# THE EFFECT OF FAST-FOOD OUTLETS AVAILABILITY ON BMI STATUS AMONG ADOLESCENTS IN KUANTAN, PAHANG

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**Abstract**

**Background/Objectives:** The global and local growth of fast food outlets and the high acceptance level of their products by consumers show that people nowadays prefer easy and convenient food choices such as food from fast food outlets due to busy and hectic lifestyle. There is abundant evidence that linked fast food consumption with obesity. However, there are not enough data mentioning the association between fast food outlets availability with adolescent's BMI status in Malaysia. Therefore, this paper aims to study the relationship of the availability of fast-food outlets availability around schools with BMI status of adolescents in Kuantan. **Subjects/Methods:** Five hundred and thirty secondary high school students from district of Kuantan, Malaysia were measured for their weights and heights. The ArcGIS Network Analyst extension was used to create a network dataset to generate 400-meter, 800-meter and 1500-m service areas around each school and numbers of fast-food outlets available within each buffer were recorded. **Results:** From total 530 students, 60% of them have normal BMIAZ while 16.6%, 14.2% and 9.2% were overweight, obese and underweight respectively. This study, however, did not find any significant factors associated with adolescents' BMI status. There is no significant different between fast food outlets availability around school areas with adolescents' BMI status. **Conclusion:** Factors like fast food prices, delivery services and adolescents' nutrition knowledge may affect the food choices although the fast-food outlets availability is high near their schools. This study also clearly showed the co-existing of over-nutrition and undernutrition among adolescents in Kuantan. Future studies on food environment with obesity in Malaysia should include more fast-food outlets, local restaurants and '*pasar malam*' where plenty of unhealthy and high caloric food being sold.

**KEYWORDS:** Adolescents, fast food outlets, geographical information system, obesity

## INTRODUCTION

Obesity and overweight are the result of "caloric imbalance" where amount of calorie intake is higher than calorie expended by the body (Daniels et al., 2005). According to Institute for Public Health in National Health and Morbidity Survey (NHMS) 2015 report, 17.7% of Malaysian adults were obese while overweight individuals make up 30% of the population. The prevalence of the childhood obesity in Malaysia increased from 5.4% in 2006 to 6.1% in 2011 and recently increased to 11.9% in 2015 as reported in NHMS 2006, NHMS 2011 and NHMS 2015 (Institute for Public Health, 2015). The recent prevalence was doubled from the childhood obesity prevalence in 2006.

Among the factors that contribute to overweight and obesity is the increased intake from fast food outlets. Fast-food is a rapidly growing industry in the world as well as in Malaysia, especially in the urban areas. Fast food outlets services seem to meet the need of consumer's busier lifestyle and dual-working parents with children as they are quick and convenience. Nowadays, working individuals do not have much available time to cook meals where cooking for many has becoming a leisure activity instead of a chore (Farzana Quoquab et al., 2011). Fast food is known to offer caloric dense meals with lower price.

Several studies had been done to discuss the effect of fast-food consumption with the obesity (Braithwaite et al., 2014; Currie et al., 2010; Fraser et al., 2010). It is clear that fast foods are usually unhealthy. The availability of food high in fat, salt and sugar through Fast Food (FF) or takeaway outlets, is important determinant of obesity epidemic (Currie et al., 2010; Fraser et al., 2010). However, there are still not enough data mentioning the association between fast food outlets availability with adolescent's weight status in Malaysia. Therefore, this paper aims to study the relationship of the availability of fast-food outlets with BMI status of adolescents in Kuantan and visual the distribution of fast food outlets using Geogrhaphic Information System (GIS).

## METHODS

This is a cross-sectional study conducted in Kuantan, Pahang, Malaysia. Stratified random sampling were used to sampling the number of schools and students to represent each sub-district in Kuantan. A total of 530 respondents aged 13, 14 and 16 years old were recruited through systematic random sampling method from 12 secondary schools in Kuantan, Pahang. This study excluded boarding school as their students' meals may be influenced more on food prepared by schools. The list of selected schools was as in Table 1.

