

Factors Influencing Expenditure on Unhealthy Foods Among the Urban Poor in Malaysia

Yong Kang Cheah^a

Universiti Utara Malaysia

Mohd Jamil Sameeha^b

Universiti Kebangsaan Malaysia

Che Wel Che Aniza^c

Universiti Kebangsaan Malaysia

Mohd Sakri Anis Munirah^d

Universiti Kebangsaan Malaysia

Sivabalan Shashidharan^e

Universiti Kebangsaan Malaysia

Adila Fahmida Saptari^f

Reconstra Utama Integra

Sirinya Phulkard^g

Mahidol University

Elaine Q. Borazon^h

National Sun Yat-Sen University

Bee Koon Pohⁱ

Universiti Kebangsaan Malaysia

^a School of Economics, Finance and Banking, College of Business, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia. Email: yong@uum.edu.my (Corresponding author)

^b Centre for Community Health Studies (ReaCH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia. Email: sameeha@ukm.edu.my

^c Faculty of Economics and Management, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia. Email: aniza@ukm.edu.my

^d Centre for Community Health Studies (ReaCH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia. Email: p111470@siswa.ukm.edu.my

^e Centre for Community Health Studies (ReaCH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia. Email: shashis85@gmail.com

^f Reconstra Utama Integra, 12150 Jakarta, Indonesia. Email: adilafsaptari@gmail.com

^g Institute for Population and Social Research, Mahidol University, 73170 Nakhon Pathom, Thailand. Email: sirinya.phu@mahidol.ac.th

^h International Graduate Program of Education and Human Development (IGPEHID), College of Social Sciences, National Sun Yat-Sen University, 80424 Kaohsiung City, Taiwan. Email: elaineqborazon@gmail.com

ⁱ Centre for Community Health Studies (ReaCH), Faculty of Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia. Email: pbkoon@ukm.edu.my

* This is part of the South East Asia Obesogenic Food Environment (SEAOFE) study funded by the International Development Research Centre (IDRC) Canada (Project ID: 109309). The funding was utilised for data collection and scientific writing.

Abstract: Consumption of unhealthy foods possesses harmful effects on health, thereby increasing the disease burden. If low-income people, especially those living in urban areas, do not make efforts to reduce their consumption on unhealthy foods, the health-economic costs borne by them will rise. To date, there is a growing number of Malaysian studies that examine factors affecting consumption expenditure on unhealthy foods, but none has paid attention to the urban poor. The objective of this study is to narrow this research gap. Cross-sectional data from the South East Asia Obesogenic Food Environment (SEAOFE) study was used. A seemingly unrelated regressions (SUR) model was utilised to estimate the effects of sociodemographic and health factors on expenditure of oil and fats, processed foods, sugar-sweetened beverages and alcoholic drinks. Findings showed that income and household size were positively associated with expenditure on unhealthy foods. Individuals who were between 61 and 70 years old had higher expenditure on unhealthy foods than their younger counterparts. The Chinese spent less on certain unhealthy foods compared to the Malays. Being employed, having tertiary-level education, being married and living with chronic diseases increased spending on unhealthy foods. These findings suggest that the Malaysian government should consider increasing the tax on sugar-sweetened beverages and using health campaigns to educate the urban poor about the risks of unhealthy foods.

Keywords: Expenditure, poverty, sociodemographic factors, unhealthy foods, urban poor
JEL classification: D1, I1, R2

1. Introduction

Low-income households in developing countries tend to possess poorer health outcomes when compared with their high-income counterparts because they are likely to face difficulty in accessing healthcare (Peters et al., 2008). This difficulty is even more profound among people who fall into poverty. While limited financial resources are the main barriers to utilising healthcare, the causality between poverty and healthcare demand is often bidirectional (Peters et al., 2008; Yadav, 2007). When low-income people seek healthcare but do not have adequate incomes, health condition of low-income people becomes worse, which consequently results in income losses. Weak health conditions can hamper work performance and earnings potential, thereby leading to poverty, and this poverty, in turn, causes illnesses (O'Donnell, 2024). It appears that the causal relationship between use of healthcare and poverty is a vicious cycle, where poverty contributes to poor health and poor health is responsible for poverty (O'Donnell, 2024).

In Malaysia, there has been a continuous upward growth in the economy. Its economic performance improves at a rapid pace, making it as one of the fast-growing countries among developing Asian economies (Azam, 2020). As pointed out by Tey and Lai (2022), the fast economic growth in Malaysia is accompanied by rapid urbanisation, and this brings about a spike in the number of urban populations. By 2040, approximately 85% of Malaysians are predicted to live in urban areas (Tey & Lai, 2022). However, excessive growth in urban areas comes with costs. Large increases in economic activities and high concentration of people in urban areas pose a challenge to society (Tey & Lai, 2022). Inadequate infrastructures and insufficiency of social services, for instance, may elevate social costs and cause urban diseconomies (Tey & Lai, 2022).

This may, in turn, contribute to urban poverty. As a recent report from the Department of Statistics Malaysia shows, the rate of urban poverty throughout the country rose from 3.9% in 2019 to 4.5% in 2022 (Department of Statistics Malaysia, 2023).

Although Malaysia provides its citizens with universal healthcare access, barriers to the use of health services remain a serious issue faced by low-income urban dwellers. Abd Wahab et al. (2020, 2022) pointed out an important fact that financial barriers, such as being unable to bear medical fees and transportation costs were the main factors preventing poor urbanites of various sociodemographic traits from visiting health clinics. This could be one of the reasons why non-communicable diseases (NCDs) and mental disorders are prevalent in the urban poor population (Shahar et al., 2019a). For instance, Shahar et al. (2019b) found poor urbanites to have higher nutritional risk and greater disability than their counterparts with higher socioeconomic status, while Sherina et al. (2011) conducted their research in several metropolitan areas and also found incidence of diabetes and hypertension to be high among low-income urban dwellers.

One of the potential methods that may help low-income people escape from the vicious cycle that traps them in poverty is adoption of healthy lifestyles. When low-income people, particularly those living in poverty maintain healthy eating behaviours, their risk of developing diseases can be lowered, therefore reducing the demand for healthcare. Research shows that excessive consumption of dietary fats, most notably saturated fats can lead to hypercholesterolemia and consequently elevate the risk of heart disease (Steinberg, 2005). A published article, using an umbrella review, found significant positive relationships between consumption of processed foods and risks of cardiovascular disease, mental disorders and diabetes (Lane et al., 2024). There are also empirical findings suggesting that high intake of added sugar can cause cardiovascular disease and diabetes (Stanhope, 2016). The study by Room et al. (2005), confirming the adverse effects of alcohol on health, found alcohol drinking to be associated with an increased likelihood of cancer and coronary heart disease. Taken together, one can conclude that individuals should make a concerted effort to reduce their consumption of fats, processed foods, added sugar and alcohol so that their risk of developing chronic diseases can be minimised.

Owing to rapid urbanisation, consumption of unhealthy foods has been increasing steadily among the low-income population in Malaysia. According to the study by Eng et al. (2022), low-income adults in urban communities not only had high intake of ultra-processed foods but also calorie-dense local foods. In another study, Azizan et al. (2018) devoted attention to urban dwellers with poor economic backgrounds. The authors found that nearly one-third of poor urbanites did not adopt a healthy dietary lifestyle, and they tended to have excessive consumption of sweetened drinks and fast food. Moreover, Shahar et al. (2019a) highlighted that low-income adults, especially those residing in urban areas, were at risk of overnutrition. Because energy-dense foods were cheap, they were often chosen by people with limited financial resources (Alaini et al., 2019). Despite the serious nutritional issues involving the low-income population, there is a lack of in-depth study examining factors affecting consumption expenditure on unhealthy foods among the urban poor.

It is important to gain a better understanding of the determining factors of demand for unhealthy foods if more effective policies directed toward reducing consumption

of unhealthy foods are to be implemented. There are few studies that shed light on sociodemographic factors affecting consumption expenditure on various unhealthy foods among households in Malaysia. For example, Cheah et al. (2019) found that household heads' age, marital status and education levels played a significant role in determining household expenditure on sugar-sweetened foods and beverages. Using a double-hurdle model, Cheah et al. (2020) observed that households with high expenditure on alcohol were more likely to be those headed by well-educated or employed individuals. In another study by Cheah et al. (2023), the authors devoted their attention to Bumiputera and non-Bumiputera ethnic groups and found that households with younger and higher income heads tended to spend more on processed meat than those having older and lower income heads. While these studies provided important empirical findings on the determining factors of unhealthy food expenditure, they used dated data and did not focus on urban poverty.

