

Factors associated with household expenditure on oil and fat products in Malaysia: application of quantile regression

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Abstract

In today's rapidly urbanising society, high-fat dietary behaviour is one of the main causes of obesity and various chronic diseases. The objective of the present study is to investigate factors associated with the consumption of oil and fat products among the Malaysian population. This research examined the oil and fat products expenditure patterns among 12798 households using the Malaysian Household Expenditure Survey (HES) 2014. Results were derived from the quantile estimation on cross-sectional data. Household heads' sociodemographic and household characteristics are used as the explanatory variables. We found positive relationships between the quantiles of household expenditure on oil and fat products and age, educational level, and household size. In terms of marital and employment status, households with married or employed heads tend to spend more on all the quantiles of oil and fat products relative to households headed by single or unemployed individuals. Furthermore, the quantiles of expenditure were higher among urban households than rural households. The findings of the present study lend support to the fact that the quantiles of household expenditure on oil and fat products vary across household heads' sociodemographic and household characteristics. The findings had important implications for how a nationwide intervention measure directed towards reducing dietary fat intake in the Malaysian population is formulated.

1. Introduction

A continuous increase in the prevalence of obesity is a serious health issue across the globe. It has been well-evident that obesity can lead to various chronic diseases (Burton and Foster, 1985). One of the main contributing factors to obesity is excessive dietary intake of oils and fats. As a systematic review study by Bray and Popkin (1998) shows, on average, if an obese person reduces his/her calorie intake from fat by 10%, his/her body weight will lower by 16 grams per day. In addition to obesity, oils and fats consumption is also positively related to the risks of developing type-2 diabetes, heart diseases and cancers (Zhang *et al.*, 1999; Hu *et al.*, 2001; Salmeron *et al.*, 2001; Mozaffarian *et al.*, 2006). In light of the negative consequences of oils and fats consumption, the World Health Organization has developed a guideline that urges countries to reduce dietary fat to less than 30% of total daily energy intake (World Health Organization, 2020).

In Malaysia, the high prevalence of obesity and consumption of oils and fats have large implications on

public health. According to the National Health and Morbidity Survey, the prevalence of obesity in the adult population increased from 27.2% in 2011 to 30.6% in 2015 (Institute for Public Health, 2011; Institute for Public Health, 2015). This figure implied that about three out of every ten Malaysian adults were obese. In terms of dietary behaviours, the Malaysian Adult Nutrition Survey reported that in 2003, on average, an adult consumed about 64 grams of fat per day, and this figure had increased to 70 grams in 2014, which was equivalent to 31% of total energy intake (Zainuddin *et al.*, 2019). This amount exceeded the Malaysian Recommended Nutrient Intake (RNI) levels (Shahar *et al.*, 2018). Furthermore, according to the report of the Household Expenditure Survey, the mean monthly household expenditure on oil and fat products increased from only Ringgit Malaysia (RM) 8 in 1994 to RM 13 in 2010 (Department of Statistics Malaysia, 2010).

Although the causal relationship between consumption of oils and fats, and obesity and various diseases has been identified in clinical research, not considerably more is known about the influences of

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sociodemographic factors on the decisions of people to consume oils and fats, especially in developing countries. The tendency to indulge in high-fat dietary behaviour cannot be easily detected, since clinical studies can only identify the disease burdens. Empirical studies related to sociodemographic factors associated with the consumption of oils and fats is seriously inadequate, and this poses a constraint to an improvement in intervention strategies and preventive measures. Similar to other health behaviours, such as smoking, alcohol drinking and physical activity participation, consumption of oils and fats can be influenced by consumers' sociodemographic characteristics. For instance, using data from Western developed countries, a few studies consistently found that dietary intake of fats and oils was associated with age, gender, income and educational level (Fraser *et al.*, 2000; Park *et al.*, 2005; Ricciuto *et al.*, 2006; Marques-Vidal *et al.*, 2018; Petrenya *et al.*, 2019). In developing countries, there is still a lack of this kind of research, even though such research is important for the countries, especially given that they have a limited budget for healthcare.

