As stated earlier, BMI is developed as an indicator of diseases, thus high BMI levels increase the chances of some conditions to occur like premature death, cardiovascular diseases (CVD), high blood pressure (hypertension) and diabetes¹².

A study from Gujarat, India was done on 775 government employees where majority of them were between 41 to 50 years old. It reported that body mass

index (BMI) was observed to be highly associated with both systolic blood pressure (SBP) and diastolic blood pressure (DBP). The risk of hypertension is higher among people who are overweight (BMI 25 - <30kg/m²) and obese (BMI ≥30 kg/m²)¹³.

Another study done in Shama, Ghana found a high prevalence of hypertension (32.5%) where there were slightly more hypertensive males than females. This study explained more on the factors that could possibly contribute to hypertension, rather than correlating BMI and blood pressure itself. However, it was indicated that individuals with BMI that are higher than normal are more prone to hypertension¹⁴.

There was an Iranian study focused on 8425 adults aging from 25 to 69 years old, as many as 950 out of 3381 men (28.1%) and 1478 out of 5044 women (29.3%) were hypertensive and majority of them belonged to the overweight or obese categories. It was also stated that the blood pressure (BP) percentiles increase as both age and BMI increase¹⁵.

In Malaysia, there was a study correlating only pre-hypertension and obesity among the pre-hypertensive respondents, where, almost half of the males (49.8%) were overweight or obese¹⁶. However, there has not been much research reported in Malaysia which directly correlates BMI and blood pressure for the age group 40-60 base on the race.

Therefore, the primary focus of this study was to find out the correlation between BMI and blood pressure among individuals in the middle age group (40-60 years old) with the intention to help them in acknowledging their health care awareness by improving lifestyle via maintaining body weight and having suitable blood pressure so that to avoid getting obesity related diseases.

MATERIALS AND METHODS

The ethical approval to perform our mini research was obtained by the ethical committee of SEGI University. We used two parameters respectively in our research which were BMI and blood pressure. Our research was conducted on a target population of age group 40-60 using cross-sectional random sampling with a total of 167 participants with 74 males (42 Malays, 18 Chinese and 14 Indians) and 93 females (55 Malays, 22 Chinese and 16 Indians). Each of the participants was provided with a consent form to record their agreement to take part in our research. We briefly explained to our research participants the purpose of our research and the methods used whereby the necessary measurements were obtained from them.

The participants were asked to take off their shoes when their respective weight and height were measured. The participants stood on the weighing scale so that their weight could be measured and recorded. In obtaining the measurements for height, we used a stadiometer. The participants were asked to stand straight without slouching to ensure that errors were minimized during measurements and measurements were taken from the tip of the participants' head to the tip of their toes. After obtaining the data for the height and weight, the respective participants

BMI value were calculated using the formula of standard equation (weight(kg)/height² (m²)¹⁷.

A sphygmomanometer was used to acquire the measurements for both the systolic and diastolic blood pressure. The participants were requested to rest for 5 minutes before taking the measurements to minimize any inaccuracy in our measurement results. During measurement, we asked our participants to sit and their arms fully barred for a more accurate result. We ensured that the cuff size fit around the respondent's upper arm to provide a more distinctive result¹⁷. After we obtained all the essential values required for the BMI and blood pressure, we performed a statistical analysis of the data collected using the SPSS¹⁸.

RESULTS

Data interpretation for mean body mass index (BMI) based on gender and race: Out of the 167 participants, 74 were males (42 Malays, 18 Chinese and 14 Indians) and 93 were females (55 Malays, 22 Chinese and 16 Indians). Table 1 shows the demographic data. Based on Figure 1, it was observed that among males, Malays had the highest mean BMI value followed by Chinese and Indians respectively. The mean BMI value for Malays was greater than that of Chinese by 4.43%; and it was greater than that of Indians by 8.85%. The mean BMI value of Chinese was greater than that of Indians by 4.42%.

In regards to females, Malays also had the highest mean BMI value, followed by Indians and Chinese respectively. The mean BMI value for Malays was greater than that of Indians by 6.81% while the mean BMI value for Malays was greater than that of Chinese by 12.09%. The mean BMI value for Indians was greater than that of Chinese by 5.28%.

Table 1: Demographic data of the participants

Participants	Frequency	%age
Total	167	100
Male	74	44
Female	93	56
Malay	97	58
Chinese	40	24
Indian	30	18
Male		
Malay	42	25
Chinese	18	11
Indian	14	8
Female		
Malay	55	33
Chinese	22	13
Indian	16	10

Data interpretation for mean systolic blood pressure based on gender and race: It is evident from Figure 2 that among males, Indians had the highest mean value of systolic blood pressure, followed by Malays and Chinese respectively. Mean value of systolic blood pressure for Indians was greater than that of Malays by 2.21% while the mean value of systolic blood pressure for Indians was greater than that of Chinese by 5.88%. On the other hand, the mean value of systolic blood pressure for Malays was greater than that of Chinese by 3.67%.