Previous studies explored food expenditure across countries in Southeast Asia. For instance, in Thailand, Wongmonta (2022), using nationwide survey data and a food demand system, found that food expenditure patterns were affected by household size, proportion of older adults and household locality. Based on Indonesian data, Nurjati (2022) made use of panel regression and found significant relationships between expenditure on food, inflation and poverty. Drawing from data in Vietnam, Vu (2020) found income, household size, age and education to be significantly associated with demand for food. However, these studies did not pay special attention to unhealthy foods and urban poverty. Therefore, findings on how sociodemographic and health factors explain differences in expenditure on unhealthy foods among the urban poor in Southeast Asia are still lacking.

The objective of the present study is to investigate factors that determine consumption expenditure on various common unhealthy foods, such as oil and fats, processed foods, sugar-sweetened beverages and alcoholic drinks using different methodological approaches from past Malaysian studies (Cheah et al., 2019, 2020, 2023). Firstly, the target population in the present study is poor urbanites. Understanding unhealthy food spending behaviours in this population is vital in the sense that there are rapid and continuous increases in the incidence of poverty in urban areas and that poverty has significant impacts on health outcomes. Secondly, the present study develops a linear system of equations to examine factors affecting consumption expenditure on several types of unhealthy foods so that more precise estimated results can be generated. One of the factors that may have significant impacts on expenditure on unhealthy foods is education. It can affect unhealthy food consumption in several ways. These include improvement in productive and allocative efficiencies, better utilisation of healthcare services, and increase in the preference for delay satisfaction. While consumption of unhealthy foods yields utility, it possesses adverse effects on health. Hence, education may alter the preference for unhealthy foods. Thirdly, findings from this study may correspond with the latest phenomena in Malaysia because data from a more recent survey are utilised. Lastly, in addition to sociodemographic variables, several health variables are analysed in order to yield findings that are more useful for policy formulation.

2. Theoretical Framework

Grossman's (2000) demand for health capital theory discussed by Santerre and Neun (2013) provides the present study with an excellent framework for analysing factors affecting expenditure on unhealthy foods. Grossman claims that people have the ability to control their health to some extent. Although individuals' health is largely determined by genetics, lifestyle behaviours, such as physical activity, smoking and use of illicit drugs, as well as medical care utilisation possess significant impacts on health outcomes. According to Grossman, people are consumers and producers of health, that is, people demand and produce health at the same time. Health is seen as a capital good that generates returns of investment in terms of higher incomes. With good health status, people can be more productive and are less likely to be absent from work. Grossman stresses that demand for healthcare is a derived demand for health. People demand for health in the sense that they enjoy being free from illnesses, meaning that health is a consumption good that yields utility.

While Grossman's health capital theory remains the main model used in health economics, it has been critiqued by researchers. As discussed in the study by Sepehri (2015), the model has received several criticisms. First, the role of uncertainty in health status is not considered by the model. In reality, individuals are uncertain about the state and depreciation of their health; thus, their demand for medical care is unpredictable. Second, the effectiveness of medical care is ambiguous. Use of medical care improves health, but it does not guarantee complete recovery from illnesses or injuries. Third, although illnesses cause loss of productive and leisure time, the amount of loss is unclear as there are many uncertainties. Fourth, there is asymmetric information regarding health status and effectiveness of health inputs between consumers and providers. Consumers possess less knowledge of medical technology than providers, but they may know more about their health. Fifth, despite health can be improved via investment in health capital, the return of investment is subject to individuals' health status. A healthy body can easily be healed and has a better capability of converting health inputs into health investment. Sixth, the assumption of constant-returns-to-scale production may not be held. It is uncertain whether a higher output can be generated by using a higher input of healthcare. Also, to some extent, the presence of chronic diseases may prevent individuals from complete recovery. Seventh, the measure of health capital varies across individuals. For instance, individuals who have adapted to changes in health due to illnesses may not perceive their health as poor. Last, joint production, producing two goods from similar inputs, is left out. Not every illness is serious enough to prevent individuals from performing other activities, such as home production and work.

In spite of the criticisms, Grossman's demand for health capital theory can still be applied to gain insight into factors affecting unhealthy behaviours, such as alcohol drinking and excessive consumption of added sugar. Although these unhealthy behaviours are negative inputs into health, many people still engage in them. Grossman argues that consumers are rational and always seek to maximise their own utility. Therefore, rational consumers may indulge in unhealthy behaviours if they expect that the utility they could reap from those behaviours is greater than the costs. In the

present study, expenditure on unhealthy foods, such as oil and fats, processed foods, sugar-sweetened beverages and alcoholic drinks is treated as an unhealthy behaviour as it has adverse effects on health.

According to Grossman, three sociodemographic factors may affect health investment. These are age, income and education. Grossman points to the fact that health depreciation rate is positively associated with age. Owing to the biological process of aging, the depreciation rate is likely to increase when people grow older. Older people may therefore have a higher incentive to control the depreciation rate by investing in their health compared to their younger counterparts. Investments done today is expected to determine the stock of health capital tomorrow. Expenditure on unhealthy foods is considered unhealthy choices. Since older people are more concerned about their health and put more efforts into health improvement than younger ones, they may spend less money on unhealthy foods.

Based on Grossman's assumption, income can motivate people to invest in their health. Assuming income is an opportunity cost of being sick, people who earn higher incomes tend to face higher opportunity costs when compared to those who make less money. Given that health investment reduces the risk of illnesses, higher income recipients tend to invest more in their health than those with lower incomes. On the other hand, according to the standard economic principles, unhealthy foods are normal goods whereby their consumption increases with income (Cawley & Ruhm, 2012). Mathieu-Bolh (2022) assessed Cawley and Ruhm's (2012) theory by conducting a review of studies on the income-obesity relationship. Findings from the review showed that income was positively correlated with obesity in developing countries but negatively correlated in developed countries, which partially lent support to the argument of Cawley and Ruhm (2012). Since unhealthy foods are normal goods and have adverse impacts on health, their expenditure may be affected by income, especially in light of the fact that income influences the preference for healthy lifestyles and consumption behaviours.

A positive association between education and health has been emphasised by Grossman. Holding the income factor constant, better educated people tend to have better health outcomes than less educated people. There are several reasons for this claim. First, education improves the productive efficiency of health. Better educated people are able to gain more health from health inputs than the less educated because they have better health knowledge and interpreting skills. Second, higher education is linked to better allocative efficiency (Viinikainen et al., 2022). In other words, better educated individuals have a higher tendency to choose inputs that can improve health compared to the less educated. Therefore, they are more likely to make healthy choices. Third, higher education leads to better use of healthcare services, resulting in adoption of healthier lifestyles (Cutler & Lleras-Muney, 2010). Fourth, as pointed out by Cawley and Ruhm (2012), education reduces the rate of time preference. Better educated people are more future oriented than less educated people and consequently are more devoted to health improvement. This theory has been tested by Viinikainen et al. (2022), who made use of Finnish data. The authors found that better educated people smoked less and were more likely to adopt healthy lifestyles compared to their less educated counterparts, which was consistent with Cawley and

Ruhm's (2012) argument. Since the theory developed by Cawley and Ruhm (2012) is supported by recent empirical studies and data, it is still relevant and appropriate to the present study, especially given that the theory provides economic insights into factors determining unhealthy lifestyle behaviours. Considering the role of education in health behaviours mentioned above, better educated people may spend less on unhealthy foods compared to the less educated because consumption of unhealthy foods is seen as an unhealthy choice.