The objective of the present study is to investigate variations in dietary intake of oils and fats across sociodemographic factors with a specific focus on the quantiles of household expenditure on oil and fat products. The present study attempts to contribute to the literature in several ways. First, the country of interest is Malaysia, that is, a fast-growing developing country in Asia, where the prevalence of obesity and dietary intake of fat is high. Even though obesity and consumption of oil and fat are major public health concerns in Malaysia, only very little research attention has been paid to the country. A recent study by Lee and Wan Muda (2019) was notable in examining the relationship between fat intake and obesity, but it did not shed light on factors affecting the amount of fat consumed by people. Also, with our findings, we can compare and contrast the scenarios in developed and developing countries.

Second, nationally representative data with large sample size is used. As a result, the present study is able to be generalizable to Malaysia and other developing countries. Our findings could suggest that assessing one's sociodemographic and household characteristics may make recommendations of lowering oils and fats consumption so that government can control the rise of obesity and some chronic diseases. While our study is done in Malaysia, other studies' findings may support our conclusions. Then, policymakers may need to look at the sociodemographic and household influences toward oils and fats consumption that they are seeing in practice

which their countries have somewhat similar population characteristics as Malaysia.

Third, the statistical analysis performed by the present study is based on the quantiles, instead of the means. Although computing the means is useful, the impacts of the independent variables may be varied by groups of a population. Hence, it is worthwhile to use quantile regression to estimate such impacts. To date, the present study is the first of its kind to examine sociodemographic and household factors associated with the quantiles of household expenditure on oil and fat products. The effects of sociodemographic and household factors on household expenditure on oil and fat products amongst households that have a low expenditure are expected to be different from those having a high expenditure.

2. Methodology

2.1 Data

Data used in the present study was extracted from the Malaysian Household Expenditure Survey (HES) 2014, that is, a nationwide cross-sectional survey conducted by the Department of Statistics Malaysia in 2014. The purpose of the survey was to examine expenditure pattern and their associated factors among households in Malaysia. A total of twelve major expenditure groups were examined: 1) food and non-alcoholic beverages; 2) alcoholic beverages and tobacco; 3) clothing and footwear; 4) housing, water, electricity, gas and other fuels; 5) furnishings, household equipment and routine household maintenance; 6) health; 7) transport; 8) communication; 9) recreation and culture; 10) education; 11) restaurants and hotels; and 12) miscellaneous goods and services.

In all the states of Malaysia, households were invited to participate in the survey based on a two-stage stratified sampling approach. In the first stage of the sampling, Enumeration Blocks (EBs), that is, geographical contiguous areas of land, were selected. Specifically, each EB was comprised of 80-120 living quarters (LQs) and was divided into urban (≥ 10000 population) and rural (< 10000 population) areas. In the second stage, households located at the selected LQs were surveyed using the personal interview method. Only the household heads were interviewed. Exclusion criteria were households resided in residential institutions, such as hotels, hostels and hospitals.

The sample size was calculated based on three criteria: 1) findings from the previous survey, 2) level of sampling design and 3) desired error. A total of 14838 households were surveyed. However, due to incomplete

information reported by some, only 12798 households were used in the present study for secondary analyses. During the survey, household heads' sociodemographic characteristics, as well as household profiles were recorded. In order to ensure that the data was of sufficiently high quality, senior officers made an effort to perform quality checks and detect any possible errors. The HES was conducted once every five years. Although the HES 2014 was not the latest survey, it had a large sample size and detailed information about household expenditure pattern. More details about the HES 2014 were described elsewhere (Department of Statistics Malaysia, 2014).

2.2 Dependent variable

Monthly household expenditure on oil and fat products (in RM), such as butter, margarine, fat and processed animal oils was used as the dependent variable. In particular, the daily expenditure on oil and fat products made by households from the first day until the last day of a month was recorded in the survey. Expenditure on healthy fats and oils was not counted. The dependent variable was categorised as a continuous variable.

2.3 Independent variables

In light of the findings of previous studies related to factors associated with dietary intake of fat and oil (Fraser et al., 2000; Sanchez-Villegas et al., 2003; Park et al., 2005; Ricciuto et al., 2006; Marques-Vidal et al., 2018; Petrenya et al., 2019), the present study explored six variables of household heads' sociodemographic characteristics: 1) age; 2) gender; 3) ethnicity; 4) marital status; 5) educational level; and 6) employment status, as well as three variables of household profiles: 1) monthly household income; 2) household size; and 3) household location. We assumed that household heads made decisions in the interest of all members.