Table 1: List of schools selected.

| Sub-districts | School name |
|---|---|
| Kuala Kuantan | SMK Sungai Isap |
| | SMK Mat Kilau |
| | SMK Astana |
| | SMK Sungai Isap Murni |
| | SMK Tanah Puteh |
| | SMK Paya Besar |
| | SMK Tg Panglima Perang Tg Muhammad |
| Penor | - |
| Beserah | SMK Beserah |
| Sungai Karang | SMK Teluk Cempedak |
| | SMK Sungai Baging |
| Ulu Lepar | SMK Lepar Hilir |
| Ulu Kuantan | SMK Sungai Lembing |

*Sociodemographic data*

A set of self-answered questionnaire was used to obtained adolescents' details (age, gender, race, home address, household number, parent's educational level, parent's marital status and parent's employment status.

*Anthropometric measurement*

Height was measured using SECA stadiometer. The subjects were barefooted and wore minimal clothing (school attire) to assist correct positioning of the body. Weight was measured using Rossmax WF260 Body Fat Monitor to the nearest 0.1 kilogram. All the measurements were taken twice, and the average value was used for data entry. Body mass index (BMI) is calculated using the formula Weight (kg)/ [height x height ($m^2$)]. BMI-for-age (BMIAZ) z scores was obtained using AnthroPlus® software to classify the categories of BMI status.

*Spatial analysis*

All data with coordinates are called spatial data. Spatial data were analyzed using ArcGIS version 10.3 software for desktop. The latitudes and longitudes coordinate of the schools and fast-food outlets were identified using Google Maps. These spatial data then converted to WGS84 code so they will be compatible with GIS for analysis.

The ArcGIS Network Analyst extension was used to create a network dataset to generate 400-meter, 800-meter and 1500-m service areas around each school. The density of fast-food outlets and convenience stores within the 400-meter, 800-meter and 1500-m from secondary school food environment was calculated using buffer analysis to quantify the degree of fast-food outlet concentration. The fast food outlets including one big brand of convenient store franchise in Malaysia that was included in this study are Kentucky Fried Chicken (KFC), McDonald's, Burger King, A&W, Pizza Hut, Domino Pizza, Secret Recipe and a convenience store (7 Eleven).

*Statistical analysis*

IBM Statistical Package for the Social Science (SPSS) version 22.0 was used for statistical analysis. Pearson Chi-Square test was performed to analyze the relationship between sociodemographic data with BMI status. One Way ANOVA was used to compared mean BMI of secondary school students according to categories of fast-food outlets availability.

*Ethical approval*

This study was conducted as part of the project title "Utilization of Geographic Information System to Explore Root Causes of Obesity in Kuantan, Pahang" and ethical approval is from the Kulliyyah of Allied Health Sciences (KAHS) and IIUM Research Ethics Committee (IIUM/504/14/11/2/REC 2019-131). The permission to conduct the study was obtained from Ministry of Education Malaysia, Jabatan Pendidikan Negeri Pahang and the selected schools.

**RESULTS**

*Sociodemographic data*

This study participated by 236 (44.5%) males and 294 (55.5%) females. The mean (SD) of their age is 171.40 (15.03) months, approximately 14.28 years. Majority of the respondents are Malay (91.3%) and

6.4%, 6% and 0.8% of them are Chinese, Indian and Bumiputera respectively. The sociodemographic were illustrated in Table 1.