3. Insights from Empirical Literature

The effects of the main variables discussed by Grossman – age, income and education – on consumption of unhealthy foods were examined in past empirical studies across the globe. In terms of age, the study by Yuan and Yen (2012), using the National Health and Nutrition Examination Survey, found age to be associated with alcohol consumption with older adults being less likely to spend on alcohol than their younger counterparts. There was also evidence suggesting that older people in Saudi Arabia had lower odds of consuming added sugar compared with younger people (Al-Hanawi et al., 2022). More recently, Cheah et al. (2020) made use of Malaysian data and a two-part model, and found an opposite result that age was positively associated with alcohol expenditure. Cultural differences could be the reason explaining why the findings from Cheah et al. (2020) contradict those of Yuan and Yen (2012). Different from the USA, the majority of Malaysians are Muslims, and they are not allowed to consume alcohol. This denotes that only a small number of people in Malaysia indulge in alcohol drinking. Therefore, there exist disparities in alcohol consumption pattern in these two countries. Moreover, drawing from data in Switzerland, Marques-Vidal et al. (2018) observed that older people were more likely to consume food with high fat and sugar contents than younger people. In northern Kenya, Matata et al. (2022) also found that oil and fat consumers were more likely to be older adults. However, based on data in Colombia, evidence from Khandpur et al. (2020) suggested otherwise with older people being less likely to consume ultra-processed foods compared to their younger counterparts. This may be because older adults in Colombia have more stable eating practices than those in Switzerland and Kenya.

The effect of income on unhealthy food consumption identified in earlier studies was mixed. Although the study by Park et al. (2013) was conducted many years ago, it provided outstanding insights into factors affecting added sugar intake. In particular, the authors, using the National Health Interview Survey, found that higher income individuals had a higher likelihood of consuming added sugar compared to their lower income counterparts. This result was reaffirmed by Farrell et al. (2019), who examined sociodemographic factors associated with consumption of certain types of food among women in Samoan. The authors found evidence that high socioeconomic status was correlated with high consumption of fattening food. Cheah et al. (2023), using data from a Malaysian household expenditure survey with a large sample size, concluded that high income was one of the main factors contributing to high intake of processed foods. Collectively, these findings indicate that regardless of the economic status of countries, higher incomes lead to higher consumption of various unhealthy foods. However, there

were several studies that reached contradictory conclusions. These included the studies by Al-Hanawi et al. (2022), which found that consumption of added sugar was lower among higher income adults in Saudi Arabia, as well as Horton et al. (2018), which identified income to be not associated with dietary fat intake within a sample of youths in the USA. Perhaps this is due to socioeconomic differences in the studied populations.

The relationship between education and demand for unhealthy foods found in empirical studies was ambiguous but noteworthy. In the USA, Yuan and Yen (2012) found that better educated individuals were more likely to consume alcohol than less educated individuals. A similar finding was evidenced in Malaysia, where Cheah et al. (2020) found educational levels to be associated with increased demand for alcohol. Using data in Turkey, Ünver and Alkan (2024) also observed that better educated women tended to consume more alcohol than their less educated counterparts because they had higher incomes. Taken together, these findings imply that though there are cultural differences across countries, the effect of education on alcohol consumption is consistent. In terms of processed foods, Olinto et al. (2010) devoted their attention to Brazilian adults. They found that processed food intake was higher among better educated adults. However, findings from a study conducted in Switzerland suggested that education reduced consumption of processed foods (Marques-Vidal et al., 2018). Likewise, Baraldi et al. (2018) used the National Health and Nutrition Examination Survey and identified that ultra-processed food consumption was negatively associated with academic qualifications among consumers of all age groups. While the actual explanation for these contradictory results is unclear, the differentiated roles of education across socioeconomic status in demand for processed foods can be the plausible reason. Well-educated people in developed countries should have better socioeconomic backgrounds than those in developing countries; thus, they tend to have lower preference for processed foods.

It is apparent that the studies related to consumption of unhealthy foods are ample but those with a focus on the urban poor are scant. Majority of the studies concentrated on general population and did not consider a wide range of unhealthy foods. The recent issue as to whether unhealthy foods should be targeted in combating the rise of chronic diseases in the low-income urban population justify more studies on factors affecting unhealthy food expenditure throughout the world, especially developing countries.

4. Methods

4.1 Data

Secondary analysis of data derived from the South East Asia Obesogenic Food Environment (SEAOFE) study was performed. The main objective of the SEAOFE study was to gain information on the retail food environment, factors affecting food demand and supply among consumers and retailers, as well as policies that influenced food retail. The SEAOFE study was conducted in several countries in Southeast Asia, namely, Malaysia, Indonesia, the Philippines and Thailand, and consisted of four phases of implementation. Only data collected in Phase Two in Malaysia were used in the

current analysis. In this phase, a consumer intercept survey was conducted to examine perception of retail food environment as well as expenditure on foods in food retailers among low-income consumers in selected urban poor areas in the Federal Territory of Kuala Lumpur (KL). KL is the largest city in Malaysia and consists of many poor urban dwellers. Urban poor areas were located using analytical hierarchy process (AHP), which was a method used to restrict the study locations and food retailers. Eligible retail stores in the urban areas were identified using Quantum Geographic Information System (QGIS) version 3.18.

Proportionate stratified sampling was used to collect data. Inclusion criteria were consumers who aged at least 18 years and reported purchasing foods in the selected food retailers. A total of 1004 respondents were surveyed using face-to-face interviews. The questionnaires were written in English and comprised numerous questions surrounding respondents' sociodemographic traits, health profiles, preference for food shopping and perception of food retailers. The questionnaires also asked about the types of foods purchased by the respondents and how much the respondents spent on those foods. To minimise non-sampling error, a pilot test and training were conducted prior to the interviews. The survey period was from March 2022 to October 2022. Respondents who did not provide written consent were not allowed to take part in the survey. The Research Ethics Committee of a local university gave ethical approval on 28 June 2021. More details about the survey were described elsewhere (Phulkard et al., 2022).

4.2 Variables

The dependent variables of the present study, monthly expenditure on several types of unhealthy foods, were formatted as continuous variables. Specifically, the variables consisted of four types of unhealthy foods: 1) oil and fats (e.g. ghee and lard); 2) processed foods (e.g. processed meat, chips, chocolate and confectionery); 3) sugar-sweetened beverages (e.g. energy drinks, soft drinks and sport drinks); and 4) alcoholic drinks. These unhealthy foods were selected in light of the availability of data. Also, they were commonly consumed by people in Malaysia. The unit of measurement of these variables was Ringgit Malaysia (RM).

The main independent variables used in the present study consisted of the three variables discussed in the Theoretical Framework and Literature Review sections, that is, age, income and education. Respondents' age was categorised into six categories: 18–30, 31–40, 41–50, 51–60, 61–70 and ≥70 years. Respondents' self-reported monthly individual incomes (RM) were treated as a continuous variable. Respondents' educational attainments consisted of three categories (primary, secondary and tertiary).

Other common sociodemographic variables that were considered in previous empirical studies, such as household size, gender, ethnicity, employment status and marital status, were used as additional independent variables in the present study (Al-Hanawi et al., 2022; Cheah et al., 2019, 2021; Friis et al., 2014; Lenz et al., 2009; Wongmonta, 2022). For instance, Cheah et al. (2019) highlighted that the number of household members was positively associated with expenditure on added sugar whereas households headed by males and non-Bumiputera tended to spend less than

those with female and Bumiputera heads. Al-Hanawi et al. (2022) found employed individuals to consume more sugar-sweetened beverages than their unemployed counterparts. Cheah et al. (2021) identified that being married was associated with increased expenditure on oil and fat products.

Respondents' household size was treated as a continuous variable. Gender referred to respondents' biological sex. Respondents' ethnic backgrounds were grouped into four categories: Malay, Chinese, Indian and other ethnicities. The questionnaires also asked about respondents' current employment status. The plausible answers were 'employed' and 'unemployed' (e.g. housewife, student and retired). Respondents' marital status consisted of three categories (married, divorced/widowed and single).

In addition to sociodemographic variables, two health variables were considered in the present study, that is, body mass index (BMI) and chronic diseases. These two health variables may affect the decisions of consumers to spend money on unhealthy foods as they may reflect respondents' health awareness. BMI was calculated based on the information on weight and height reported by respondents. Chronic diseases listed in the questionnaires included cardiovascular disease, cancer, diabetes and hypertension.