We created a categorical variable for household income: \leq RM 1499, RM 1500-2999, RM 3000-4499, RM 4500-5999, RM 6000-7499 and \geq RM 7500. Age was grouped into five categories: \leq 29, 30-39, 40-49, 50-59 and \geq 60 years. In terms of household heads' ethnicity, it was categorised into two categories: Bumiputera (Malaysians of indigenous Malay origin) and non-Bumiputera. We developed three categories for household heads' marital status: single, married and widowed/divorced.

Household heads' educational level was comprised of no formal education, primary-, secondary- and tertiary-level education. Household heads' employment status was measured based on employed and unemployed. Three categories of household size were formed: small

(\leq 4 members), medium (5-7 members) and large (\geq 8 members) (Mok et al., 2011). The location of the household was divided into two categories: urban and rural.

2.4 Statistical analysis

Prior to performing any test, we calculated descriptive statistics of all the independent variables, reporting the frequencies and percentages. Then, we used a one-way analysis of variance (ANOVA) to investigate the bivariate relationships between household expenditure on oil and fat products and household heads' sociodemographic and household variables, describing the means and differences according to two-tailed F-tests. In terms of multivariate analysis, we estimated a quantile regression model for the outcome of household expenditure on oil and fat products. Five quantiles were estimated: 0.1, 0.25, 0.5, 0.75 and 0.9. The quantile of 0.5 was equivalent to the median. More details about quantile regression were described elsewhere (Wooldridge, 2010). For all the tests, the p -value of 0.05 (two-sided) was chosen as the significant level. Statistical analyses were performed using Stata statistical software (StataCorp., 2019).

3. Results

Overall, the household heads' age breakdown consisted of 9.17% \leq 29 years, 22.32% 30-39 years, 27.98% 40-49 years, 24.16% 50-59 years and 16.37% \geq 60 years. The majority of household heads had secondary-level education (56.84%), followed by those with tertiary-level (20.78%), primary-level (17.97%) and no formal education (4.41%). Approximately 7.50%, 23.67%, 21.66%, 14.23%, 9.48% and 23.46% of households had monthly income of RM \leq 1499, RM 1500-2999, RM 3000-4499, RM 4500-5999, RM 6000-7499 and RM \geq 7500, respectively. A large proportion of household heads were males (84.71%), married (80.04%) and employed (92.63%). Slightly more than half of the households were small (56.23%) and located in urban areas (68.40%) (Table 1).

Results of the one-way ANOVA test showed that the mean of household expenditure on oil and fat products was varied by household heads' sociodemographic and household characteristics, and this supported the use of quantile regression. On average, households with heads aged 50-59 years spent the highest amount of money on oil and fat products (RM 20.69), whereas households headed by individuals aged \leq 29 years spent the lowest (RM 16.87). Households with tertiary-educated heads spent RM 22.46 on oil and fat products, compared to households with heads having no formal education, which spent about RM 15.38 only. On average,

Table 1. Descriptive statistics of independent variables (n = 12798)

Variables	Frequency	Percent
Age		
≤29 years	1174	9.17
30-39 years	2859	22.32
40-49 years	3581	27.98
50-59 years	3092	24.16
≥60 years	2095	16.37
Education		
No formal	565	4.41
Primary	2300	17.97
Secondary	7274	56.84
Tertiary	2659	20.78
Income		
≤RM1,499	960	7.5
RM 1500-2999	3028	23.67
RM 3000-4499	2771	21.66
RM 4500-5999	1820	14.23
RM 6000-7499	1213	9.48
≥RM7,500	3001	23.46
Gender		
Male	10841	84.71
Female	1957	15.29
Household size		
Small	7196	56.23
Medium	4689	36.64
Large	913	7.13
Marital status		
Single	1461	11.42
Married	10243	80.04
Widow/divorce	1094	8.55
Employment status		
Employed	11855	92.63
Unemployed	943	7.37
Household location		
Urban	8754	68.4
Rural	4044	31.6

Source: Malaysian Household Expenditure Survey 2014

households headed by males (RM 19.54), married individuals (RM 19.73) and employed individuals (RM 19.48) spent more on oil and fat products than those headed by females (RM 18.02), single individuals (RM 17.95) and the unemployed (RM 17.15). The mean expenditure on oil and fat products was significantly higher among large (RM 22.59) and urban households (RM 20.38) compared with small (RM 18.49) and rural households (RM 16.99) (Table 2).