With respect to females, they showed similar results where Indians had the highest mean value of systolic blood pressure, followed by Malays and Chinese respectively. The mean value of systolic blood pressure for Indians was greater than that of Malays by 2.26%; and it was greater than that of Chinese by 4.51%. Mean value of systolic blood pressure for Malays was greater than that of Chinese by 2.25%.

Figure 1: Data interpretation for mean body mass index (BMI) based on gender and race

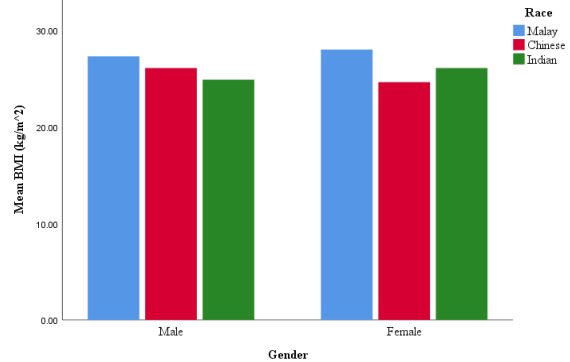
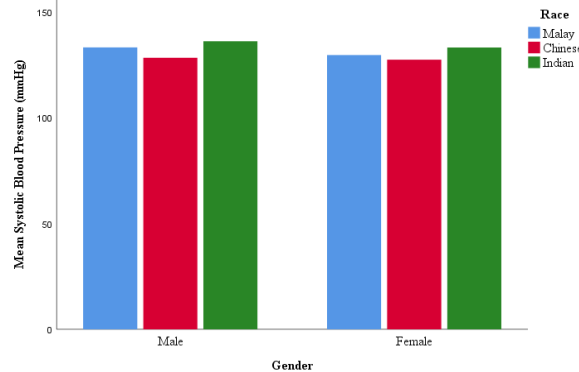


Figure 2: Data interpretation for mean systolic blood pressure based on gender and race



Data interpretation for mean diastolic blood pressure based on gender and race: Based on Figure 3, among males, Indians had the highest mean value of diastolic blood pressure. The mean value of diastolic blood pressure for Malays and Chinese were the same. Mean value of diastolic blood pressure for Indians was greater than that of both Malays and Chinese by 1.2%.

Among females, Chinese had the highest mean value of diastolic blood pressure. Mean value of diastolic blood pressure for Malays and Indians were the same. The mean value of diastolic blood pressure for Chinese was greater than that of both Malays and Indians by 2.56%.

Data interpretation of correlation between body mass index (BMI) and systolic blood pressure in overall, male and female participants: The scatter plots in Figures 4a, 4b and 4c showed a statistically significant correlation between BMI and systolic blood pressure in overall participants (N=167, p-value=0.000 for p≤0.05 and r value=0.285), male participants (N=74, p-value=0.004 for

$p \leq 0.05$ and r value=0.145) and female participants (N=93, p -value=0.000 for $p \leq 0.05$ and r value=0.362).

Figure 3: Data interpretation for mean diastolic blood pressure based on gender and race

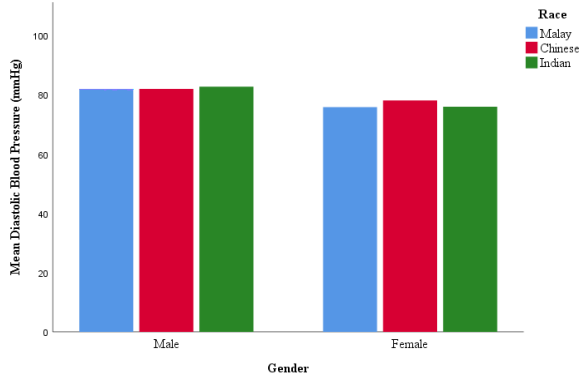


Figure 4a, 4b and 4c: Showing data interpretation of correlation between body mass index (BMI) and systolic blood pressure in overall, male and female participants