4.3 Statistical Analysis

Prior to estimating the regressions, one-way ANOVA was used to explore socio-demographic and health differences in the means of expenditure on oil and fats, processed foods, sugar-sweetened beverages and alcoholic drinks. Next, the present study used a seemingly unrelated regressions (SUR) model, that is, a linear system of equation, to examine factors affecting expenditure on four types of unhealthy foods. SUR was estimated using feasible generalised least squares (FGLS). Its equations can be written as:

$$y_1 = \mathbf{x}_1\boldsymbol{\beta}_1 + u_1$$

$$y_2 = \mathbf{x}_2\boldsymbol{\beta}_2 + u_2$$

$$y_3 = \mathbf{x}_3\boldsymbol{\beta}_3 + u_3$$

$$y_4 = \mathbf{x}_4\boldsymbol{\beta}_4 + u_4$$

where y_1 is oil and fats, y_2 is processed foods, y_3 is sugar-sweetened beverages, y_4 is alcoholic drinks, $\mathbf{x}$ denotes the independent variables, $\boldsymbol{\beta}$ indicates parameters, and u refers to error terms. Since each equation in the system has its own parameters and errors, the equations are unrelated. In other words, the errors are uncorrelated with the independent variables in all the equations. Nevertheless, the errors in different equations are assumed to be correlated. Therefore, use of ordinary least square (OLS) to estimate each equation separately may not be the best approach. Furthermore, FGLS can generate more efficient estimators than OLS equation by equation. A more thorough discussion about SUR is provided in Chapter 7 of Wooldridge (2010).

In order to ensure that SUR did not have potential specification error, we performed a link test by Pregibon (1980) for each equation separately. Overall significance of the regression was assessed using F-statistic. Moreover, computing the variance inflation factor (VIF) is important for detecting plausible multicollinearities. p -values of

less than 0.05 were selected as the levels of significance. The Stata statistical software was used to perform all the statistical tests (StataCorp, 2019).

5. Results

Summary statistics of variables are presented in Table 1. On average, a respondent spent around RM18.94, RM102.67, RM6.30 and RM1.73 on oil and fats, processed foods, sugar-sweetened beverages and alcoholic drinks per month, respectively. The mean of monthly household income was RM2326.74. The average household size was approximately 4 members. The majority of respondents were males (64.54%). Slightly more than half of the respondents aged between 18 and 30 years (53.09%), were unemployed (55.18%) and were single (53.39%). The BMI breakdown consisted of 8.86% underweight, 31.77% normal weight, 17.23% overweight and 42.13% obese. About two-third of the respondents were Malays (66.24%), while only less than one-tenth were Indians (7.57%) and those of other ethnic groups (2.29%). A large proportion of the respondents had tertiary-level education (60.36%), followed by those with secondary- (32.27%) and primary-level education (7.37%). Out of the total respondents, approximately one-third (33.17%) had chronic diseases.

Table 2 shows sociodemographic and health differences in average monthly expenditure on oil and fats, processed foods, sugar-sweetened beverages, and alcoholic drinks. In general, males spent more on processed food (RM108.43 vs. RM99.50) and sugar-sweetened beverages (RM7.45 vs. RM5.67) than females. Among the respondents of all age groups, those aged between 31 and 40 years had the highest expenditure on oil and fats (RM25.78), processed foods (RM138.36) and sugar-sweetened beverages (RM8.70). Expenditure on oil and fats (RM22.21) and sugar-sweetened beverages (RM7.39) was the highest among obese respondents. Of all the ethnic groups, Malays had the highest expenditure on sugar-sweetened beverages (RM7.14), whereas Chinese allocated the largest amount of money to alcoholic beverages (RM5.57). An employed respondent spent around RM22.76, RM119.90 and RM7.91 on oil and fats, processed food and sugar-sweetened beverages, respectively. Respondents with tertiary-level education spent approximately RM111.12 on processed foods. Married respondents had higher expenditure on oil and fats (RM25), processed food (RM119.66) and sugar-sweetened beverages (RM7.24) than the divorced/widowed and single. The differences between the amount of money spent on oil and fats, and processed foods by respondents with and without chronic diseases were RM5.93 and RM18.47, respectively.

Table 3 illustrates the results for SUR for expenditure on oil and fats, processed foods, sugar-sweetened beverages, and alcoholic drinks. In terms of the link test, the prediction squared of all the equations was insignificant, except the equation for alcoholic drinks. This indicated that only alcoholic drinks specification was not very good. Nevertheless, all the independent variables were jointly significant in affecting the dependent variables. Moreover, multicollinearity was not detected in all the equations as the VIFs were less than ten (Wooldridge, 2020).

An increase of RM100 in monthly household income raised expenditure on oil and fats, processed foods and sugar-sweetened beverages by RM0.12, RM0.71 and RM0.03, respectively. An additional member of household increased expenditure on oil and fats,

Table 1. Summary statistics of variables (n = 1004)

Variables	Mean	Std. dev.	Frequency	Percent
<i>Continuous</i>				
Oil and fats	18.94	22.46	—	—
Processed food	102.67	124.99	—	—
Sugar-sweetened beverages	6.30	10.37	—	—
Alcoholic drinks	1.73	11.49	—	—
Income (RM)	2326.74	2673.36	—	—
Household size	4.02	1.93	—	—
<i>Categorical</i>				
Gender				
Male	—	—	648	64.54
Female	—	—	356	35.46
Age (years)				
18–30	—	—	533	53.09
31–40	—	—	150	14.94
41–50	—	—	130	12.95
51–60	—	—	93	9.26
61–70	—	—	66	6.57
≥70	—	—	32	3.19
Body mass index (BMI)				
Underweight	—	—	89	8.86
Normal weight	—	—	319	31.77
Overweight	—	—	173	17.23
Obese	—	—	423	42.13
Ethnicity				
Malay	—	—	665	66.24
Chinese	—	—	240	23.90
Indian	—	—	76	7.57
Others	—	—	23	2.29
Employed				
Yes	—	—	450	44.82
No	—	—	554	55.18
Education				
Primary	—	—	74	7.37
Secondary	—	—	324	32.27
Tertiary	—	—	606	60.36
Marital status				
Married	—	—	419	41.73
Divorced/widowed	—	—	49	4.88
Single	—	—	536	53.39
Chronic diseases				
Yes	—	—	333	33.17
No	—	—	671	66.83

Source: SEAOFÉ.

Table 2. Average monthly expenditure on oil and fats, processed food, sugar-sweetened beverages and alcoholic drinks by categorical variables (n = 1004)

Variables	Oil and fats	Processed food	Sugar-sweetened beverages	Alcoholic drinks
Gender				
Male	20.47 (24.28)	108.43 (135.45)	7.45 (11.70)	2.06 (13.37)
Female	18.09 (21.37)	99.50 (118.84)	5.67 (9.51)	1.56 (10.31)
<i>p</i> -value	0.108	0.005	0.009	0.507
Age (years)				
18–30	14.26 (20.32)	95.93 (118.23)	5.87 (10.13)	0.98 (6.39)
31–40	25.78 (27.66)	138.36 (163.77)	8.70 (11.21)	3.65 (19.75)
41–50	24.05 (22.02)	122.39 (101.62)	7.28 (10.67)	1.37 (6.15)
51–60	24.14 (20.79)	87.06 (123.13)	5.57 (10.96)	0.43 (2.52)
61–70	23.87 (22.79)	84.03 (127.17)	5.17 (9.65)	6.86 (26.07)
≥70	18.59 (18.12)	51.26 (44.68)	2.77 (6.05)	0 (0)
<i>p</i> -value	<0.001	<0.001	0.010	<0.001
Body mass index (BMI)				
Underweight	16.41 (26.83)	96.93 (114.62)	6.56 (11.92)	0.62 (3.83)
Normal weight	15.36 (19.40)	88.55 (116.45)	5.09 (8.11)	2.55 (12.40)
Overweight	18.82 (20.00)	104.04 (91.71)	5.73 (8.58)	0.95 (5.40)
Obese	22.21 (24.10)	113.97 (143.03)	7.39 (12.00)	1.67 (13.48)
<i>p</i> -value	<0.001	0.052	0.022	0.351
Ethnicity				
Malay	19.31 (20.84)	112.81 (129.32)	7.14 (11.13)	0.18 (1.68)
Chinese	16.00 (24.72)	74.51 (89.34)	3.98 (8.13)	5.57 (21.37)
Indian	22.18 (19.81)	92.08 (112.85)	6.25 (9.49)	2.71 (13.12)
Others	28.07 (41.14)	138.33 (252.69)	6.35 (7.59)	3.48 (11.91)
<i>p</i> -value	0.021	<0.001	<0.001	<0.001
Employed				
Yes	22.76 (24.21)	119.90 (132.07)	7.91 (11.32)	2.04 (13.05)
No	15.83 (20.43)	88.68 (117.19)	5.00 (9.34)	1.48 (10.04)
<i>p</i> -value	<0.001	<0.001	<0.001	0.444

