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Correlation Between Body Mass Index (BMI) And Fasting Blood Glucose (FBG) Level Among Undergraduate Students.

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ABSTRACT

Body mass index (BMI) is simple, low cost and a good proxy for adiposity and overweight related problems. It is used to raise awareness to several disease and severe health issues in the population such as obesity. Fasting blood glucose (FBG) level is used to diagnose the pre-diabetic and diabetic state of individuals. This study was designed to determine the correlation between BMI and FBG level among undergraduate students, between the ages of 18 – 24 years old of SEGi University Kota Damansara based on the gender and ethnicity. Population for this study was 126 students, 71 females (30 Malays, 21 Chinese and 20 Indians) and 55 males (18 Malays, 20 Chinese and 17 Indians). The participants were randomly selected to participate in our cross-sectional study. Student's weight was measured using a weighing scale and height was measured using a stadiometer. BMI was calculated using formula weight (kg) over height squared (m^2). For FBG test, students were tested using the Easy Touch Blood Glucose Monitor after a 10 hour overnight fast. All data was tabulated systematically and a statistical analysis using the Statistical Package for the Social Science software v22 (SPSS) was performed. The results obtained from BMI analysis showed that among males, Indians had the highest mean BMI value, followed closely by Malays and lastly Chinese. Among females, Malays had the highest mean BMI value, followed closely by Indians and then Chinese. Our study on FBG level showed that among males, Malays had the highest mean FBG level followed by Indians and then Chinese. While among females, Indians had the highest mean FBG level followed by Chinese and then Malays. A significant correlation was obtained between BMI and FBG level for overall male and female participants (p=0.04, r=0.165), male participants (p=0.03, r=0.226) and female participants (p=0.04, r=0.151). The significant correlation observed in this study between BMI and FBG level, can hence be used as a basic guideline to spread awareness amongst Malaysian undergraduate students regarding their lifestyle, diet and daily physical activity in respect to obesity. By doing so, the risks of acquiring non-communicable diseases such as diabetes, hypertension, stroke and heart diseases can be significantly reduced over time.

Keywords: Body mass index (BMI), Fasting blood glucose level, Obesity

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INTRODUCTION

The most commonly used method to identify an individual's fatness is the body mass index (BMI). It is a metric used to define characteristics of anthropometric height/weight in adults and to systematise them into set groups [1]. A high quality and good data collection is required for the calculation of BMI. BMI (kg/m^2) is calculated as the weight (kg) divided by the square of height in meters (m^2). BMI values that are obtained from each individual, are classified into groups of varying levels of body fat content by the World Health Organisation (WHO) into: underweight (≤18.5 kg/m^2); normal range (18.6-24.99 kg/m^2); overweight (≥ 25 kg/m^2) and obese (≥30 kg/m^2) [2, 3]. BMI also plays a great importance in monitoring the spectrum of nutritional status, for surveillance and report of the health population by the government and WHO. It is also applied in raising awareness to several disease and severe health issues in the population, such as obesity [3]. The main advantage of BMI usage is being a simple and low cost method to measure body fat. Researchers noticed that BMI appeared to be a good proxy for adiposity and overweight related problems [3, 4]. However, BMI also comes with some disadvantages. BMI has a poor gauge in indicating the area and percentage of body fat. Besides, it is also unable to differentiate between fat mass and lean body mass [1, 5]. Other limitations are that gender, age, ethnicity, bone structures and the fat distribution or muscle mass are not taken into account for calculating BMI. This may lead to the misrepresentation of the quantity that BMI is used to measure [1, 6]. BMI should not be mistaken as basal metabolic rate (BMR), which is defined as the minimum energy required by the body during emotional, physical and digestive rest [7].

