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FEEDING THE OBESITY EPIDEMIC: THE ROLE OF THE OBESOGENIC FOOD ENVIRONMENT

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Abstract:

The food environment is a crucial factor in either promoting or discouraging an obesogenic environment. Despite Malaysia being recognized as the country with the highest obesity rate in Southeast Asia, research in this area remains unclear. This paper aims to illuminate the relationship between the food environment, measured by perceived accessibility to grocery and convenience stores, and the intake of healthy and unhealthy foods among urban residents, while accounting for socio-demographic characteristics. A face-to-face questionnaire survey was administered to 256 eligible respondents. Using Structural Equation Modeling at a 95% confidence interval, four main findings were revealed: i) a positive relationship between education level and healthy food intake ($\beta=.510$, $p<.000$); ii) a negative relationship between age and unhealthy food intake ($\beta=-.190$, $p=.027$); iii) higher grocery store access was associated with lower unhealthy food intake ($\beta=-.118$, $p=.008$); and iv) higher convenience store access was associated with lower intakes of both healthy ($\beta=-.137$, $p<.000$) and unhealthy foods ($\beta=-.110$, $p=.006$), with a slightly stronger relationship for the former. Combating obesity requires the active collaboration of multiple stakeholders and policymakers. More comprehensive studies on our food environment are needed to facilitate changes to our living environment. Effective neighborhood planning strategies that encourage healthier decisions have significant potential to reduce obesogenicity in our cities, supporting a sustainable future and well-being for Malaysians.

Keywords:

Obesogenic Environment; Food Environment; Healthy Food Intake; Neighbourhood Planning

1. Introduction:

Obesity has become a significant concern for both public health and society, reaching global proportions. The obesogenic environment refers to the sum of factors within an environment that encourage obesity in individuals or populations (Lake & Townshend, 2006; Lim, Majid, Zainol & Teh, 2022). Essentially, the term 'obesogenic environment' encompasses the effects of the environment, available opportunities, and life circumstances in promoting obesity among individuals and communities (Swinburne, Egger & Raza, 1999). Efforts to combat obesity have primarily centered around medical and healthcare facilities, which have demonstrated limited effectiveness. This is evident from the National Health and Morbidity Survey (NHMS), which shows that the proportion of overweight and obese adults in Malaysia nearly doubled from 1996 to 2016. A more sustainable and long-term approach would involve examining the living environments of inhabitants to facilitate healthy calorie consumption and active lifestyles, a dimension not yet fully understood in Malaysia (Majid, Lim, Zaman & Ruslik, 2021).

Therefore, to design successful environmental interventions for addressing obesity, it is crucial to understand how individuals and various demographic groups interact with their surroundings concerning physical activity via the built environment and dietary habits via the food environment. In this paper, we specifically investigate the urban food environment, exploring the relationship between perceived grocery store and convenience store accessibilities and healthy and unhealthy food intakes among urban dwellers while controlling for socio-demographic characteristics.

2. Methodology:

Sampling

The study included 43 urban neighborhoods in the city of Johor Bahru, Johor. Trained enumerators conducted face-to-face questionnaire surveys with 256 eligible participants, who were at least 18 years old, had been living in their neighborhoods for more than three years, did not have any known ailments, and were not adhering to any special diet.

Confounding Variables – Demography: The respondents' age, gender, race, highest educational attainment, and monthly household income were collected and treated as categorical confounding variables of the study.

Independent Variables – Perceived Geographical Food Access to Grocery Store and Convenience Store: Gustafson et al.'s (2011) "perceived distance of food stores from home" item was modified for use in this study to assess respondents' perceived geographic accessibility to convenience stores and grocery stores. The questions were measured on a 6-point scale ranging from 1= 1 to 5 minutes to 5= More than 30 minutes and 6= Not sure.

Dependent Variables – Healthy and Unhealthy Food Intake: Fokeena et al.'s (2016) Diet Quality Index-Food Frequency Questionnaire (DQI-FFQ) was adapted for use in this study. Six food groups were included: healthy food intake (1= fruits and 2= vegetables) and unhealthy food intake (3= high-fat protein foods, 4= fat-rich foods, 5= salt-rich foods, and 6= sugar-rich foods). The questions were measured on a 6-point Likert scale ranging from 1= More than once daily to 6= Rarely or never.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0 and IBM SPSS Amos version 24.0. Due diligence was conducted on the dataset, e.g., missing data, outliers, abnormality, linearity, and multicollinearity. Exploratory Factor Analysis (EFA) was conducted via Maximum Likelihood extraction and Promax rotation. Factors were

extracted with acceptable Kaiser-Meyer-Olkin Measure (.809), significant Bartlett's Test of Sphericity ($p < .000$), good value of non-redundant residuals (.0%), and no communalities issue (.793 to .952). Adequacy, convergent validity, discriminant validity, and internal reliability were achieved. Confirmatory Factor Analysis (CFA) was performed using the Maximum Likelihood estimator to verify the factor structure of the variables. Model fitness adequacy was based on CMIN/df (< 5), TLI closer to 1, CFI closer to 1, and RMSEA ($< .08$). The correlation coefficient between the variables is less than .80. Construct validity and reliability were achieved. Structural Equation Modeling (SEM) was utilized to test the direct effects for the entire model, which consists of confounding, independent, and dependent variables of the study. Variables that did not meet any passing requirements along the way were excluded from further analysis. Model fitness adequacy was as per mentioned above.