Table 2. Continued

Variables	Oil and fats	Processed food	Sugar-sweetened beverages	Alcoholic drinks
Education				
Primary	19.82 (17.31)	64.76 (68.09)	5.12 (8.23)	0.65 (3.30)
Secondary	20.42 (20.80)	95.53 (94.21)	6.66 (11.36)	1.61 (11.18)
Tertiary	18.04 (23.82)	111.12 (142.57)	6.25 (10.05)	1.93 (12.27)
<i>p</i> -value	0.287	0.005	0.508	0.643
Marital status				
Married	25.00 (23.69)	119.66 (141.03)	7.24 (10.86)	2.10 (12.03)
Divorced/widowed	19.72 (17.94)	71.21 (77.42)	6.40 (11.35)	0.20 (1.43)
Single	14.13 (20.66)	92.26 (113.07)	5.56 (9.83)	1.59 (11.57)
<i>p</i> -value	<0.001	<0.001	0.046	0.504
Chronic diseases				
Yes	22.90 (22.18)	90.33 (89.61)	5.56 (10.08)	1.47 (10.33)
No	16.97 (22.36)	108.80 (138.90)	6.67 (10.50)	1.87 (12.03)
<i>p</i> -value	<0.001	0.027	0.112	0.602

Note: Standard deviations in parentheses. The *p*-value is based on one-way ANOVA.
Source: SEAOFFE.

Table 3. Seemingly unrelated regression for expenditure on oil and fats, processed foods, sugar-sweetened beverages and alcoholic drinks (n = 1004)

Variables	Oil and fats	Processed food	Sugar-sweetened beverages	Alcoholic drinks
Constant	-4.829 (3.863)	21.942 (22.088)	3.081 (1.864)	-3.667 (2.044)
Income (RM/100)	0.113* (0.030)	0.710* (0.171)	0.031* (0.014)	0.025 (0.016)
Household size	2.166* (0.360)	7.638* (2.058)	0.449* (0.174)	0.109 (0.190)
Gender				
Male	0.844 (1.461)	-4.441 (8.351)	1.069 (0.705)	0.144 (0.773)
Female	Ref.	Ref.	Ref.	Ref.
Age (years)				
18–30	Ref.	Ref.	Ref.	Ref.
31–40	4.064 (2.458)	9.472 (14.053)	0.193 (1.186)	3.499* (1.301)
41–50	1.203 (2.761)	-5.169 (15.787)	-1.291 (1.332)	1.510 (1.461)
51–60	2.918 (3.145)	-18.819 (17.981)	-2.277 (1.517)	1.247 (1.664)

Table 3. Continued

Variables	Oil and fats	Processed food	Sugar-sweetened beverages	Alcoholic drinks
61–70	6.126* (3.560)	-2.856 (20.355)	-1.843 (1.717)	8.097* (1.884)
≥70	4.749 (4.859)	-10.298 (27.778)	-2.593 (2.344)	1.326 (2.571)
Body mass index (BMI)				
Underweight	2.387 (2.528)	10.990 (14.452)	1.974 (1.219)	-2.126 (1.338)
Normal weight	Ref.	Ref.	Ref.	Ref.
Overweight	1.143 (2.019)	10.278 (11.540)	0.196 (0.974)	-1.877 (1.068)
Obese	1.452 (1.700)	12.748 (9.719)	1.329 (0.820)	-0.471 (0.899)
Ethnicity				
Malay	Ref.	Ref.	Ref.	Ref.
Chinese	-0.943 (1.688)	-29.199* (9.649)	-2.242* (0.814)	5.381* (0.893)
Indian	1.660 (2.667)	-5.104 (15.248)	-0.638 (1.287)	3.047* (1.411)
Others	9.544* (4.462)	30.565 (25.507)	-0.790 (2.152)	2.944 (2.361)
Employed				
Yes	2.996* (1.609)	6.750 (9.199)	1.400* (0.776)	-0.170 (0.851)
No	Ref.	Ref.	Ref.	Ref.
Education				
Primary	Ref.	Ref.	Ref.	Ref.
Secondary	3.551 (3.095)	19.347 (17.693)	0.052 (1.493)	2.786* (1.637)
Tertiary	4.845 (3.252)	35.169* (18.591)	-0.484 (1.569)	3.261* (1.721)
Marital status				
Married	5.548* (2.171)	19.549 (12.413)	1.179 (1.047)	-0.988 (1.149)
Divorced/widowed	2.932 (3.822)	8.053 (21.852)	2.602 (1.844)	-2.974 (2.022)
Single	Ref.	Ref.	Ref.	Ref.
Chronic diseases				
Yes	4.611* (1.539)	-11.823 (8.798)	-0.822 (0.742)	-0.552 (0.814)
No	Ref.	Ref.	Ref.	Ref.
Prediction squared#	-0.006 (0.007)	0.001 (0.002)	0.012 (0.038)	0.194 (0.025)
p-value	0.417	0.816	0.758	<0.001
F-statistic	7.880	4.870	3.090	4.120
p-value	<0.001	<0.001	<0.001	<0.001
Maximum VIF			5.850	

Note: Standard errors in parentheses. Ref. refers to reference group. #Prediction squared generated from the link test. *p<0.05.

Source: SEAOFÉ.

processed foods and sugar-sweetened beverages by RM2.16, RM7.64 and RM0.45, correspondingly. Compared to respondents aged 18–30, those aged 31–40 spent RM3.50 more on alcoholic drinks, while those aged 61–70 spent RM6.13 and RM8.10 more on oil and fats, and alcoholic drinks, respectively. The Chinese spent RM29.20 and RM2.24 less on processed foods and sugar-sweetened beverages, correspondingly, but spent RM5.38 more on alcoholic drinks than Malays. If the respondents were employed, their expenditure on oil and fats increased by RM3 and their expenditure on sugar-sweetened beverages increased by RM1.40. Respondents with tertiary-level education had RM35.17 and RM3.26 higher expenditure on processed foods and alcoholic drinks, respectively, than those with primary-level education. Being married (RM5.55) and having chronic diseases (RM4.61) were associated with higher expenditure on oil and fats.

6. Discussion

The spike in the prevalence of various NCDs is a significant public health problem that requires urgent attention. Despite the important role of healthy diets in NCD prevention, many poor urban dwellers in Malaysia spend a large amount of money on unhealthy foods, especially processed foods. The present study found that unhealthy food expenditure among the urban poor was affected by numerous sociodemographic and health factors.

Positive relationships existed between household income and expenditure on oil and fats, processed foods, and sugar-sweetened beverages. Although these findings do not support the evidence of Al-Hanawi et al. (2022) that income reduced consumption of added sugar, as well as Grossman's (2000) theory that high-income promoted healthy lifestyles, they lead to a conclusion that oil and fats, processed foods, and sugar-sweetened beverages are normal goods. This is consistent with the argument of Cawley and Ruhm (2012) that the demand for unhealthy goods increases with income if unhealthy goods are normal goods. Several previous studies also found a positive association between income and demand for unhealthy foods. For instance, Cheah et al. (2023) found that higher income recipients had a better financial background than their lower income counterparts and thus were able to spend more on processed foods. Farell et al. (2019) stressed that individuals of higher socioeconomic status spent more on high fat food than those with a poorer economic background. Furthermore, Park and her colleagues observed family income to be positively associated with consumption of sugar-added beverages (Park et al., 2013).