Obesity is defined as the accumulation of fat in the body due to an excess caloric energy intake and insufficient expenditure of the excess energy. This phenomenon is a gateway to many known diseases that may depress an individual's health and hence shortening the life expectancy [8]. There are several factors that lead to the morbid condition in which a person's obese is closely associated with an individual's daily activities and diet. An increased consumption of fast food, sugary foods, oily foods and refined sugar is one of the major factors contributing to obesity [8, 9]. A sedentary lifestyle which lacks any physical activity over a long period of time is also a significant factor of obesity. A few other factors include genetics, endocrine disorders, medications or psychiatric disorders [4, 5, 8, 9]. Obesity has reached to an epidemic level in Malaysia. In 2010, WHO ranked Malaysia as the 6th country with the highest prevalence of obesity in Asia [10]. The Ministry of Health (MOH) of Singapore, a neighbouring country with similar ethnic groups as Malaysia, conducted a national health survey in 1992 on obesity. They found that, among males, Indians had the highest rate of obesity followed by Malays and Chinese, and among females, Malays had the highest rate of obesity followed by Indians and Chinese [11]. In Malaysia, a 2016 national survey of obesity showed that among the ethnicities, Indians were more obese in both genders followed by Malays and Chinese [12]. However, a 2009 survey among university students, unlike the national survey, showed that Malays were more obese followed by Indians and Chinese [13]. In two of the researches conducted previously by the Medical Faculty of SEGi University, Kota Damansara, on the pattern of BMI among undergraduate medical science students based on the gender and ethnicity, showed the results similar to the Singapore national health survey, where among males, Indians had the highest mean BMI value followed by Malays and Chinese and among females, Malays had the highest mean BMI value followed by Indians and Chinese. These results show that the rate of obesity tends to fluctuate between the Malay and Indian ethnic groups, while the rate of obesity among the Chinese population remains the lowest of the three main ethnics in Malaysia [4, 5].

Excessive weight is associated with increased risk of death. Broad spectrum of health risks are associated with obesity which are: Type 2 diabetes mellitus, dyslipidaemia, hypertension, various cardiovascular diseases and development of some cancers (breast endometrial colorectal, liver, prostate, gall bladder) [2, 3, 14-17]. Fasting blood glucose (FBG) test is mainly used to check for pre-diabetes and diabetes [18]. A FBG level below 100mg/dL is considered as normal, glucose level between 100-125 mg/dL is classified as pre-diabetes (high risk state for developing diabetes) and glucose level of 126mg/dL or more indicates as diabetes [19, 20]. Diabetes mellitus is a lifelong condition wherein an individual's blood glucose level is too high. There are two types of diabetes. Type 1 diabetes is an autoimmune disease where the pancreas does not produce insulin hormone. Type2 diabetes is a condition where the pancreas does not produce enough insulin hormones or body cells are not capable to react to insulin hormone [21, 22]. The function of insulin is to maintain blood glucose level by storing glucose as energy fuel in body cells. However, when glucose cannot enter the cells, a high level of sugar accumulates in the blood and this condition is termed hyperglycaemia. Therefore, body is incapable of using the energy and this leads to the symptoms of Type 2 diabetes mellitus [22, 23]. Most of the people with Type 2 diabetes mellitus have been diagnosed with obesity [23, 24]. In

Malaysia, an analysis on ethnic disparities in metabolic syndrome between ages 40 to 45 years old was conducted in 2011. The results showed that, in both gender, FBG level was significantly higher in Indians followed by Malays and then Chinese [25]. A positive correlation exists between BMI and FBG level in the incidence of obesity and diabetes mellitus [24]. Such correlations have been reported in Korea (2011) among the age group of 40 to 50 years old and in Nigeria (2013) among undergraduate students between ages 22 to 28 years old [26, 27].

However in Malaysia, there are not many reports on the pattern of fasting blood glucose level based on gender and ethnicity, as well as reports on the correlation between BMI and FBG level. Therefore, we have conducted a study to determine the correlation between BMI and FBG level among undergraduate students in SEGi University, Kota Damansara based on gender and ethnicity, between ages 18 to 24 years old, in order to bring health care awareness in this age group.

