Association between Community and Consumer Food Environment with Body Mass Index-for-age (BMI-for-age) among Adolescents aged 13 to 17 years in Sandakan, Sabah

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INTRODUCTION

- Food environment is defined as any opportunity to obtain food which includes physical, socio-cultural, economic and policy (Belon et al., 2016).
- Food environments influence people's food choices and nutritional status (Swinburn et al., 2013).
- Food Environment consists of four interlinked components which include the community food environment, the consumer food environment, the organizational food environment and the information food environment (Glanz et al., 2005).
- Community Food environment includes distance and density of food outlets.
- Consumer Food Environment includes price and availability of healthy food items in the food outlets.

OBJECTIVE

To determine the association between the community food environments (Distance of food outlets, numbers of food outlets), consumer food environment (Price of food items in the food outlets, availability of healthy foods items in the food outlets) and Body Mass Index-for-age (BMI-for-age) among adolescent aged 13-17 years old.

METHODS

- Study Design: A cross sectional study in SMK Muhibbah and SMK Elopura Bestari, Sandakan, Sabah
- Analysis: SPSS version 25 with significant level $p<0.05$

Table 1: List of variables and tools

Variables	Tools
Socio-demographic Factor	Online Questionnaire
Distance of food outlets	Online Questionairre & Geographical Information System (GIS)
Number of food outlets	
Price of food items in the food outlets	Nutrition Environment Measures Survey for Stores (NEMS-S) & Nutrition Environment Measures Survey for Restaurants (NEMS-R)
Availability of healthy and unhealthy food items in the food outlets	
Body Mass Index of adolescent	Online Questionnaire & World Health Organization (WHO) AnthroPlus

RESULTS

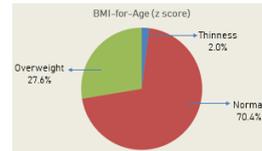
Figure 1: Distribution of BMI-for-age of respondents

Table 2: Distribution of BMI-for-age of respondents

Variable	Mean ± SD
Age (Year)	15.9 ± 1.12

Table 3: Age of respondents

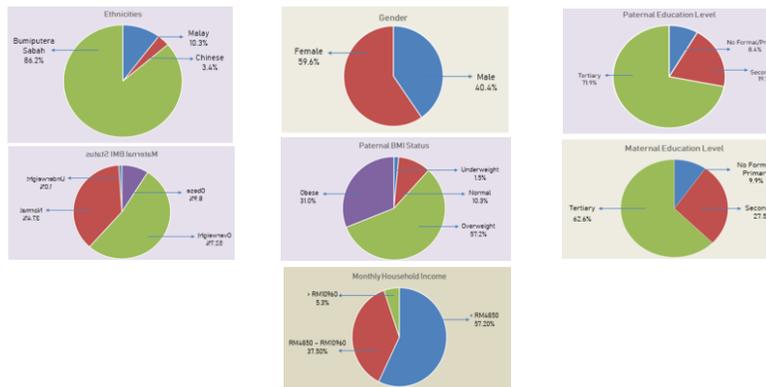| Variable	Mean ± SD
BMI-for-Age (z score)	0.36 ± 0.87

Figure 2: Sociodemographic characteristics of subjects

Figure 3: Identify the shortest route from residential area to food outlets using QGIS

Table 4: Distance from residential area to food outlets of the respondents

Distance from Residential Area to Food Outlets (km)	Mean ± SD
Supermarket	7.85 ± 3.40
Convenience Store	5.14 ± 5.28
Fast Food	4.74 ± 3.83
Restaurant	4.90 ± 4.32

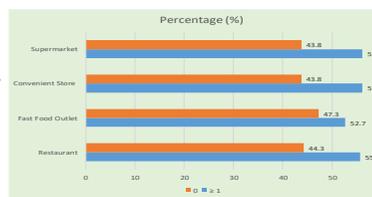Figure 4: Buffer Analysis of Food Outlets location within 1000m radius from residential area using QGIS

Table 5: Price of food items in the food outlets score

Price of food items in the Food Outlets Score	Mean ± SD
Supermarket	0.89 ± 0.99
Convenience store	-0.42 ± 3.31
Fast food outlet	-1.01 ± 2.55
Restaurant	0.37 ± 1.86

Table 6: Availability of healthy food items in the food outlets score

Availability of Healthy Foods Items in the Food Outlets Score	Mean ± SD
Supermarket	25.01 ± 4.98
Convenience Store	19.68 ± 2.30
Fast Food Outlets	2.29 ± 1.72
Restaurant	7.66 ± 5.34