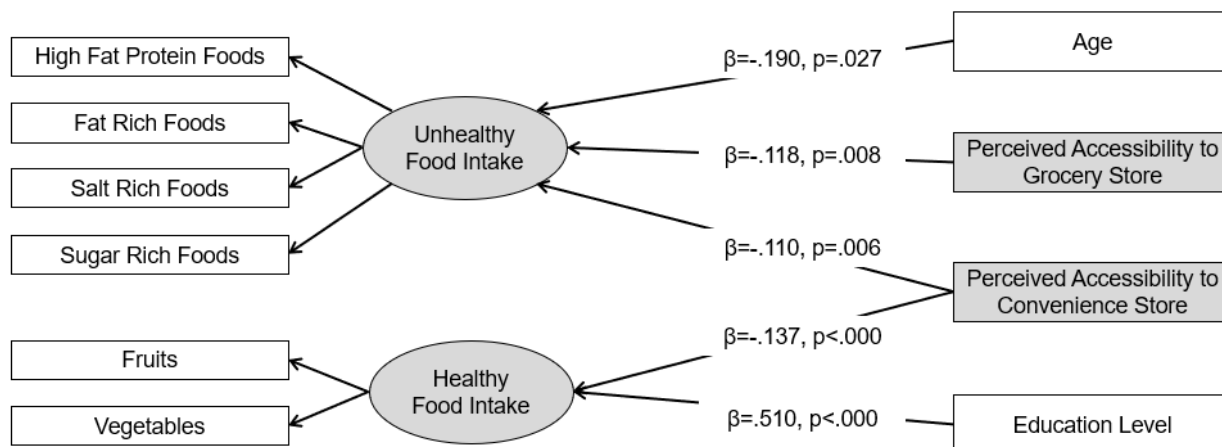
3. Results:

Model 1: Socio-demographic Characteristics, Healthy and Unhealthy Food Intakes

The direct effects between socio-demographic characteristics and healthy and unhealthy food intakes were estimated to account for confounding variables in the model. After several rounds of variable and pathway elimination due to insignificant effects, the final model achieved adequate model fitness (CMIN: 79.015, df: 54, CMIN/df: 1.463, TLI: .988, CFI: .992, RMSEA: .030). Significant relationships were found between the highest educational attainment ($\beta = .530$, $p < .000$) and healthy food intake, and age ($\beta = -.222$, $p = .010$) and unhealthy food intake. All other pathways were insignificant. As such, the highest educational attainment and age were retained in the model, while gender, race, and monthly household income were eliminated from further analysis.

Model 2: Perceived Geographical Grocery Store and Convenience Store Accessibility, Healthy and Unhealthy Food Intakes while Controlling for Socio-demographic Characteristics

When estimating the direct effects of perceived geographical grocery store accessibility and perceived geographical convenience store accessibility on healthy and unhealthy food intakes while controlling for socio-demographic characteristics, the model achieved a good fit (refer **Figure 1**) (CMIN: 103.548, df: 87, CMIN/df: 1.190, TLI: .992, CFI: .995, RMSEA: .019). Again, a positive relationship between education level and healthy food intake ($\beta = .510$, $p < .000$); as well as a negative relationship between age and unhealthy food intake ($\beta = -.190$, $p = .027$) were present. Results showed that both perceived walking minutes to the nearest grocery store ($\beta = -.118$, $p = .008$) and perceived walking minutes to the nearest convenience store ($\beta = -.110$, $p = .006$) had significant negative relationships with unhealthy food intake. This indicated that the closer the grocery and convenience stores are to a person's house, as perceived by walking minutes, the less likely that person is to consume unhealthy food. When comparing the effects of the two food stores, the perception of a shorter walk to the nearest grocery store has a slightly higher effect than the convenience store in reducing unhealthy food intake. On the other hand, perceived walking minutes to the convenience store was shown to have a significant negative relationship with healthy food intake ($\beta = -.137$, $p < .000$), but not the grocery store ($\beta = -.059$, $p = .188$). This indicated that perceiving a longer walk to the nearest convenience store decreases a person's healthy food intake. The results indicated that the convenience store is an important indicator of a person's food intake at the neighborhood level, regardless of healthy and unhealthy food intake.