Table 1: Demographic characteristic of respondents

| Respondents Characteristic | | Frequency (%) | Mean ± SD/ Median ± IQR |
|---|---|---|---|
| **Gender** | | | |
| | **Male** | 236 (44.5) | |
| | **Female** | 294 (55.5) | |
| **Age (months)** | | | 171.40 ± 15.03 |
| **Race** | | | |
| | **Malay** | 484 (91.3) | |
| | **Chinese** | 34 (6.4) | |
| | **Indian** | 8 (1.5) | |
| | **Bumiputera** | 4 (0.8) | |
| **School Location** | | | |
| | **Urban** | 272 (51.3) | |
| | **Rural** | 258 (48.7) | |
| **Age of Mother (yrs)** | | | 44.03 ± 6.42 |
| **Mother's Education Level** | **Non-Schooling** | 12 (2.3) | |
| | **Primary Education** | 59 (11.4) | |
| | **Secondary Education** | 341 (66.0) | |
| | **Tertiary Education** | 105 (20.3) | |
| **Mother's Employment Status** | **Working** | 222 (42.9) | |
| | **Not Working** | 295 (57.1) | |
| **Age of Father (yrs)** | | | 47.35 ± 6.80 |
| **Father's Eduacation Level** | **Non-Schooling** | 14 (2.9) | |
| | **Primary Education** | 52 (10.8) | |
| | **Secondary Education** | 307 (63.7) | |
| | **Tertiary Education** | 109 (22.6) | |
| **Father's Employment Status** | **Working** | 468 (97.1) | |
| | **Not Working** | 14 (2.9) | |
| **Household Monthly Income** | | | RM 2500 ± RM 2900[a] |
| **Household Income Level (n=527)** | **B40** | 384 (71.9) | |
| | **M40** | 92 (17.4) | |
| | **T20** | 51 (9.7) | |
| **Household Size** | **1 to 5** | 241(45.5) | |
| | **>5** | 289 (54.5) | |
| **Number of children going to school** | **1 to 3** | 385 (72.6) | |
| | **>3** | 145 (27.4) | |
| **Weekly Grocery expenses** | **<RM100** | 122 (23.0) | |
| | **RM 101 to RM199** | 112 (21.1) | RM 216.18 ± RM 116.00 |
| | **>RM200** | 296 (55.9) | |

[a]Median±IQR

*BMI status*

In general, 60% (n=318) of the respondents are having normal BMI for age z-score while 16.6% (n=88) and 14.2% (n=75) are overweight and obese respectively. Others fall into underweight category.

Table 2: Percentage of Respondents' BMI Status

| Variables | No. of Respondents (%) | Mean (SD) |
|---|---|---|
| **BMI-for-age** | | |
| **Normal** | 318 (60.0) | |
| **Overweight** | 88 (16.6) | 1.75 (±1.04) |
| **Obese** | 75 (14.2) | |
| **Underweight** | 49 (9.2) | |

*Sociodemographic and BMI status*

Table 3: Association between sociodemographic with BMI status

| Variables | Normal | Overweight | Obese | Underweight | *p*-value* |
|---|---|---|---|---|---|
| | N (%) | N (%) | N (%) | N (%) | |
| **Gender** | | | | | |
| Male | 146 (45.9) | 31 (35.2) | 37 (49.3) | 22 (44.9) | 0.258 |
| Female | 172 (54.1) | 57 (64.8) | 38 (50.7) | 27 (55.1) | |
| **School location** | | | | | |
| Urban | 158 (49.7) | 45 (51.1) | 44 (58.7) | 25 (51.0) | 0.580 |
| Rural | 160 (50.3) | 43 (48.9) | 31 (41.3) | 24 (49.0) | |
| **Mothers' Education Level** | | | | | |
| Non-Schooling | 9 (75.0) | 2 (16.7) | 0 (0.0) | 1 (8.3) | |
| Primary Education | 33 (55.9) | 9 (15.3) | 9 (15.3) | 8 (13.6) | 0.795 |
| Secondary Education | 200 (58.7) | 61 (17.9) | 51 (15.0) | 29 (8.5) | |
| Tertiary Education | 68 (64.8) | 15 (14.3) | 13 (12.4) | 9 (8.6) | |
| **Mothers' Employment Status** | | | | | |
| Working | 139 (62.6) | 34 (15.3) | 29 (13.1) | 20 (9.0) | 0.730 |
| Not Working | 171 (58.0) | 53 (18.0) | 44 (14.9) | 27 (9.2) | |
| **Mother Income Level** | | | | | |
| No income | 156 (57.6) | 48 (17.7) | 42 (15.5) | 25 (9.2) | |
| RM1 – RM1000 | 58 (60.4) | 15 (15.6) | 15 (15.6) | 8 (8.3) | 0.689 |
| RM1001- RM4999 | 69 (67.6) | 17 (16.7) | 9 (8.8) | 7 (6.9) | |
| >RM5000 | 27 (56.3) | 7 (14.6) | 7 (14.6) | 7 (14.6) | |
| **Fathers' Education Level** | | | | | |
| Non-Schooling | 10 (71.4) | 2 (14.3) | 2 (14.3) | 0 (0.0) | |
| Primary Education | 31 (59.6) | 11 (21.2) | 6 (11.5) | 4 (7.7) | 0.934 |
| Secondary Education | 184 (59.9) | 53 (17.3) | 41 (13.4) | 29 (9.4) | |
| Tertiary Education | 64 (58.7) | 16 (14.7) | 18 (16.5) | 11 (10.1) | |
| **Fathers' Employment Status** | | | | | |
| Working | 280 (59.8) | 80 (17.1) | 65 (13.9) | 1(7.1) | 0.982 |
| Not Working | 9 (64.3) | 2 (14.3) | 2 (14.3) | 43 (9.2) | |
| **Father Income Level** | | | | | |
| No income | 8 (66.7) | 2 (16.7) | 1 (8.3) | 1 (8.3) | |
| RM1 – RM1000 | 70 (62.5) | 16 (14.3) | 19 (17.0) | 7 (6.3) | 0.844 |
| RM1001- RM4999 | 161 (59.0) | 50 (18.3) | 33 (12.1) | 29 (10.6) | |
| >RM5000 | 50 (58.8) | 14 (16.5) | 14 (16.5) | 7 (8.2) | |