MATERIALS AND METHODS

In this research, two measurements were taken; body mass index (BMI) and fasting blood glucose (FBG) level. The measurements were taken from undergraduate students of SEGi University Kota Damansara, between the ages 18 to 24. Our sample size was 126 students, 71 females (30 Malays, 21 Chinese and 20 Indians) and 55 males (18 Malays, 20 Chinese and 17 Indians). The participants were randomly selected to participate in this cross sectional study. The Ethical Committee of SEGi University approved the consent form for this research. Participating students were gathered at the Physiology Laboratory at the Faculty of Medicine SEGi University, Kota Damansara. Consent forms were distributed and filled by each student and they were briefed on the procedure for each measurement.

BMI measurement was done according to the formula weight (kg) divided by height squared (m^2). Hence, the weight and height of each student was measured. Students were requested to remove their shoes and wear light clothing before stepping onto the weighing scale to measure their weight. For height, students were asked to look forward while standing straight without shoes, on the stadiometer, and their height was obtained by measuring from their toes to the head, in meters. Data obtained was tabulated and BMI was calculated using the BMI formula [28].

Students were informed the night before testing to fast from 11pm to 9am the next day (10 hours), in order to get an accurate reading for FBG level [19, 26]. Disposable blood glucose test strip was inserted into the Easy Touch Blood Glucose Monitor (manufactured by MHC Medical Products) [29]. Student's index finger was sterilised using an alcohol swab, once dry the student's finger was pricked using a lancing device to draw out blood. A drop of expelled blood was placed on the disposable test strip. Readings obtained from the blood glucose device were tabulated systematically [30].

After the data was obtained from all 126 participants, a statistical analysis of data was done using the Statistical Package for the Social Science software (SPSS) version 22 [31].

RESULTS

Data interpretation for mean body mass index (BMI) based on gender and ethnicity

The Table 1 of the demographic data shows that the total number of participants was 126, with 55 males (18 Malays, 20 Chinese and 17 Indians) and 71 females (30 Malays, 21 Chinese and 20 Indians). The Figure 1 shows that among the males, Indians had the highest mean BMI value followed by Malays and Chinese. The mean BMI value for Indians was higher than that for Malays by 9.8% and simultaneously higher than that for Chinese by 14.7%. However, the mean BMI value for Malays was higher than that for Chinese by 5.0%.

As for the females, Malays had the highest mean BMI value, followed by Indians and Chinese. The mean BMI value for Malays was higher than that for Indians by 3.8% and simultaneously higher than that for Chinese by 10.5%. However, the mean BMI value for Indians was higher than that for Chinese by 6.6%.

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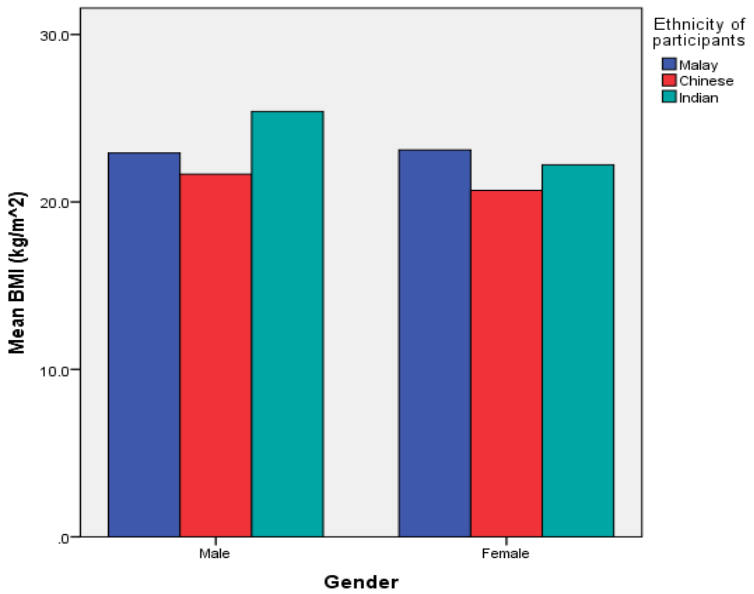
Table 1: Showing the demographic data.