In terms of the results of quantile regression, relative to households headed by individuals aged ≤29 years, those with heads aged 40-49, 50-59 and ≥60 years spent about RM 0.88-4.59, RM 1.57-7.39 and RM 1.11-7.85 more on the 0.1-0.9 quantiles of oil and fat products, respectively. The 0.75-0.9 quantiles of

Table 2. Average monthly household expenditure on oil and fat products (n = 12798)

Variables	Mean	Std. Dev.	F-statistic [#]
Age			
≤29 years	16.87	12.67	16.12*
30-39 years	19.01	15.92	
40-49 years	19.67	14.84	
50-59 years	20.69	16.38	
≥60 years	18.44	15.25	
Education			
No formal	15.38	12.85	66.87*
Primary	17.06	13.46	
Secondary	19.18	15.37	
Tertiary	22.46	16.89	
Income			
≤RM1,499	19.68	15.03	0.89
RM 1500-2999	19.61	15.35	
RM 3000-4499	19.1	15.55	
RM 4500-5999	19.54	15.74	
RM 6000-7499	18.74	13.87	
≥RM7,500	19.19	15.78	
Gender			
Male	19.54	15.49	16.30*
Female	18.02	14.78	
Household size			
Small	18.49	14.93	34.79*
Medium	19.92	15.42	
Large	22.59	18.08	
Marital status			
Single	17.95	15.76	20.34*
Married	19.73	15.38	
Widow/divorce	17.16	14.72	
Employment status			
Employed	19.48	15.46	20.15*
Unemployed	17.15	14.34	
Household location			
Urban	20.38	16.30	135.26*
Rural	16.99	12.92	

Note: Std. Dev. refers to standard deviations. [#]F-statistic used in ANOVA to test the equality of means. * $p < 0.05$.

Source: Malaysian Household Expenditure Survey 2014

expenditure on oil and fat products were RM 5.17-5.88 and RM 9.78-12.90 higher for households headed by individuals who had secondary- and tertiary-level education, respectively, than households headed by uneducated individuals. For the 0.1-0.5 quantiles, compared to households with uneducated heads, those with secondary educated heads spent approximately RM 1.18-2.76 more, whilst those with tertiary-educated heads spent about RM 2.39-5.63 more (Table 3).

Medium households spent about RM 2.49 more on the 0.9 quantile and RM 0.68 more on the 0.1 quantile of oil and fat products than small households. If households were large instead of small, the 0.9 quantile of household

Table 3. Quantiles of monthly household expenditure on oil and fat products (n = 12798)