Path Coefficients: β = Standardised Regression Weight, p = p-value

Model fit: CMIN= 103.548, df= 87, CMIN/df= 1.190, TLI= .992, CFI= .995, RMSEA= .019

Figure 1 Model of perceived geographical grocery store and convenience store accessibility, healthy and unhealthy food intakes while controlling for socio-demographic characteristics

4. Discussion and Conclusion:

Exploring School Food Environment: Education Institutions as Advocates for Healthy Food Intake among Malaysians

The study found a significant positive relationship between education level and healthy food intake, aligning with several other local-based studies (Rezai, et al., 2012; Hoque et al., 2019; Teo et al., 2019). This suggests that: i) the more educated a person is, the more likely they are to eat healthily; ii) higher access to education provides more opportunities to access knowledge about food and eating behavior; and iii) educational institutions are highly suitable platforms to disseminate information, instill awareness, nurture healthy habits, and monitor progress. Unhealthy eating can also be addressed by investigating the school food environment (Driessen et al., 2014; Pineda, Swinburn & Sassi, 2019), especially in cities and urban areas. Hoque et al. (2016) supported the idea that building and correcting healthy eating habits should start at a young age via school institutions and education. Efforts to advocate for healthy eating should consider past initiatives, e.g., the Malaysian School Health Program (1967), Integrated School Health Programme (ISHP), Supplementary Food Program (SFP), and School Milk Program (SMP), while crafting more such initiatives in the future with a priority to increase life-long awareness and healthy behaviours.

Reassessing the Roles and Potentials of Grocery Stores or 'Kedai Runcit' as Healthy Food Sources

In the past, daily and weekly needs could be easily acquired from neighborhood local grocery stores or 'kedai runcit', which were an important part of the Malaysian neighborhood food environment, supplying sundries, fresh fruits and vegetables, fish,

meat, legumes, wheat products, and more. It is also where local products were sold and found. Since the first hypermarkets, Makro and Carrefour, set foot in Malaysia in 1993 (Lee, 2004) and 1994 (Hamilton, Senauer & Petrovic, 2011) respectively, modern retailing has continuously expanded and evolved. This forced local grocery stores to change their trajectory, trying to keep up with competition in terms of pricing, goods offered, quality, and consumer in-store buying experience.

Hence, it is not surprising that this study found local grocery stores to be an insignificant factor in influencing a person's healthy food intake. This could mean several things: i) healthy foods, i.e., fruits and vegetables, are no longer largely sold and available at local grocery stores; ii) when a person wants to buy healthy foods, local grocery stores are not the first choice that comes to mind; and iii) the quality and variety of healthy food offered at local grocery stores might not meet today's consumer expectations.

In 2011, under the 12 National Key Economic Areas (NKEA), Malaysia's Domestic Trade, Cooperatives and Consumerism Ministry introduced the Program Transformasi Kedai Runcit (TUKAR) with the aim to transform 5,000 grocery shops and create 51,540 jobs by 2020. As we are now in 2023, it is high time to reassess the roles and potentials of local grocery stores, not only to revive local businesses but also to furnish our food environment landscape with a healthy food variety.

Shaping a Healthy Food Environment via Convenience Stores While Considering the Local Context

Continuing the narrative to assess food establishments, the roles, impacts, and potentials of convenience stores should also be investigated with special attention to the local context. Past studies conducted in foreign countries concurred that convenience stores correlate positively with unhealthy food intake, regardless of demographic characteristics (Lim & Majid, 2017). This food establishment has always been used as a proxy to quantify the presence of unhealthy food stores, as demonstrated by Lind, Jensen, Glümer & Toft (2016). The problem is more dominant among low-income families, as Gustafson et al. (2011) reported that those living near convenience stores eat fewer fruits and vegetables. However, evidence from the current study disagrees with the above findings. Those studies were conducted more than six years ago, and some even date back more than a decade. The results of foreign countries do not necessarily reflect that of Malaysia's food environment and its people.

As we have seen immense transformation of convenience stores across Malaysia, e.g., the introduction of foreign brands and the expansion of ready-to-eat products on the shelves, the impacts of these rapid changes on Malaysia's food environment need to be studied. As suggested by Marshall (2016, pp. 1), "*Convenience stores represent an important 'shopping habitat' for consumers to engage in discretionary food shopping. While these convenience store purchases are not always unhealthy, the promotion and pricing strategies used by retailers can influence the final selection of products, and convenience stores provide a unique opportunity to cultivate more healthful behaviors.*"

This study scratches the surface and offers a glimpse into the potential of studying our food environment with the aim to understand ways to discourage the formation of an obesogenic environment. In conclusion, the persisting problem of the obesity epidemic needs to be addressed across multiple domains, including policymakers and professional practices, especially urban planners. Modifying the environment to encourage healthier choices holds great potential as a key element in effective obesity prevention measures.

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