	Mean	SD	Frequency	Percentage (%)
Gender				
Male			55	43.7
Female			71	56.3
Total			126	100
Ethnicity				
Malay			48	38.1
Chinese			41	32.5
Indian			37	29.4
Total			126	100
Weight (kg)	61.68	17.78		
Height (m)	1.65	0.095		
BMI (kg/m^2)				
Underweight			18	14.3
Normal weight	22.62	4.09	58	46.0
Overweight			20	15.9
Obese I			23	18.3
Obese II			7	5.6
Total			126	100
Fasting Blood Glucose Level (mg/dL)	84.63	7.52		

Fig 1: Showing the data interpretation for mean BMI based on gender and ethnicity.



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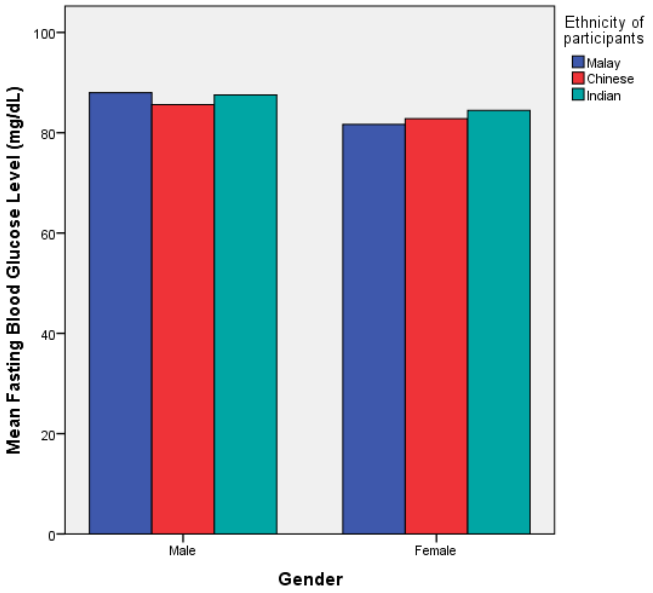
Data interpretation for mean fasting blood glucose (FBG) level based on the gender and ethnicity

As shown in Figure 2, among males, Malays had the highest mean value of fasting blood glucose (FBG) level, followed by Indians and Chinese. Mean value of FBG level for Malays was higher than that for Indians by 0.5% and simultaneously higher than that for Chinese by 2.7%. The mean value of FBG level for Indians was higher than that for Chinese by 2.2%.

Fig 2: Showing data interpretation for mean fasting blood glucose (FBG) level based on gender and ethnicity.



However unlike males, amongst females, Indians had the highest mean value of FBG level followed by Chinese and Malays. Mean value of FBG level for Indians was higher than that for Chinese by 2% and simultaneously higher than that for Malays by 3.3%. The mean value of FBG level for Chinese was higher than that for Malays by 1.35%.

Data interpretation of correlation between the BMI and FBG level based on gender and ethnicity for overall male and female participants:

The scatter plot of Figure 3 shows that there was significant correlation between BMI and FBG level among overall male and female participants (N = 126, $p = 0.04$ for $p \leq 0.05$, $r = 0.165$).

Data interpretation of correlation between the BMI and FBG level based on gender and ethnicity for male participants:

The scatter plot of Figure 4 shows that there was significant correlation between BMI and FBG level among male participants. (N = 55 , $p = 0.03$ for $p \leq 0.05$, $r = 0.226$).

Data interpretation of correlation between the BMI and FBG level based on gender and ethnicity for female participants:

The scatter plot of Figure 5 shows that there was a significant correlation between BMI and FBG level among female participants (N = 71 , $p = 0.04$ for $p \leq 0.05$, $r = 0.151$).