Variables	Quantiles				
	0.10	0.25	0.50	0.75	0.90
Constant	1.550*	1.298	6.040*	9.084*	20.400*
	(0.715)	(0.951)	(0.953)	(1.792)	(3.230)
Age					
≤29 years	Ref.	Ref.	Ref.	Ref.	Ref.
30-39 years	0.467	1.007*	0.810	1.793*	2.463
	(0.339)	(0.451)	(0.452)	(0.850)	(1.531)
40-49 years	0.883*	1.764*	1.670*	3.178*	4.588*
	(0.343)	(0.457)	(0.457)	(0.860)	(1.550)
50-59 years	1.567*	3.143*	2.820*	5.602*	7.388*
	(0.353)	(0.470)	(0.470)	(0.884)	(1.594)
≥60 years	1.108*	2.563*	2.765*	5.594*	7.850*
	(0.405)	(0.539)	(0.540)	(1.015)	(1.830)
Education					
No formal	Ref.	Ref.	Ref.	Ref.	Ref.
Primary	0.483	0.866	0.975	2.141	1.587
	(0.445)	(0.591)	(0.592)	(1.114)	(2.008)
Secondary	1.183*	2.373*	2.760*	5.170*	5.875*
	(0.432)	(0.575)	(0.575)	(1.082)	(1.951)
Tertiary	2.392*	4.686*	5.630*	9.779*	12.900*
	(0.466)	(0.620)	(0.620)	(1.167)	(2.103)
Income					
≤RM 1499	Ref.	Ref.	Ref.	Ref.	Ref.
RM 1500-2999	-0.017	0.273	0.260	-0.890	-0.800
	(0.347)	(0.462)	(0.462)	(0.869)	(1.567)
RM 3000-4499	-0.292	0.243	-0.100	-0.766	-1.762
	(0.351)	(0.467)	(0.467)	(0.879)	(1.584)
RM 4500-5999	0.042	0.049	-0.030	-0.802	-1.337
	(0.374)	(0.497)	(0.498)	(0.937)	(1.689)
RM 6000-7499	-0.100	-0.214	-0.170	-1.875	-1.562
	(0.405)	(0.539)	(0.539)	(1.015)	(1.829)
≥RM 7500	-0.217	-0.063	-0.220	-1.375	-0.925
	(0.348)	(0.462)	(0.463)	(0.870)	(1.569)
Gender					
Male	-0.042	0.207	0.680	1.048	-1.975
	(0.280)	(0.372)	(0.372)	(0.700)	(1.262)
Female	Ref.	Ref.	Ref.	Ref.	Ref.
Household size					
Small	Ref.	Ref.	Ref.	Ref.	Ref.
Medium	0.683*	1.214*	0.840*	1.476*	2.487*
	(0.185)	(0.246)	(0.247)	(0.464)	(0.837)
Large	1.758*	2.592*	3.940*	5.337*	8.288*
	(0.336)	(0.447)	(0.448)	(0.842)	(1.517)
Marital status					
Single	Ref.	Ref.	Ref.	Ref.	Ref.
Married	0.717*	1.293*	0.990*	0.938	0.062
	(0.302)	(0.402)	(0.402)	(0.757)	(1.364)
Widow/divorce	-0.383	0.001	0.070	0.628	-1.488
	(0.422)	(0.561)	(0.562)	(1.058)	(1.906)
Employment status					
Employed	0.442	1.336*	1.950*	3.134*	3.525*
	(0.365)	(0.486)	(0.486)	(0.915)	(1.649)
Unemployed	Ref.	Ref.	Ref.	Ref.	Ref.
Household location					
Urban	0.683*	1.486*	1.790*	3.337*	4.450*
	(0.188)	(0.250)	(0.250)	(0.471)	(0.848)
Rural	Ref.	Ref.	Ref.	Ref.	Ref.

Note: Standard errors in parentheses. Ref. refers to reference category. * $p < 0.05$.

Source: Malaysian Household Expenditure Survey 2014

expenditure on oil and fat products increased by RM 8.29, whilst the 0.1 and 0.25 quantiles increased by RM 1.76 and RM 2.59 only, respectively. Households headed by married individuals spent about RM 0.72, RM 1.29 and RM 0.99 more on the 0.1, 0.25 and 0.5 quantiles of oil and fat products, respectively, compared with households headed by single individuals. Relative to households with unemployed heads, those with employed heads spent approximately RM 1.34-3.53 more on the 0.25-0.9 quantiles of oil and fat products. If the households were located in urban areas instead of rural areas, the 0.1, 0.25, 0.5, 0.75 and 0.9 quantiles of expenditure on oil and fat products were RM 0.68, RM 1.49, RM 1.79, RM 3.34 and RM 4.45 higher, respectively.

4. Discussion

High-fat dietary behaviour is one of the main causes of obesity and chronic diseases in today's rapidly urbanising society. In spite of the high prevalence of obesity and dietary intake of fat, little is known about factors influencing oil and fat consumption behaviour among Malaysian people. This information is important as it can assist policymakers in formulating a more appropriate intervention measure directed towards reducing illnesses caused by obesity and a high-fat diet. The purpose of the present study is to narrow this research gap. Using nationally representative data with large sample size and a quantile regression, we found variations in the quantiles of household expenditure on oil and fat products across household heads' sociodemographic (age, educational level, marital status, employment status) and household (household size, household location) characteristics. Surprisingly, however, we found that household income did not play an important role in influencing the expenditure. This finding is in contrast to the findings of previous studies, which show that income is significant in affecting the likelihood of indulging in a high-fat diet (Guenther *et al.*, 2005; Ricciuto *et al.*, 2006; Lenz *et al.*, 2009; Petrenya *et al.*, 2019; Farrell *et al.*, 2019). Policymakers are, therefore, suggested not to devote too much attention to income factor if the goal of reducing fat intake in the Malaysian population is to be achieved in a more efficient manner.