Table 7: Association between the socio-demographic and BMI-for-age

Variables	BMI-for-age		x^2/r	p-value
	Normal	Abnormal		
Gender				
Male	39 (27.3)	43 (71.7)	34.596[a]	0.000*
Female	104 (72.7)	17 (28.3)		
Age (unit)			0.007[b]	0.917
Ethnicity				
Malay	10 (7.0)	9 (15.0)	3.194[a]	0.074
Non-Malay	133 (93.0)	51 (85.0)		
Father's Education Level				
Secondary/Tertiary	138 (96.5)	51 (85.0)	8.711[a]	0.003*
Non-Formal /Primary	5 (3.5)	9 (15.0)		
Mother's Education Level				
Secondary/Tertiary	138 (96.5)	49 (81.7)	12.815[a]	0.000*
Non-Formal/Primary	5 (3.5)	11 (18.3)		
Monthly Household Income (RM)			-0.129[b]	0.067
Father's BMI (kg/m2)			0.759[b]	0.000*
Mother's BMI (kg/m2)			0.777[b]	0.000*

Table 8: Association between the distances of food outlets from home with BMI-for-age

Variables	BMI-for-age	
	r-value	p-value
Distance from Residential Area to Food Outlets		
Supermarket	0.069	0.327
Convenience Store	-0.125	0.075
Fast Food	-0.191	0.006*
Restaurant	-0.139	0.048*

Table 9: Association between the numbers of food outlets within 1000m radius of residential area with BMI-for-age

Variable	BMI-for-age		x^2	P-value
	Normal	Abnormal		
Supermarket				
0	58 (40.6)	31 (51.7)	2.118	0.146
≥ 1	85 (59.4)	29 (48.3)		
Convenience Store				
0	72 (50.3)	17 (28.3)	8.321	0.004*
≥ 1	71 (49.7)	43 (71.7)		
Fast Food Outlets				
0	93 (65.0)	3 (5.0)	61.113	0.000*
≥ 1	50 (35.0)	57 (95.0)		
Restaurant				
0	86 (60.1)	4 (6.7)	48.971	0.000*
≥ 1	57 (39.9)	56 (93.3)		

Table 10: Association between the price of food items in the food outlets score with BMI status among adolescents.

Variables	BMI-for-age	
	r-value	p-value
Score Price of items in the Food Outlets		
Supermarket	-0.366	0.000*
Convenience store	-0.335	0.000*
Fast food outlet	-0.320	0.000*
Restaurant	-0.302	0.000*

Table 11: Association between the score availability of healthy food items in the food outlets with BMI status among the adolescents.

Variables	BMI-for-age	
	r-value	p-value
Score Availability of healthy foods in the food outlets		
Supermarket	-0.343	0.000*
Convenience Store	-0.383	0.000*
Fast Food Outlets	-0.472	0.000*
Restaurant	-0.300	0.000*

DISCUSSION

- In the present study, it is found that 2.0%, 27.6% of the adolescents were thinness and overweight respectively. The percentage of overweight in the present study is higher compared to the past study that reported Malaysian adolescents aged 13 to 17 years old who are overweight is 15.2% (Mahaletchumy et al., 2019).
- In the present study, there is significant association of distance of food outlets, number of food outlets within residential area, price and availability of healthy food items in the food outlets with BMI-for-age of the adolescents.
- The result is similar with the past study that was done in America in which they found that adolescents who lived far from fast food outlets and restaurant may have a better BMI status compared to the adolescents who lived closed with it (Fietchner et al., 2016). The possible reason for The similar findings between these studies may be due to the same characteristics of fast foods available in the outlet which is high in fat, sugars and salts which may lead to higher chances of getting overweight and obesity.
- Besides, the finding also may be supported by the study that was done in United Kingdom in which they found that there was significant relationship between the availability of healthy foods sold in the food outlets and the prevalence of overweight and obese children (Wilsher et al., 2016). The possible reason for the similar results may be due to the fact that price motivates the possibility for the consumer to buy healthy food items such as vegetables, and fruits when the price is lowered compared to non-healthy food items like soft drink, and snacks (Powell et al., 2009).

CONCLUSION

- The distance and numbers of the food outlets are associated with the BMI status of the adolescents, in which a 'Healthy' food outlets may have positive correlation with the BMI status. Apart from that, lower prices and higher availability for healthy food options in supermarket, convenience stores, fast-food outlets, and restaurants are associated with decreased number of overweight or obesity. Therefore, interventions to build healthier food outlets close to residential area, reduce food prices of healthy food items and increase the availability for healthy options in food outlets and restaurants may have favourable effects on adolescents BMI.