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Fig 3: Showing data interpretation of correlation between the BMI and FBG level based on gender and ethnicity for overall male and female participants.

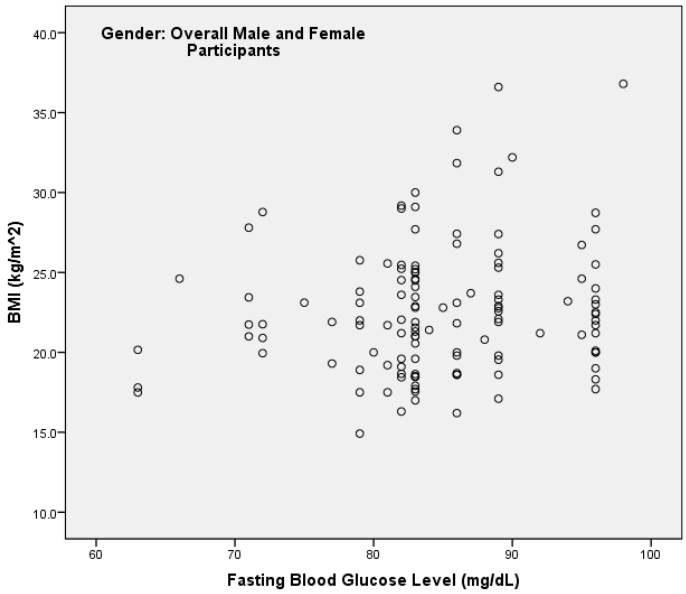

Fig 4: Showing data interpretation of correlation between the BMI and FBG level based on gender and ethnicity for male participants.

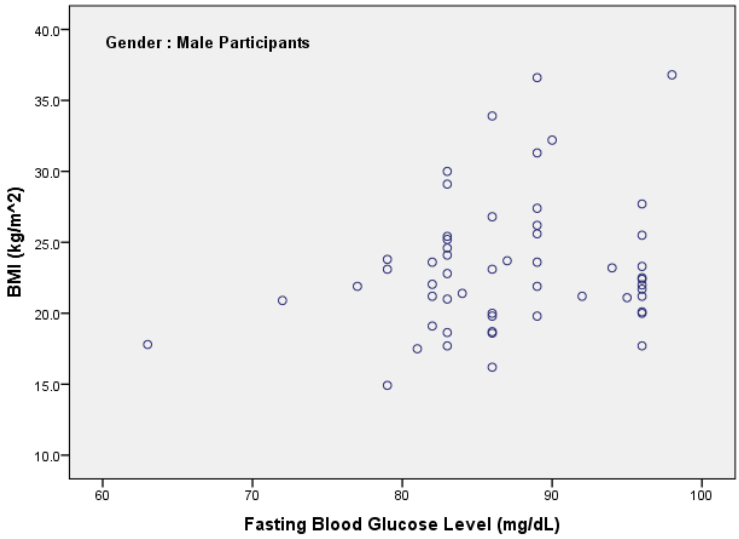

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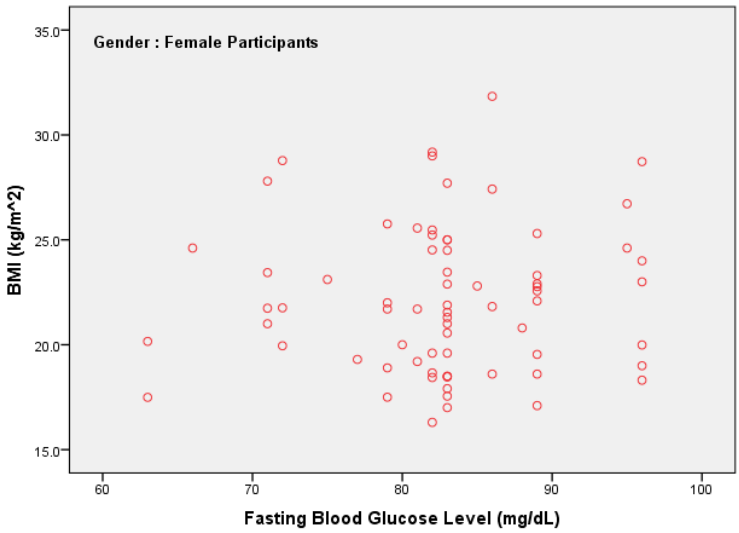
Fig 5: Showing data interpretation of correlation between the BMI and the FBG level based on gender and ethnicity for female participants.