Household heads' age was positively associated with household expenditure on oil and fat products. More specifically, the effects of age at the upper end of household expenditure were larger than those at the lower end. While previous studies often found that age was inversely associated with consumption of fat, there appeared to be a few studies showing that older people were more likely to indulge in fattening foods relative to

their younger peers. For instance, Marques-Vidal *et al.* (2018) using nationwide data of Switzerland found that consumption of fatty and sugary foods was more frequent among older individuals than younger individuals, and Fraser *et al.* (2000) drawing from a survey data collected in the United Kingdom (UK) observed that older people consumed more food with high fatty acid content relative to their younger counterparts. A plausible contributing factor to the higher fat consumption among older individuals is that eating behaviours developed at a young age are difficult to be changed over time (Fraser *et al.*, 2000). Given our findings, it is important that special policy attention be paid to households that are headed by the elderly and consume a lot of oil and fat products. This could ensure that the prevalence of obesity and dietary fat intake is to be lowered efficiently.

A previous study conducted in Spain found that well-educated people were more likely to adhere to dietary patterns that consisted of a high amount of fattening foods compared with less-educated people (Sanchez-Villegas *et al.*, 2003). Other studies which were conducted elsewhere suggested likewise that educational level was associated with an increase in dietary fat intake (Fraser *et al.*, 2000; Ternus *et al.*, 2019). Similarly, our findings showed that households with well-educated heads consumed more oil and fat products relative to their counterparts having less-educated heads. Comparing among quantiles, the effect of educational level on the lowest quantile was less than half of that on the highest quantile. Although we are unable to identify the causal effects of educational level on fat intake, it could be that well-educated people tend to face more stress at work, leading to indulgence in an unhealthy diet (Sanchez-Villegas *et al.*, 2003). Another plausible factor is attributable to the nexus between high socioeconomic status and adoption of an unhealthy dietary lifestyle (Ternus *et al.*, 2019). It is also possible that fattening foods are widely available in restaurants, and well-educated people visit restaurants more often than less-educated people. This indicates that the education factor affects the consumption of fattening foods through the mediation of food availability in restaurants. With data availability, this mediating effect can be explored in great detail in a future study. While there seem to be numerous studies claiming that being well-educated reduced consumption of fat because education improved health awareness (Evans *et al.*, 2000; Park *et al.*, 2005; Ricciuto *et al.*, 2006; Lenz *et al.*, 2009; Petrenya *et al.*, 2019), this may not reflect the scenario in Malaysia. It can, therefore, be concluded that improving educational level among the less-educated segment of the Malaysian population may not be desirable. Policymakers are suggested to shift their focuses to people who have a

good educational background and consume a lot of oil and fat products.

The association between household size and consumption of dietary fat was seldom examined in the past, except a study by Ricciuto *et al.* (2006). The authors, in examining demographic determinants of food consumption in Canada, contended that larger households consumed more high-fat foods compared with smaller households because of economies of scale. According to this economic theory, larger households could purchase the same quantity of food at a lower price. A similar finding was evidenced in the present study. We found that household expenditure on oil and fat products was higher for larger households, which along with an increasing impact of household size across the quantiles. More specifically, the impacts increased by nearly fivefold from the lowest to the highest end of expenditure. We can simply relate our finding to the fact that household consumption increases with household size. A policy implication of our finding is that continuous efforts could be made by policymakers to reduce dietary fat intake among large households with high expenditure on oil and fat products. Though the effect of household size is smaller among households with a low expenditure, it should not be neglected as it is highly significant.