| | | | | | |
|---|---|---|---|---|---|
| **Household Income** | | | | | |
| Below RM 940 | 60 (18.9) | 13 (15.1) | 19 (25.3) | 7 (14.3) | 0.318 |
| Above RM940 | 257 (81.1) | 73 (84.9) | 56 (74.7) | 42 (85.7) | |
| **Household Size** | | | | | |
| 1 to 5 | 148 (61.4) | 32 (14.9) | 36 (14.9) | 25 (10.4) | 0.273 |
| >5 | 170 (58.8) | 56 (19.4) | 39 (13.5) | 24 (8.3) | |
| **School location** | | | | | |
| Urban | 158 (49.7) | 45 (51.1) | 44 (58.7) | 25 (51.0) | 0.580 |
| Rural | 160 (50.3) | 43 (48.9) | 31 (41.3) | 24 (49.0) | |

*Chi Square test

*Fast food outlets and school distribution*

In Figure 1, buffer analysis was done to identify the number of fast-food outlets available within buffer ranges from school location.

Table 4: Number of fast-food outlets from 400-m, 800-m and 1500-m buffer from school.

| No. | Schools' name | 400-m | 800-m | 1500-m | TOTAL |
|---|---|---|---|---|---|
| **0** | SMK Beserah | 0 | 0 | 0 | 0 |
| **1** | SMK PayaBesar | 1 | 2 | 0 | 3 |
| **2** | ***SMK Tg Panglima Perang Tg Muhammad*** | ***3*** | ***1*** | ***5*** | ***9*** |
| **3** | SMK LeparHilir | 0 | 0 | 0 | 0 |
| **4** | SMK SgIsap | 0 | 1 | 0 | 1 |
| **5** | SMK Astana | 0 | 0 | 0 | 0 |
| **6** | SMK Sungai Baging | 0 | 0 | 0 | 0 |
| **7** | SMK Mat Kilau | 0 | 1 | 0 | 1 |
| **8** | SMK TelukChempedak | 0 | 0 | 2 | 2 |
| **9** | SMK SgIsapMurni | 0 | 1 | 1 | 2 |
| **10** | SMK Tanah Puteh | 0 | 3 | 2 | 5 |
| **11** | SMK Sungai Lembing | 0 | 0 | 0 | 0 |
| | TOTAL | 4 | 9 | 10 | 23 |

The number of fast-food outlets located in fixed buffers were recorded in Table 3. From all twelve secondary schools selected, SMK Tg Panglima Perang Tg Muhammad has the highest total number of fast-food outlets within 1500-m buffer.