DISCUSSION

The study conducted on undergraduate students of SEGi University, Kota Damansara was to find out the correlation between body mass index (BMI) and fasting blood glucose (FBG) level. The results obtained from BMI analysis showed that among males, Indians had the highest mean BMI value, followed closely by Malays and lastly Chinese. Among females, Malays had the highest mean BMI value, followed closely by Indians and then Chinese. These results were similar to the 1992 national health survey conducted in Singapore [11]. The result obtained for males, was in line with the 2016 national survey of obesity in Malaysia wherein Indians were more obese than Malays and Chinese [12]. The result for females was in par with the 2009 report done among undergraduate students where Malays were more obese compared to Indians and Chinese [13]. On overall, our results showed consistency with the three previous results obtained by the Medical Faculty of SEGi University, Kota Damansara, where the highest mean BMI in both genders, tends to fluctuate between the Malay and Indian ethnics while the Chinese ethnic had the lowest mean BMI value [4, 5, 32].

In our study, it was also found that among males, Malays had the highest mean FBG level followed by Indians and then Chinese. While among females, Indians had the highest mean FBG level followed by Chinese and then Malays. These results had some similarities and differences to the 2011 Malaysian analysis on FBG level. They had reported that for both males and females, Indians had the highest FBG level followed by Malays and then Chinese [25].

In our research, a significant correlation was obtained between BMI and FBG level for overall male and female participants (p=0.04, r=0.165), male participants (p=0.03, r=0.226) and female participants (p=0.04, r=0.151). Similar to our findings were reported in Korea (2011) and Nigeria(2013), where they showed in their research that people with high BMI value have high FBG level [26, 27].

CONCLUSION

Significant correlation was seen between BMI and FBG level for the overall male and female participants, male participants and female participants. Hence, the correlation observed in this study can be used as a basic guideline to spread awareness amongst Malaysian undergraduate students regarding their lifestyle, diet and daily physical activity in respect to obesity. By doing so, the risks of acquiring non-communicable diseases such as diabetes, hypertension, stroke and heart diseases can be significantly reduced over time.

COMPETING INTERESTS: The authors declare they have no competing interests.

AUTHOR CONTRIBUTIONS: Conceived and designed the experiments: NSS SRD. Performed the experiments: CMS MZB MSH NMA SBP. Analyzed the data: CMS MZB MSH NMA SBP SAM. Wrote the paper: NSS SRD. Revised the paper: NSS SRD ATK KTZ HTD CMS MZB MSH NMA SBP KAJ MES NHL SYAK JZ RM AY RSYW KTO SWWL MNH WML DM SAM NA NDMA MM . All authors read and approved the final manuscript to be published.

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REFERENCES

[1] Nuttall FQ (2015). Body mass index: Obesity, BMI and Health : A critical review. *Nutrition Today*, 50 (3) : 117-128.

[2] Katzmarzyk PT, Perusse L, Rao DC, Bouchard C (2000). Familial risk of overweight and obesity in the Canadian population using the WHO/NIH criteria. *Obesity Research,* 8(2): 194– 197.

[3] WHO (2017). Body mass index (updated 2017 ; cited 2017 May 24), http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/a-healthy-lifestyle/body-mass-index-bmi.