If we compared households with married heads and households with single heads, the median of oil and fat products expenditure was slightly higher for those with married heads. It was noteworthy that the effect at the median was smaller than that at the second-lowest quantile, but it was larger than that at the lowest quantile. Our findings contradicted those of Lenz *et al.* (2009). While the relationship between marital status and fat consumption was found to be significant in their study, their findings showed that married individuals were less likely to incorporate unhealthy fattening foods in their diet compared with their single counterparts. Based on our findings, it can be postulated that household commitment or family burden may explain the decisions of married people to indulge in fattening foods. In-depth qualitative research could be conducted with the aim of understanding better the factors explaining the relationship between marital status and consumption of oil and fat products. Our findings have an important implication for policy. In a concerted effort to reduce consumption of oil and fat products among households that have a low expenditure, households headed by married heads should be given priority. However, if the target group is households with a high expenditure, the marital status factor is suggested not to be given too much attention as it does not affect their dietary behaviour.

We found that being employed increased consumption of oil and fat products. The effect of employment status seemed to escalate with the quantiles. Specifically, the estimated coefficients of employment status increased by more than twofold as we moved up the distribution (from the 0.25 to 0.9 quantiles). It is plausible that the financial factor is at play here. Employed individuals tend to have a better financial capability compared with the unemployed and consequently are more able to purchase oil and fat products. As pointed out by Cheah *et al.* (2019) and Cheah *et al.* (2020), who studied household expenditure pattern in Malaysia, households with employed heads faced less barrier to consuming sugar-sweetened foods and alcohol because they had a better financial background. In contrast, Evans *et al.* (2000) using survey data collected in Australia found that being employed was associated with a lower dietary fat intake because health awareness was greater among people with higher socioeconomic status. Though this is the case in Australia, it is not held for Malaysia. Considering our findings, an intervention measure directed towards reducing dietary intake of fat among households that are headed by employed individuals and spend a lot on oil and fat products is worthy of consideration. However, this does not mean that those with unemployed heads should be neglected.

With regard to household location, we found that urban households consumed more oil and fat products relative to rural households. Comparing between quantiles, the household location had a larger effect at the upper end of expenditure on oil and fat products than at the lower end given that the estimated coefficient of household location variable at the 0.9 quantile was about six times higher than that at the 0.1 quantile. Using nationwide data of the United States (US), Siega-Riz *et al.* (2000) found likewise that adults who stayed in urban areas had a higher likelihood of adopting a high-fat diet compared with their peers residing in rural areas. We can relate our findings to a study by Yen and Tan (2012). The authors found that urbanites were less likely to consume vegetables than rural dwellers, and claimed that urban dwellers tended to live a busier and more hectic lifestyle, and thus were less likely to take care of their diet (Yen and Tan, 2012). In terms of policy implication, one could follow the recommendation of Yen and Tan (2012) that urbanites should be strongly advised to adopt a healthy eating lifestyle. Special attention could be paid to urban households which spend a high amount of money on oil and fat products.

As pointed out earlier, the present study is by far the most comprehensive study that examines factors associated with the quantiles of household expenditure

on oil and fat products in Malaysia. Since the findings of the present study are derived from large nationwide data, they can be generalizable to the entire Malaysian population. With the findings, policymakers are able to understand which groups of households are more or less likely to consume oil and fat products. In spite of these strengths, the present study has several limitations. First, the present study is unable to establish causalities because of cross-sectional data. Second, since the data used in the present study is household data, it does not allow us to accurately identify which individuals consume more or less oil and fat products. Third, owing to data limitation, some lifestyle and health variables, such as smoking, alcohol drinking and being diagnosed with chronic diseases are omitted. Also, we are uncertain which specific kinds of oil and fat products were purchased by households.

5. Conclusion

The present study has important implications for policy development, specifically with regard to the identification of households that have a high consumption of oil and fat products. Our findings suggest that policymakers should pay special attention to households with heads aged ≥ 60 years, having tertiary-level education, as well as those with married and employed heads. In addition, large and urban households should also be given consideration. Overall, the results of the present study contribute to the growing literature related to dietary fat consumption behaviour by offering a better understanding of the relationships between the quantiles of household expenditure on oil and fat products, and household heads' sociodemographic characteristics and household profiles.

Conflict of interest

The authors report no conflicts of interest.

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