In the present study, poor urbanites spent more on oil and fats, processed foods, and sugar-sweetened beverages as their family size increased. Economies of scale may be a contributing factor to this outcome. As Ricciuto et al. (2006) mentioned, the average cost of purchasing food reduced when household size became larger. Similar findings were evidenced by Cheah et al. (2019), who found that household size was associated with increased expenditure on sugar-sweetened foods and beverages. Focusing on other types of food, Adebayo et al. (2017) and Wongmonta (2022) also found a positive relationship between household size and food consumption. The authors claimed that added dietary variations in large households was the reason.

Age was associated with expenditure on unhealthy foods with older poor urbanites spending more money on oil and fats, and alcoholic drinks than their younger peers. This finding contradicts not only those of Yuan and Yen (2012) and Khandpur et al. (2020), but also the theory of Grossman (2000). According to Grossman (2000), older individuals should consume less unhealthy foods than their younger counterparts because unhealthy foods are harmful to health. Despite these contradictions, the present study's finding is consistent with the evidence of Cheah et al. (2020) that age increased expenditure on alcohol, as well as the findings of Marques-Vidal et al. (2018) that fatty and sugary food consumers were more likely to be older adults. In a more recent study, Matata et al. (2022) also found age to have a positive effect on expenditure on oil and fats.

There were ethnic differences in expenditure on unhealthy foods. While Chinese consumed less processed foods and sugar-sweetened beverages than Malays, they spent more on alcoholic drinks. On average, a Chinese consumer spent almost RM6 on alcohol per month whereas a Malay spent only RM0.18. The actual reason for this outcome was not verified in the present study but culture could be the plausible contributing factor. For instance, Cheah et al. (2020) found that Malays were less likely to consume alcohol when compared to Chinese because alcohol was not permitted to be consumed by Muslims according to Islamic religion whereas it was a common beverage for Chinese, especially during the Chinese traditional festivals. It is also noteworthy that the higher preference for processed foods and sugar-sweetened beverages among Malays may explain why diabetes and obesity are more prevalent in the Malay population than Chinese (Akhtar et al., 2022; Ghee, 2016).

Employment status was associated with consumption of unhealthy foods as employed poor urbanites spent more on oil and fats, and sugar-sweetened beverages than the unemployed. The explanation for this outcome is straightforward. Because employed people have better financial capability and less budget constraint, they are able to allocate more money to foods. Findings from the studies by Al-Hanawi et al. (2022), Cheah et al. (2019) and Friis et al. (2014) likewise showed that employed individuals were more likely to consume and spent more on added sugar than their unemployed counterparts. However, Evans and her colleagues suggested otherwise (Evans et al., 2000). They argued that employed individuals had better socioeconomic status than those of unemployed and consequently possessed better health awareness.

In contrast to health economic theories, better educated poor urban dwellers, especially those with tertiary educational attainment spent more on processed foods and alcoholic drinks than their less educated counterparts. In fact, better educated people have better health awareness and higher preference for healthy foods (Santerre & Neun, 2013; Viinikainen et al., 2022). Thereby, unhealthy food consumers should be more likely to be people with a poor educational background. Also, Cawley and Ruhm's (2012) argument that better educated people are more patient and future oriented is not supported by the present study. Nonetheless, past empirical findings related to education and alcohol consumption are in line with the evidence of the present study. For instance, Cheah et al. (2020), Ünver and Alkan (2024) and Yuan and Yen (2012), consistently found that the probability of alcohol drinking as well as expenditure on alcohol were higher among well-educated individuals than the less educated. This

was simply attributed to the fact that better educated adults tended to experience profounder work-related stress induced by higher job responsibilities; thus, they were more likely to indulge in alcohol drinking (Cheah et al., 2020). In addition, results of the present study pertaining to processed foods are in agreement with those of Olinto et al. (2010) that better educated people are more likely to consume processed foods than less educated people.

While the role of marital status in expenditure on unhealthy foods was not as important as other sociodemographic factors as it only had a significant effect on expenditure on oil and fats, it was worthy of note. Specifically, married poor urbanites spent more on oil and fats when compared with their single peers. This finding does not lend support to the evidence of past studies that single adults consumed more fattening and sugar-sweetened foods than the married (Al-Hanawi et al., 2022; Lenz et al., 2009), but it is consistent with the results from the study by Cheah et al. (2021), which showed that households with married heads allocated more money to oil and fat products than those with single heads. A likely explanation for the present study's finding is that presence of children in a family, especially adolescents may increase consumption of fattening food.

With regard to the health variables, BMI was not a significant determinant of expenditure on unhealthy foods, but presence of chronic disease was. Particularly, individuals who had chronic diseases tended to spend more on oil and fats compared to those without chronic diseases. This finding is somewhat surprising as one may expect that people who suffer from diseases should be more aware of their health than those who do not; thus, they are more inclined to avoid consumption of unhealthy foods. An in-depth qualitative study can be carried out to seek the actual reason that explains why chronic diseases are positively associated with spending on oil and fats. Of note, the nature of cross-sectional data may explain why BMI was not associated with unhealthy food expenditure. It is believed that consumption of unhealthy foods affects BMI, instead of the other way around. However, due to cross-sectional data, such bidirectional causalities could not be examined, thereby generating insignificant results.

There were no gender variations in expenditure on unhealthy foods. This finding is somewhat consistent with that of Dahal et al. (2022), which showed no significant relationship between gender and dietary practice. This may be because in the urban poor community, men and women are not very concerned about healthy eating. Instead, they focus more on food security. Therefore, even though women may have better health awareness than men, they may not put more efforts into making healthy food choices if they live in poverty.

Based on the findings of the present study, several policies directed toward reducing consumption expenditure on unhealthy foods among poor urban dwellers are recommended. First, in light of the role of income in unhealthy food expenditure, the Malaysian government may want to consider raising the tax on sugar-sweetened beverages. The current sugary drink tax imposed by the government is 50 cents per litre on ready-to-drink beverages with a sugar level exceeding 5 grams per 100ml, such as sports drinks, soft drinks and energy drinks, but it may be too low and can be increased. Additionally, the government can regulate food ingredients and nutritional content in an effort to reduce consumption of processed foods. Second, use of health

campaigns to educate older poor urbanites, especially those aged between 61 and 70 years about the risks of oil and fats, and alcoholic drinks is worthy of consideration. The government must ensure that the information provided by the campaigns must be easily understood.

Third, policymakers are advised to devote their special attention to lowering consumption of alcohol among Chinese whereas reducing demand for processed foods and sugar-sweetened beverages within the Malay community. Health professionals from various ethnic groups can be invited to co-organise multilingual health awareness campaigns to advertise the adverse effects of unhealthy foods. Fourth, employers are urged to organise various health promotion programmes at workplaces with a focus on promoting healthy lifestyles among employees. This is because the present study found that the employed urban poor tended to spend more on unhealthy foods than the unemployed. Incentives can be given to those who have made changes to their lifestyles by adopting and portraying healthy eating behaviours.

The present study is not without its limitations. First, the current analysis was unable to shed light on the causalities between variables because of cross-sectional data. Second, although the data had a large sample size, they may not be nationally representative because the data were collected in the selected urban poor communities. Third, only four types of unhealthy foods were examined. Fourth, information on quantity demanded was unavailable, otherwise income elasticity of demand for unhealthy foods could be estimated. Last, expenditure on alcoholic drinks may be partly affected by unobserved hereditary and health variables, but these variables were not included in the analysis due to data limitation. Notwithstanding these shortcomings, the present study is the first to our knowledge to explore sociodemographic and health factors affecting consumption expenditure on oil and fats, processed foods, sugar-sweetened beverages and alcoholic drinks within a large sample of poor urban dwellers in Malaysia. Furthermore, the data used in the present study are comprehensive, thereby, allowing the current analysis to take a wide range of variables into account. Use of panel data to explore the causal effect of demand for unhealthy foods on the risks of NCDs is suggested to be the scope of future research. The effects of cultural factors on food consumption behaviours can also be explored if data allow.

7. Conclusion

High demand for unhealthy foods among the urban poor is seen as a threat to lowering the prevalence of NCDs in Malaysia. The present study found differentiated effects of sociodemographic and health factors on unhealthy food expenditure. Three main results are noteworthy. First, income is positively associated with expenditure on oil and fats, processed foods and sugar-sweetened beverages, indicating that unhealthy foods are normal goods for poor urban consumers. Second, older poor urban dwellers spend more on oil and fats, and alcoholic drinks compared to younger ones. This implies that despite health deterioration increases with age, the preference for certain unhealthy foods is greater among older adults living in poverty. Third, although better educated poor urbanites have better health awareness and are more future oriented than their less educated counterparts, they are likely to spend more on processed foods and

alcoholic drinks. Taken together, these key findings imply that the roles of income, age and education as the determinants of expenditure on unhealthy foods should be given consideration when formulating policies aimed at increasing the tax on sugary drink, organising health campaigns and designing health promotion programmes.