[4] Doustjalali SR, Kumar RG, Sharma R, Nurfatiha M, Nur-Firzanah R, Muhamad-Syukri MK, Napatr WA, Nurul-Syahirah TKZ, Al-Jashamy K, Irfan M, El-Sersi M, Khin TZ, Nyan HL, Wai-Ma L, Vinothini A, Abdul-Kadir SY, Mohamad R, Wong AC, Yusuf A, Rebecca-Wong SY, Kumarasamy V, Nadankutty J, Nazrila SSF, Hlaing TD, Myo NH, Nazmul MHM, Ahmad TK, Htet H, Saw AY, Munira B, Christinal PWT, Sami ARA, Fidel F, Muftah AE, Mirhasheminasab SA, Marzalina M, Sabet NS (2016). Correlation between body mass index (BMI) and waist to hip ratio (WHR) among undergraduate students. *Pakistan Journal of Nutrition*, 15(7):618-624.

[5] Doustjalali SR, Hlaing TD, Khin TZ, Kumar RG, Sharma R, Jasman NN, Bhaukaurally W, Fatoumatta LS, Lim SJ, Izyan YH, Lwin YK, Al-Jashamy K, Irfan M, El-Sersi M, Nyan HL, Wai-Ma L, Vinothini A, Samiah YAK, Rohaini M, Wong AC, Yusuf A, Rebecca WSY, Vinoth K, Jeyaseelan N, Nazrila SFS, Christinal TPW, Myo NH, Ahmad TK, Htet H, Saw AY, Munira B, Sami ARAD, Fidel F, Muftah AE, Seyyed AM, Marzalina M, Negar SS (2016). Correlation between body mass index (BMI) and fasting total blood cholesterol level among undergraduate students. *Pakistan Journal of Nutrition*, 15(9):873-877.

[6] Rothman KJ (2008). BMI-Related errors in the measurement of obesity. *International Journal of Obesity*, 32: 56-59.

[7] Bhagavan NV (2001). Medical Biochemistry. *Academic Press*.

[8] Tanjila TS, Myonuddin PK (2010). Obesity and Disease Association : A Review. *Modern Medical College Journal*, 178(2) : 230-235.

[9] Muhamod MNW, Musa KI, Khir SMI, Ismail AAS, Ismail IS, Kadir KA, Kamaruddin NA, Yaacob NA, Mustafa N, Ali O, Isa SH, Bebakar WM (2011). Prevalence of overweight and obesity among adult Malaysians : An update. *Asia Pacific Journal of Clinical Nutrition*, 20(1) : 35-41.

[10] David S (2013). Obesity and overweight management in Malaysia and Singapore: Progress on right track. *Journal of Clinical and Diagnostic Research*, 7(12): 3124–3125.

[11] Cheah J (1996). Current Management of Obesity. *Singapore Medical Journal*, 37:299-303.

[12] Lim KG (2016). A review of adult obesity research in Malaysia. *The Med J Malaysia*, 71(1):1-19.

[13] Huda N, Ahmad R (2010). Preliminary survey on nutritional status among university students at Malaysia. *Pakistan Journal of Nutrition*, 9(2):125-127.

[14] Colditz GA, Willet WC, Stampfer MJ, Manson JE, Hennekens CH, Arky RA, Speizer FE (1990). Weight as a risk factor for clinical diabetes in women. *Am J Epidemiol*, 132(3): 501–513.

[15] Chan JM, Rimm EB, Colditz GA, Stampfer MJ, Willet W C (1994). Obesity, fat distribution, and weight gain as risk factors for clinical diabetes in men. *Diabetes Care*, 17(9): 961–969.

[16] Ismail IS, WanBebakar WM, Noor MI, Kamaruddin NA, Singh R, Abdullah NH, Hussein Z, MdZain F, Lee LF, MohdTaib SH, Lam V, Baharuddin F (2003). Clinical Practice Guidelines on Management of Obesity. *Academy of Medicine of Malaysia*, 1-31.