Figure 4a

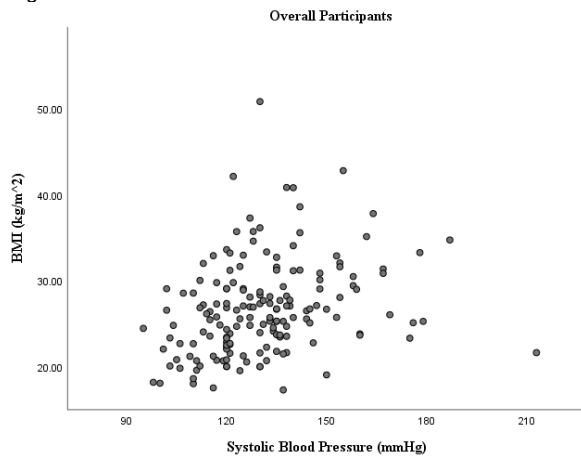


Figure 4b

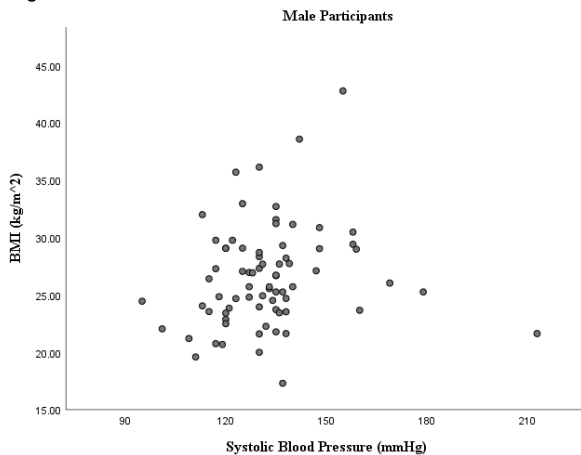
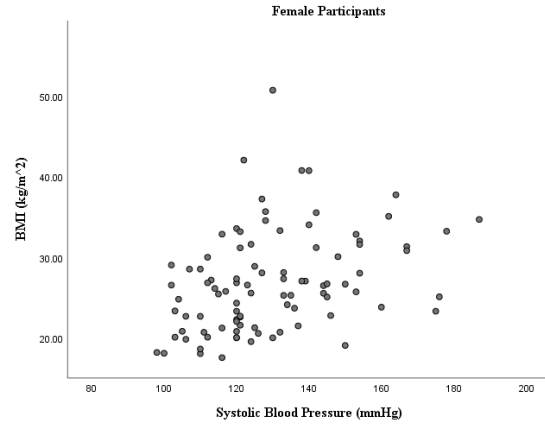


Figure 4c



Data interpretation of correlation between body mass index (BMI) and diastolic blood pressure in overall, male and female participants

The scatter plots in Figure 5a, 5b and 5c showed statistically significant correlation between BMI and diastolic blood pressure in overall participants (N=167, p -value=0.006 for $p \leq 0.05$ and r value=0.213), male participants (N=74, p -value=0.004 for $p \leq 0.05$ and r value=0.163) and female participants (N=93, p -value=0.008 for $p \leq 0.05$ and r value=0.275).

Figure 5a, 5b and 5c: Data interpretation of correlation between BMI and diastolic BP in overall, male and female participants

Figure 5a

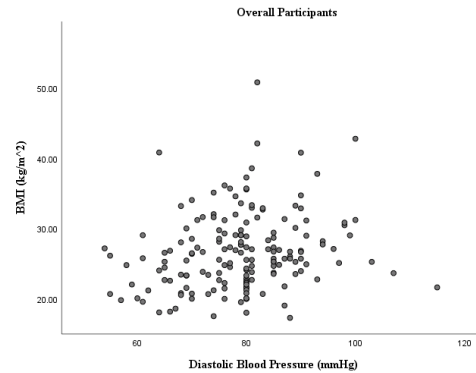


Figure 5b

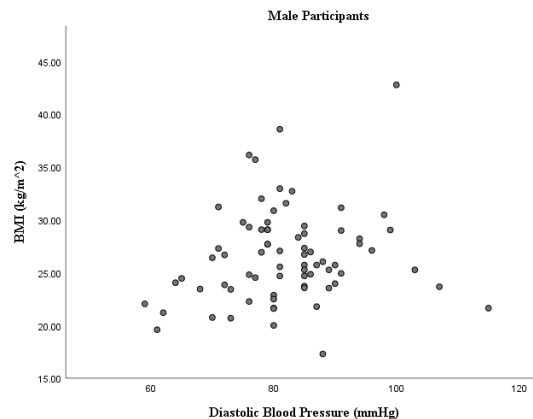
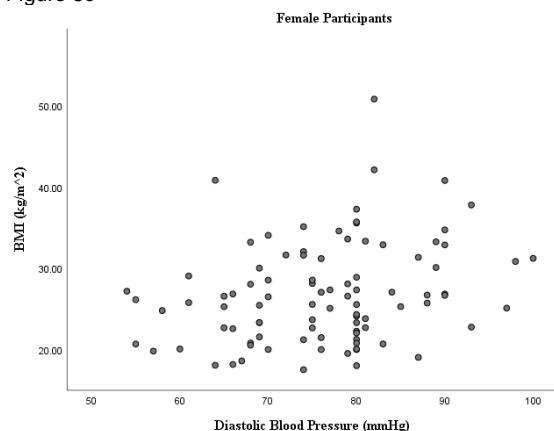