References

- Abd Wahab, S.N., Mohd Satar, N.H., & Tumin, M. (2020). Socio-demographic factors and structural barrier in accessing public clinics among the urban poor in Malaysia. *Journal of Social Sciences and Humanities*, 17(3), 71–81. <https://ejournals.ukm.my/ebangi/article/view/39061/10392>
- Abd Wahab, S.N., Mohd Satar, N.H., & Tumin, M. (2022). Urban poor: Evidence of barriers in accessing public clinics in Kuala Lumpur, Malaysia. *Malaysian Journal of Public Health Medicine*, 22(1), 193–204. <https://doi.org/10.37268/mjphm/vol.22/no.1/art.1148>
- Adebayo, F.A., Itkonen, S.T., Koponen, P., Prättälä, R., Härkänen, T., Lamberg-Allardt, C., & Erkkola, M. (2017). Consumption of healthy foods and associated socio-demographic factors among Russian, Somali and Kurdish immigrants in Finland. *Scandinavian Journal of Public Health*, 45(3), 277–287. <https://doi.org/10.1177/1403494817693457>
- Akhtar, S., Abdul Nasir, J., Ali, A., Asghar, M., Majeed, R., & Sarwar, A. (2022). Prevalence of type-2 diabetes and prediabetes in Malaysia: A systematic review and meta-analysis. *PLoS ONE*, 17(1), Article e0263139. <https://doi.org/10.1371/journal.pone.0263139>
- Al-Hanawi, M.K., Ahmed, M.U., Alshareef, N., Qattan, A.M.N., & Pulok, M.H. (2022). Determinants of sugar-sweetened beverage consumption among the Saudi adults: Findings from a nationally representative survey. *Frontiers in Nutrition*, 9, Article 744116. <https://doi.org/10.3389/fnut.2022.744116>
- Alaini, R., Rajikan, R., & Elias, S.M. (2019). Diet optimization using linear programming to develop low cost cancer prevention food plan for selected adults in Kuala Lumpur, Malaysia. *BMC Public Health*, 19(S4), Article 546. <https://doi.org/10.1186/s12889-019-6872-4>
- Azam, M. (2020). Energy and economic growth in developing Asian economies. *Journal of the Asia Pacific Economy*, 25(3), 447–471. <https://doi.org/10.1080/13547860.2019.1665328>
- Azizan, N.A., Thangiah, N., Su, T.T., & Abdul Majid, H. (2018). Does a low-income urban population practise healthy dietary habits? *International Health*, 10(2), 108–115. <https://doi.org/10.1093/inthealth/ihy001>
- Baraldi, L.G., Steele, E.M., Canella, D.S., & Monteiro, C.A. (2018). Consumption of ultra-processed foods and associated sociodemographic factors in the USA between 2007 and 2012: Evidence from a nationally representative cross-sectional study. *BMJ Open*, 8(3), Article e020574. <https://doi.org/10.1136/bmjopen-2017-020574>
- Cawley, J., & Ruhm, C.J. (2012). The economics of risky health behaviors. In M.V. Pauly, T.G. McGuire & P.P. Barros (Eds.), *Handbook of health economics*, volume 2 (pp. 95–199). Elsevier. <https://doi.org/10.1016/B978-0-444-53592-4.00003-7>
- Cheah, Y.K., Abdul Adzis, A., Abu Bakar, J., & Applanaidu, S.D. (2019). Factors associated with consumption of sugar-sweetened foods and beverages in Malaysia: An ethnic comparison. *International Journal of Diabetes in Developing Countries*, 39, 568–578. <https://doi.org/10.1007/s13410-018-0673-7>
- Cheah, Y.K., Abdul Adzis, A., Abu Bakar, J., & Applanaidu, S.D. (2020). Sociodemographic determinants of Malaysian household's use of and expenditure on alcohol: A regional comparison. *Drugs: Education, Prevention and Policy*, 27(2), 165–172. <https://doi.org/10.1080/09687637.2019.1587387>

- Cheah, Y.K., Abdul Adzis, A., Abu Bakar, J., & Applanaidu, S.D. (2021). Factors associated with household expenditure on oil and fat products in Malaysia: Application of quantile regression. *Food Research*, 5(3), 112–120. [https://doi.org/10.26656/fr.2017.5\(3\).650](https://doi.org/10.26656/fr.2017.5(3).650)
- Cheah, Y.K., Appannah, G., & Abdul Adzis, A. (2023). Consumption expenditure on processed meat and its correlates: An ethnic comparison. *Nutrition and Cancer*, 75(2), 498–509. <https://doi.org/10.1080/01635581.2022.2123534>
- Cutler, D.M., & Lleras-Muney, A. (2010). Understanding differences in health behaviors by education. *Journal of Health Economics*, 29(1), 1–28. <https://doi.org/10.1016/j.jhealeco.2009.10.003>
- Dahal, M., Basnet, A., Khanal, S., Baral, K., & Dhakal, S. (2022). Gender difference in food choice and eating practice and their association with health among students of Kathmandu, Nepal. *Journal of Obesity*, 2022(1), Article 2340809. <https://doi.org/10.1155/2022/2340809>
- Department of Statistics Malaysia. (2023). *Household Income Survey Report 2022*. https://storage.dosm.gov.my/technotes/hies_poverty.pdf
- Eng, C.W., Lim, S.C., Ngongo, C., Sham, Z.H., Kataria, I., Chandran, A., & Mustapha, F.I. (2022). Dietary practices, food purchasing, and perceptions about healthy food availability and affordability: A cross-sectional study of low-income Malaysian adults. *BMC Public Health*, 22, Article 192. <https://doi.org/10.1186/s12889-022-12598-y>
- Evans, A., Booth, H., & Cashel, K. (2000). Sociodemographic determinants of energy, fat and dietary fibre intake in Australian adults. *Public Health Nutrition*, 3(1), 67–75. <https://doi.org/10.1017/S1368980000000082>
- Farrell, P., Negin, J., Awoke, M., Thow, A.M., Taua, M., Faumuina, T., Mihrshashi, S., Vizintin, P., & Richards, J. (2019). Associations between sociodemographic and behaviour factors, and dietary risk factors for overweight and obesity, in Samoan women. *Appetite*, 134, 155–161. <https://doi.org/10.1016/j.appet.2018.12.037>
- Friis, K., Lyng, J.I., Lasgaard, M., & Larsen, F.B. (2014). Energy drink consumption and the relation to socio-demographic factors and health behaviour among young adults in Denmark. A population-based study. *European Journal of Public Health*, 24(5), 840–844. <https://doi.org/10.1093/eurpub/cku003>
- Ghee, L.K. (2016). A review of adult obesity research in Malaysia. *Medical Journal of Malaysia*, 71(S1), 1–19. <https://www.e-mjm.org/2016/v71s1/adult-obesity-research.pdf>
- Grossman, M. (2000). The human capital model. In A.J. Culyer & J.P. Newhouse (Eds.), *Handbook of health economics, volume 1, part A* (pp. 347–408). Elsevier. [https://doi.org/10.1016/S1574-0064\(00\)80166-3](https://doi.org/10.1016/S1574-0064(00)80166-3)
- Horton, S.E.B., Timmerman, G.M., & Brown, A. (2018). Factors influencing dietary fat intake among black emerging adults. *Journal of American College Health*, 66(3), 155–164. <https://doi.org/10.1080/07448481.2017.1390669>
- Khandpur, N., Cediell, G., Obando, D.A., Jaime, P.C., & Parra, D.C. (2020). Sociodemographic factors associated with the consumption of ultra-processed foods in Colombia. *Rev Saude Publica*, 54(19), Article 1176. <https://doi.org/10.11606/s1518-8787.2020054001176>
- Lane, M.M., Gamage, E., Du, S., Ashtree, D.N., McGuinness, A.J., Gauci, S., Baker, P., Lawrence, M., Rebholz, C.M., Srour, B., Touvier, M., Jacka, F.N., O'Neil, A., Segasby, T., & Marx, W. (2024). Ultra-processed food exposure and adverse health outcomes: Umbrella review of epidemiological meta-analyses. *BMJ*, 384, Article e077310. <https://doi.org/10.1136/bmj-2023-077310>
- Lenz, A., Olinto, M.T.A., Dias-da-Costa, J.S., Alves, A.L., Balbinotti, M., Pattussi, M.P., & Bassani, D.G. (2009). Socioeconomic, demographic and lifestyle factors associated with dietary patterns of women living in Southern Brazil. *Cad. Saúde Pública*, 25(6), 1297–1306. <https://doi.org/10.1590/s0102-311x2009000600012>