Table 5: Mean and standard deviation of BMI in secondary school students by groups of fast-food outlet availability.

| Study groups | Mean (SD) | *F* statistics (df) | *p* value* |
|---|---|---|---|
| **No FFO Available** | 0.004 (1.62) | | |
| **<5 FFO** | 0.17(1.56) | 1.24 (2, 527) | **0.289** |
| **5 and Above** | 0.32 (1.63) | | |

*One-way ANOVA

Based on the Table 5 above, there were no significant differences of mean BMI in secondary school students at three level of fast-food outlet availability [F (2, 527) = 1.24, p = 0.289].

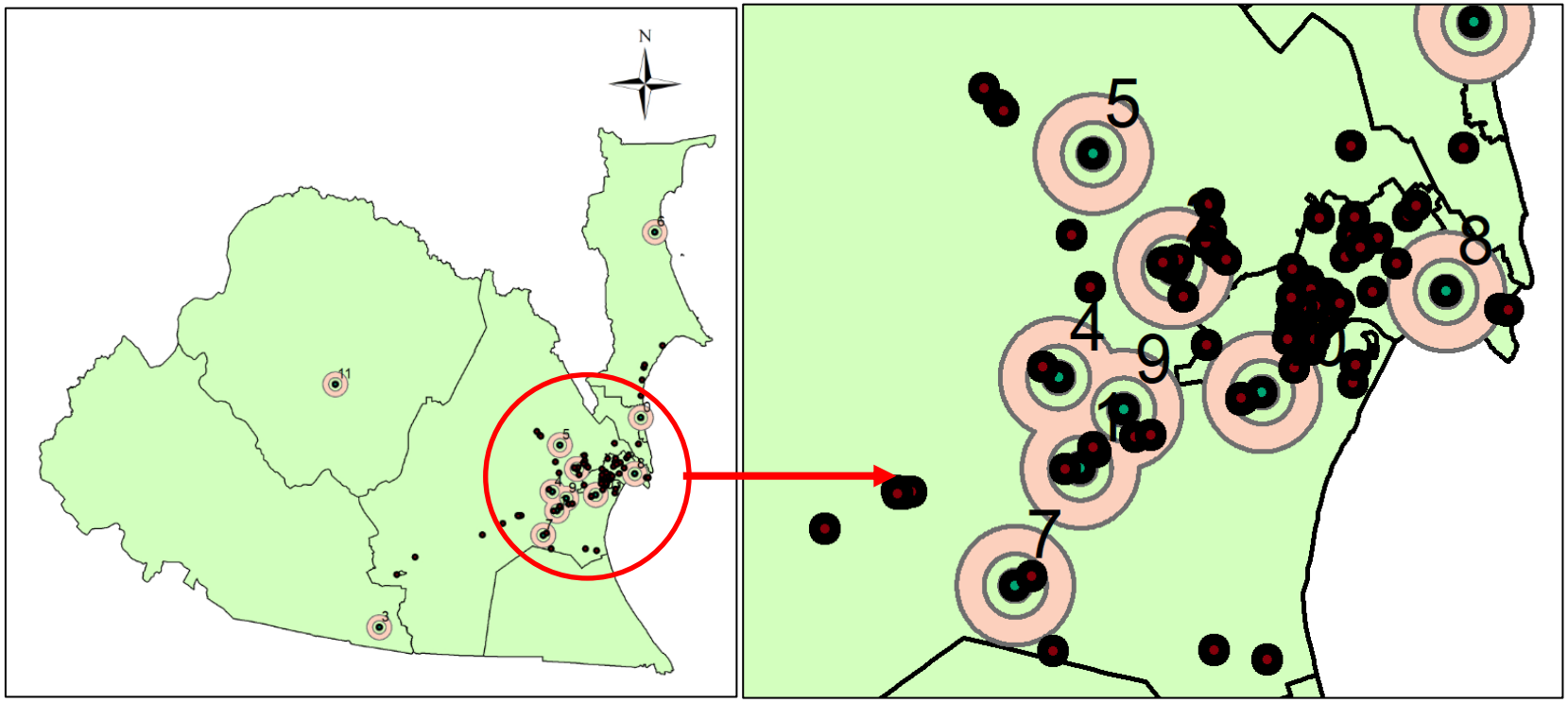


Figure 1: Buffer analysis of fast-food outlets location from schools' location

## DISCUSSION

*Sociodemographic and BMI status*

This study found that there are both under and over nutrition among adolescents in Kuantan, Pahang. The prevalence of overweight, obese and thinness were 16.6% (n=88), 14.2% (n=75) and 9.2% (n=49). These findings illustrate some increment from previous study done in Kuantan. Previous study done by Mat Ya (2017), found that 11.2%, 14.9% and 7.1% of overweight, obese and thinness prevalence respectively in Kuantan Pahang. Except for obese, the overweight and thinness prevalence showed an increment by 5.4% and 2.1% respectively. Although, the prevalence of obese lesser by 0.7% from previous study, the recent finding still considered as high.

The prevalence of overweight and thinness even higher compared to national prevalence. According to the report by National Health and Morbidity Survey 2017 (NHMS 2017), the prevalence of overweight and obese adolescents was 15.6% and 14.8% respectively while underweight prevalence was 6.6%. The prevalence of childhood obesity showed an inclining trend each year in Malaysia. The childhood obesity doubled from 5.4% according to National Health and Morbidity Survey (NHMS) to 11.9% reported by NHMS 2015 and recent NHMS 2017 report found that adolescents' obesity prevalence was 14.8% (Institute for Public Health, 2015; Institute for Public Health Malaysia, 2017). These findings were very alarming since childhood obesity can lead to various other health concerns including increase risk of lower extremity venous edema, walking limitation, kidney dysfunction, polycystic ovary syndrome, respiratory conditions, diabetes and hypertension in adulthood (Inge et al., 2013).