Figure 5c



DISCUSSION

The results obtained from our study which was conducted on individuals in the middle age group (40 - 60 years old) showed that the mean BMI value was the highest among Malays for both males and females. Among males, the BMI value was followed by Chinese and Indians respectively. While among females, the BMI value was followed by Indians and then Chinese respectively. These results contradict the findings from a previous study which was conducted on Malaysian adults. They reported that the highest prevalence of obesity was detected in Indians, followed by Malays and Chinese³. However, there was a study conducted in Malaysia on students aged 13-17 years old which states that prevalence of overweight was highest among Malays followed by Indians and Chinese¹⁹. This study supports our result on mean BMI value among race in females but it still contradicts among race in males.

Our study also showed that the mean systolic blood pressure value was highest among Indian males, followed by Malays, and then Chinese respectively. Similar results were recorded among females; Indian females had the highest mean value of systolic blood pressure followed by Malays, and then Chinese. Based on our knowledge, there were no studies reported in Malaysian adults on systolic blood pressure among individuals based on their races. Yet, there was a previous study which was conducted on undergraduate students. They reported that among males, Indians had the highest mean systolic blood pressure value followed by Chinese and Malays. But, in females, Chinese had the highest mean systolic blood pressure value followed by Malays and Indians²⁰. This report only supports our results that Indian males had the highest mean systolic blood pressure value while the rest are contradicting each other.

Our result showed that, among males, Indians had the highest mean value of diastolic blood pressure. But the mean value of diastolic blood pressure for Malays and Chinese were the same. Among females, Chinese had the highest mean value of diastolic blood pressure. But mean value of diastolic blood pressure for Malays and Indians were the same. Based on our knowledge, there were no studies reported in Malaysian adults on diastolic blood pressure among individuals based on their races. However, there was a previous study which was conducted on

undergraduate students. They reported that among males, Indians had the highest mean diastolic blood pressure value followed by Malays and Chinese. However, in females, Malays had the highest mean systolic blood pressure value followed by Chinese and Indians²⁰. Still, this study contradicts our results.

Our results also showed a statistically significant correlation between BMI and systolic blood pressure among overall participants (N=167, p-value=0.000 for $p \leq 0.05$ and r value=0.285), male participants (N=74, p-value=0.004 for $p \leq 0.05$ and r value=0.145) and female participants (N=93, p-value=0.000 for $p \leq 0.05$ and r value=0.362). Similarly, our data also showed a statistically significant correlation between BMI and diastolic blood pressure among overall participants (N=167, p-value=0.006 for $p \leq 0.05$ and r value=0.213), male participants (N=74, p-value=0.004 for $p \leq 0.05$ and r value=0.163) and female participants (N=93, p-value=0.008 for $p \leq 0.05$ and r value=0.275). These findings matched with the previous study which reported that the blood pressure increase as BMI increase among adults aged 25 - 69 years old¹⁵. Even another study established a significant correlation between BMI and systolic and diastolic blood pressure among undergraduate students²⁰.

CONCLUSION

In conclusion, Malay males and females had the highest BMI value, followed by Chinese and Indians in males, but in females, it was followed by Indians and Chinese. The mean value of systolic blood pressure was highest in Indians followed by Malays and Chinese respectively in both genders. Besides, Indian males and Chinese females had the highest mean value of diastolic blood pressure. Malay and Chinese males had same mean value. Malay and Indian females also had the same mean value. There was also a statistically significant correlation between BMI and systolic and diastolic blood pressures in overall, male and female participants respectively. Hence, the statistically significant correlation which was observed in our study between BMI and blood pressure could be used by middle age group in acknowledging their health care awareness by improving their lifestyle via maintaining body weight and having suitable blood pressure so that to avoid getting obesity related diseases.

Competing interests: The authors declare they have no competing interests.

Author contributions: Conceived and designed the experiments: SRD NSS. Performed the experiments: REB SVS MAHS ASI CLCF Analyzed the data: REB SVS MAHS ASI CLCF. Wrote the paper: SRD NSS. Revised the paper: SRD NSS REB SVS MAHS ASI CLCF NHL KTZ SSK HTD KTO RSYW SWWL NR SL MAE AY MNMD NMHM KAJ ATK JH. All authors read and approved the final manuscript to be published.

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