- Marques-Vidal, P., Waeber, G., Vollenweider, P., & Guessous, I. (2018). Socio-demographic and lifestyle determinants of dietary patterns in French-speaking Switzerland, 2009–2012. *BMC Public Health*, 18, Article 131. <https://doi.org/10.1186/s12889-018-5045-1>
- Matata, M.J., Ngigi, M.W., Bett, H.K., & Michael, P.M. (2022). Effects of cash transfers on food expenditure patterns in northern Kenya. *Cogent Food and Agriculture*, 8(1), Article 2149138. <https://doi.org/10.1080/23311932.2022.2149138>
- Mathieu-Bolh, N. (2022). The elusive link between income and obesity. *Journal of Economic Surveys*, 36(4), 935–968. <https://doi.org/10.1111/joes.12458>
- Nurjati, E. (2022). The determinants of food consumption expenditure in Central Java. *Jurnal Ekonomi Pembangunan*, 23(1), 63–78. [10.23917/jep.v23i1.16788](https://doi.org/10.23917/jep.v23i1.16788)
- O'Donnell, O. (2024). Health and health system effects on poverty: A narrative review of global evidence. *Health Policy*, 142, Article 105018. <https://doi.org/10.1016/j.healthpol.2024.105018>
- Olinto, M.T.A., Willett, W.C., Gigante, D.P., & Victora, C.G. (2010). Sociodemographic and lifestyle characteristics in relation to dietary patterns among young Brazilian adults. *Public Health Nutrition*, 14(1), 150–159. <https://doi.org/10.1017/s136898001000162x>
- Park, S., Onufrak, S., Blanck, H.M., & Sherry, B. (2013). Characteristics associated with consumption of sports and energy drinks among US adults: National Health Interview Survey, 2010. *Journal of the Academy of Nutrition and Dietetics*, 113(1), 112–119. <https://doi.org/10.1016/j.jand.2012.09.019>
- Peters, D.H., Garg, A., Bloom, G., Walker, D.G., Brieger, W.R., & Rahman, M.H. (2008). Poverty and access to health care in developing countries. *Annals of the New York Academy of Sciences*, 1136(1), 161–171. <https://doi.org/10.1196/annals.1425.011>
- Phulkard, S., Rachmi, C.N., Sameeha, M.J., Borazon, E.Q., Thow, A.M., Trevena, H., Saptari, A.F., Cheah, Y.K., Che Wel, C.A., Marquez, V.T., Sakulsri, T., Thongcharoenchupong, N., & Poh, B.K. (2022). Identifying opportunities for strategic policy design to address the double burden of malnutrition through healthier retail food: Protocol for South East Asia Obesogenic Food Environment (SEAOFE) study. *International Journal of Environmental Research and Public Health*, 19(1), Article 528. <https://doi.org/10.3390/ijerph19010528>
- Pregibon, D. (1980). Goodness of link tests for generalized linear models. *Journal of the Royal Statistical Society. Series C (Applied Statistics)*, 29(1), 15–23. <https://doi.org/10.2307/2346405>
- Ricciuto, L., Tarasuk, V., & Yatchew, A. (2006). Socio-demographic influences on food purchasing among Canadian households. *European Journal of Clinical Nutrition*, 60, 778–790. <https://doi.org/10.1038/sj.ejcn.1602382>
- Room, R., Babor, T., & Rehm, J. (2005). Alcohol and public health. *Lancet*, 365(9458), 519–530. [https://doi.org/10.1016/s0140-6736\(05\)17870-2](https://doi.org/10.1016/s0140-6736(05)17870-2)
- Santerre, R.E., & Neun, S.P. (2013). *Health economics: Theory, insights, and industry studies* (6th ed.). South-Western Cengage Learning.
- Sepehri, A. (2015). A critique of Grossman's canonical model of health capital. *International Journal of Health Services*, 45(4), 762–778. <https://doi.org/10.1177/0020731415586407>
- Shahar, S., Lau, H., Wan Puteh, S.E., Amara, S., & Abdul Razak, N. (2019a). Health, access and nutritional issues among low-income population in Malaysia: Introductory note. *BMC Public Health*, 19(S4), Article 552. <https://doi.org/10.1186/s12889-019-6852-8>
- Shahar, S., Vanoh, D., Mat Ludin, A.F., Ajit Singh, D.K., & Hamid, T.A. (2019b). Factors associated with poor socioeconomic status among Malaysian older adults: An analysis according to urban and rural settings. *BMC Public Health*, 19(S4), Article 549. <https://doi.org/10.1186/s12889-019-6866-2>
- Sherina, M.S., Rampal, L., Hejar, A.R., Rozali, A., & Mohd Yunus, A. (2011). Prevalence of urban poor and its health related factors in the state of Selangor, Malaysia. *Malaysian Journal of*

- Medicine and Health Sciences*, 7(1), 17–25. <http://psasir.upm.edu.my/id/eprint/24406/1/Prevalence%20of%20Urban%20Poor%20and%20Its%20Health%20Related%20Factors.pdf>
- Stanhope, K.L. (2016). Sugar consumption, metabolic disease and obesity: The state of the controversy. *Critical Reviews in Clinical Laboratory Sciences*, 53(1), 52–67. <https://doi.org/10.3109/10408363.2015.1084990>
- StataCorp. (2019). *Stata statistical software: Release 16.1*. Stata Corporation.
- Steinberg, D. (2005). An interpretive history of the cholesterol controversy: part II: The early evidence linking hypercholesterolemia to coronary disease in humans. *Journal of Lipid Research*, 46(2), 179–190. <https://doi.org/10.1194/jlr.r400012-jlr200>
- Tey, N.P., & Lai, S.L. (2022). Population redistribution and concentration in Malaysia, 1970–2020. *Planning Malaysia*, 20(3), 227–238. <https://doi.org/10.21837/pm.v20i22.1141>
- Ünver, Ş., & Alkan, Ö. (2024). Sociodemographic factors associated with alcohol use in Turkish women. *Journal of Substance Use*, 29(4), 495–500. <https://doi.org/10.1080/14659891.2023.2284942>
- Viinikainen, J., Bryson, A., Böckerman, P., Kari, J.T., Lehtimäki, T., Raitakari, O., Viikari, J., & Pehkonen, J. (2022). Does better education mitigate risky health behavior? A mendelian randomization study. *Economics and Human Biology*, 46, Article 101134. <https://doi.org/10.1016/j.ehb.2022.101134>
- Vu, L.H. (2020). Estimation and analysis of food demand patterns in Vietnam. *Economies*, 8(1), Article 11. <https://doi.org/10.3390/economies8010011>
- Wongmonta, S. (2022). An assessment of household food consumption patterns in Thailand. *Journal of the Asia Pacific Economy*, 27(2), 289–309. <https://doi.org/10.1080/13547860.2020.1811191>
- Wooldridge, J. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). MIT Press.
- Wooldridge, J. (2020). *Introductory econometrics: A modern approach* (7th ed.). Cengage Learning.
- Yadav, H. (2007). Poverty and health development. *Medical Journal of Malaysia*, 62(4), 278–281. https://www.e-mjm.org/2007/v62n4/Poverty_Health_Development.pdf
- Yuan, Y., & Yen, S.T. (2012). Alcohol consumption by individuals in the United States: A sample selection approach. *Applied Economics Letters*, 19(14), 1353–1358. <https://doi.org/10.1080/13504851.2011.628290>