This study also found that, prevalence of overweight and obese adolescents was higher in female adolescents compared to male. Female undergo early puberty compared to male. The hormonal factor also affecting the adiposity distribution for female and male. In girls, the morphological changes of puberty including secondary sex characteristics begin between age of 8 and 12 years, while 9 and 14 years in boys (Solorzano & Mccartney, 2011). In addition, the initial appearance of breast tissue in girls known as thelarche, indicates the production of gonadotropin-driven estrogen. Estrogen besides promotes female breast development, it also influences body fat composition and distribution throughout puberty (Solorzano & Mccartney, 2011). Weight gain during puberty is physiologic as puberty in female is normally accompanied by increases of BMI and subcutaneous adiposity which in some extends explain early puberty can result in physiologic increases in parameter to measure obesity including BMI for age.

Although there was no significant association, the prevalence of overweight and obesity was higher in urban area while for underweight, the distribution was almost similar in both urban and rural. The high prevalence of overweight and obesity in urban area was parallel to findings by NHMS 2015. Urbanization lead to inadequate social environment and buildings not suitable for walking around causing children and adolescent physically inactive (Ahmed, Shah, & Kshirsagar, 2016; Pirgon & Aslan, 2015). Diminished access to sporting activities and other means of physical exercise due to improper urban planning decreased suitable walking and play areas for children. This forced families living in inner city areas prefer their children to stay indoors playing on a computer or watching television (Pirgon & Aslan, 2015). Physical inactivity will become their habit until they become adults and eventually led to obesity.

The current study found that there was no association between household income and adolescents' BMI status. However, many studies linked low-income families with the development of obesity. One study reported that the prevalence of obesity among adolescents from high-socioeconomic families decreased in recent years while obesity prevalence among their low-socioeconomic status friends kept increasing (Frederick, Snellman, & Putnam, 2013). This study propose that many low SES children live in environments that do not support a physically active lifestyle.

Neighborhood constrains including unavailability or lack of public recreational parks, playground, or sidewalks and concerns for safety when outdoors can hinder children from becoming active (Frederick et al., 2013). Other studies also found that many low-income communities had limited access to sidewalks, green space, parks, and recreation centers that may be perceived as unsafe; all are likely barriers to leisure time physical activity (Finkelstein, Petersen, & Schottenfeld, 2017). In addition, low-income families usually have less access to healthy food choices which leading to poor diet quality among family members.