[17] Kirk P, Phillips J, Murray PG (2001). The biology of disease. 1st ed. *Oxford: Blackwell Science*.

[18] Rama Rao AVSS, Suryalakshmi A (2007). Textbook of biochemistry for medical students. 1st ed. *New Delhi: UBS*.
[19] MFMER (Mayo Foundation for Medical Education and Research) (2014). Disease and conditions-Diabetes-Test and diagnosis. *United States: MAYO Clinic*, http://www.mayoclinic.org/diseases-conditions/diabetes/basics/tests-diagnosis/con-20033091.
[20] Estela C (2011). Blood glucose levels. *Undergraduate Journal of Mathematical Modeling: One + Two,* 3(2): 12.
[21] NHS (2015). Type1 diabetes. *United Kingdom: National Health Services (NHS)*, http://www.nhs.uk/conditions/Diabetes-type1/Pages/Introduction.aspx.
[22] Goldman L, Schafer A (2012). Goldman's Cecil medicine. 24th ed. *Philadelphia: Elsevier Saunders*.
[23] Brent W, David Z, Isla O and ADAM (2017). Type2 diabetes. *United States : MedlinePlus*, https://medlineplus.gov/ency/article/000313.htm.
[24] Vital B G, Praveen G, Deepak P (2010). A study of body mass index in healthy individuals and it's relationship with fasting blood sugar. *Journal Of Clinical And Diagnostic Research,* 4:3421-3424.
[25] Tan A, Dunn R, Yen S (2011). Ethnic disparities in metabolic syndrome in Malaysia: An analysis by risk factors. *Metabolic Syndrome and Related Disorders,* 9(6):441-451.
[26] Lee WY, Kwon CH, Rhee EJ, Park JB, Kim YK, Woo SY, Kim S, Sung KC (2011). The effect of body mass index and fasting glucose on the relationship between blood pressure and incident diabetes mellitus: A 5-year follow-up study. *Hypertension Research*, 34(10):1093-1097.
[27] Innocent O, ThankGod O, Sandra E, Josiah I (2013). Correlation between body mass index and blood glucose levels among some Nigerian undergraduates. *HOAJ Biology*, 2(1):1.
[28] Odenigbo UM, Odenigbo UC, Oguejiofor OC, Adogu POU (2011). Relationship of waist circumference, Waist hip ratio and body mass index as predictors of obesity in adult Nigerians. *Pakistan Journal of Nutrition*, 10(1):15-18.
[29] MHCmed (2017). EasyTouch Glucose Monitoring System. *United States: Mhcmed,* http://mhcmed.com/products/easytouch-diabetic-products/easytouch-glucose-meter-test-strips.
[30] MFMER (Mayo Foundation for Medical Education and Research) (2014). Disease and conditions-Diabetes. How to test your blood sugar. *United States: MAYO clinic*, http://www.mayoclinic.org/diseases-conditions/diabetes/in-depth/blood-sugar/art-20046628?pg=2.
[31] IBM Corp (2012). IBM SPSS Statistic Windows, Version 22.0. Armonk, NY: IBM Corp.
[32] Sabet NS, Doustjalali SR, Khin TZ, Hlaing TD, Kenneth SYY, Sarah A, Geethaa A, Maram RM, Al-Jashamy K, Muftah AE, El-Sersi M, Vinothini A, Abdul-Kadir SY, Zainol J, Mohamad R, Wong AC, Yusuf A, Rebecca-Wong SY, Nazmul MHM, Ahmad TK, Saw AY, Munira B, Khin TO, Su WWL, Khatiza HA, Muzaffar D, Vinoth K, Mirhasheminasab SA, Marzalina M (2017). Correlation between body mass index (BMI) and blood pressure among undergraduate students. *Research Journal of Pharmaceutical, Biological and Chemical Sciences,* 8(4):857-865.