*The impact of fast-food outlets availability from school on over-nutrition among youth*

Studies on obesity commonly reported the food environment as one of the factors influencing the increasing of obesity prevalence. Food availability is often defined as the number of food locations within a predetermined area (Caspi, Sorensen, Subramanian, & Kawachi, 2012). Caspi et al. (2012) also emphasize the used of GIS as a tool to measure food availability. In this present study, the availability of fast-food outlets was measured from schools. The number of fast-food outlets available within 400-m, 800-m and 1500-m buffers were recorded as in Table 4.6. Caspi (2012) explained that there was a wide range of buffer distances used, ranging from 100-m to 2 miles. Study by Walker, Keane, & Burke (2010), considered distance less than 1000-m are walkable. Therefore, for this present study, the 400-m and 800-m were walkable distance for adolescents from school to fast food outlets.

However, this study did not find any significant difference between the availability of fast-food outlets from schools with adolescents' BMI status in Kuantan, Pahang. This is contradicting with theory that claimed people living in areas with a dense unhealthy fast-food option may associate with higher levels of fast-food consumption, a factor that often overlaps with being overweight or obese (Oexle et al., 2016). Oexle also proposed that measuring food availability in a particular area is hard to achieve consistently as there may be differences in how researchers perceived food availability as compared to how individuals or respondents perceive their personal food availability.

Other factors may have contributed to this insignificant difference. The price of meals available in fast food outlets in Malaysia is considered high. Food price is an important factor of food choice particularly for low-income people (Steenhuis, Waterlander, & Mul, 2014). Adolescents from low socio-economic household will be more conscious of value and price of food. Recently, there are several consumer complaints regarding fast food price. Aiman (2019) reported consumer rights group in Semenyih protested the increase in price of fast-food items from KFC and McDonald's, claiming a rise of 30% compared to 2014.

This issue was looked up by Malaysia Domestic Trade and Consumer Affair Minister, Datuk Seri Saifuddin Nasution Ismail. He stated that, the government cannot dictate prices at fast food chains as these are not legally controlled (Dzulkifly, 2019). One study proved that price of food influencing food choices where they used price reduction strategies to promote targeted vending machine foods available in schools (French, 2003). This study found that price reductions of 10%, 25% and 50% on snacks resulted in an increase in sales of 9%, 39% and 93%, respectively, compared with usual price conditions.

The introduction of delivery service for food industries may affecting this present study result. This service makes individuals able to buy fast food without need to go to the outlets themselves. Adolescents only need to make a phone call or order through application available for android and OS phone. Healthy nutrition knowledge among adolescents also can be one of the factors that leading to this result. However, this study did not measure the healthy nutrition among adolescents to statistically investigate the role of this variable towards BMI status. In this current globalization world, adolescents become technology literate. All information regarding healthy nutrition can be easily access. Individuals with healthy nutrition may not choose fast food as their meals although the location of the outlets near their schools or houses.

Lastly, this study only included large fast-food brand franchise. Increasing the inclusion of fast-food franchise and maybe night market may be producing different outcome. In Kuantan, there were many nights market available in different location every day. Night market also associated with the availability of unhealthy, high dense calorie but low nutrient content food. Future study can be done to overcome this current study gap including to include the frequency of fast-food consumption.

## CONCLUSION

The prevalence of adolescents' who are overweight and obese in Kuantan is worrisome. At first, we are suspecting that the availability of fast-food outlets around schools will influence the BMI status of adolescents. However, the result showed otherwise. It is true that the availability of fast-food outlets does increase the accessibility of unhealthy food to individual, but the location does not give impact on obesity prevalence in the area based on this study. There are factors such as price range of the meals available at the outlets, the delivery service and healthy nutrition knowledge among students that may affect their fast-food intakes. As obesity is a complex and multifactorial disease, there are many other factors can be associated with its development.

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