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Ethnic Variability of Health-Promoting Behaviours of Older Adults in Malaysia

Saidatulakmal Mohd[1] · Abdul Rais Abdul Latiff[2] · Radieah Mohd Noor[3] · Sharifah Nurlaili Farhana Syed Azhar[3]

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Abstract

The increasing number of non-communicable diseases among older adults requires a thorough understanding of health status and health behaviour among older adults for effective policy measures to prevent age-related diseases. As such, this study aims to answer the following questions: (i) what types of health-promoting behaviours are adopted by older Malaysians? (ii) what are the health conditions of older Malaysians? (iii) how do ethnicity and other factors influence the health-promoting behaviours of older Malaysians? and (iv) how do these behaviours differ across different ethnic groups? By using the 2011 and 2015 National Health and Morbidity Surveys (NHMS) containing 2,721 and 3,790 observations for 2011 and 2015, the study finds a significant relationship between ethnicity and the health-promoting behaviours and health status of older adults in Malaysia. While health-promoting behaviour showed improvement over the study period across all ethnic groups, health status differs across the years and between ethnic groups. A common trend was that Chinese older adults are prone to be involved in at least two health-promoting behaviours while the Malay and Indian older adults are involved in at least one, with the probability of involvement in such health-promoting behaviours showing a reduction in 2015. The findings suggest that more awareness of health-promoting behaviours is needed according to ethnicity at a younger age, as a preventive measure for better health.

Keywords Health-promoting behaviour · Older adults · Ethnicity · Malaysia · Non-communicable diseases

✉ Saidatulakmal Mohd
eieydda@usm.my

Extended author information available on the last page of the article

Introduction

Following global demographic shifts, Malaysia is experiencing a year-on-year increase in the percentage of adults aged 60 years and over. The percentage of the population aged 60 years and above was 10.7% in 2020, an increase from 8.5% in 2013, and is expected to increase to 19.8% by 2040 (Department of Statistic Malaysia, 2020). The increasing number of older populations poses a significant health challenge, as health conditions generally worsen with age. Older adults are more susceptible to non-communicable diseases (NCDs) such as hypertension, cardiovascular disease, diabetes, degenerative arthritis and depression (Chang, et al., 2017). The prevalence of hypercholesterolemia increases with age from 11.3% and 22.0% among the 18–19 year old age group for 2011 and 2015, reaching a peak of 57.2% and 68.8% among the older population aged 65–69 years old, for 2011 and 2015, respectively (Ministry of Health, 2011, 2015). A similar trend is observed for hypertension that is higher among the older population aged 65–69 years old of 74.1% in 2011 and among 70–74 years of 75.4% in 2015 (Ministry of Health, 2011, 2015). Hence, more funding needs to be allocated to older adults health care, resulting in a significant increase in health expenditures (Cheah, 2018).

Health-promoting behaviours (HPBs) are actions that an individual takes that affect their health, illnesses, disability or mortality (Rubinelli & Diviani, 2020). Health promotion involves enabling people to increase control over and to improve their health (World Health Organisation, 2018), and to reach a state of complete physical, mental and social wellbeing (Ntuli, 2002). It also moves beyond a focus on individual behaviour towards a wide range of social and environmental interventions. According to Sonmezer et al. (2012), HPBs include proper nutrition, sufficient sleep, regular exercise, protection against accidents, early diagnosis of symptoms of physical and emotional diseases, and control of feelings, while staying away from stress, fatigue and destructive behaviours such as drugs. In addition, HPBs refer to general activities that improve self-realisation and a sense of wellbeing, including acts that assist individuals in maintaining and promoting healthy lifestyles (Pender et al., 2006). HPBs include a variety of activities that help prevent illnesses and improve health and are important criteria for determining health and preventing many known diseases (Loeb, 2003). According to Mirghafourvand et al. (2015), HPBs are one of the main determinants of health as a known underlying factor in the prevention of many diseases. Following HPBs is one of the most effective ways by which people can protect and control their health (Enjezab et al., 2012).

HPBs such as regular exercise, regular checkups on blood pressure and sugar levels, and weight control are among the behaviours that could prevent old-age diseases (Taylor, 2014), improve health conditions (Ji, 2001), minimise limitations imposed by the ageing process, promote independence and maximise remaining ability (Lim, et al., 2015a, 2015b). Unhealthy eating habits and lack of physical activity are the most important modifiable risk factors for NCDs (Wu et al., 2015). Although Malaysia provides a wide range of health care services and health-promotion programmes for the general population, specific health

programmes or interventions to enhance physical activity among older adults are lacking (Chan et al., 2019). Maintaining healthy behaviour among older adults is seen as a great challenge (Chang et al., 2017). The Institute for Public Health (2011) reported that a substantial proportion of older adults in Malaysia suffer mostly from hypertension and hypercholesterolemia.

Ethnicity can be distinguished in a variety of approaches with the oldest being a sociological and anthropological approach that considers ethnicity as fixed and permanent as it is something ascribed at birth, deriving from the kin-and-clan structure of human society (Isajiw, 1993). Ethnicity is an important determinant of health status in a population (Zhang, et al., 2016) but research in assessing the health status of older adults often regards them as a homogenous group and ignores ethnic differences that may impact health outcomes (Walker, 2002). Notably, studies on health expectancy among differential ethnic groups in developing countries are scarce (Chan, et al., 2016) and negligible among older adults.

As people with different ethnic backgrounds possess different attitudes, values and norms that reflect their cultural heritage (Abu Bakar, et al., 2018), understanding the impact of ethnicity on health behaviour is vital to overcoming public health challenges, particularly among older adults. In a multiracial country like Malaysia, improving health behaviour could be challenging due to the significant disparities in health and economic situations between the different ethnic groups (Tan et al., 2011). The three major ethnic groups in Malaysia are the Malay (Bumiputera and Other Bumiputera), Chinese and Indian. In Article 160 of the Federal Constitution, 'Malay' is defined as 'a person who professes the religion of Islam, habitually speaks the Malay language and conforms to Malay custom' (Laws of Malaysia, 1963). Other Bumiputera refers to the natives of Sabah and Sarawak, as indicated in Article 161A of the Federal Constitution. Nevertheless, Bumiputera is often used to represent the Malay and the natives of Sabah and Sarawak. In Malaysia, ethnicity is often associated with religion, in which the Malays are assumed to be Muslims, Chinese are assumed to be Buddhist, Indian are assumed to be Hindus and Other Bumiputeras are assumed to be following their ancestral beliefs.

Common findings from past studies indicate that the majority ethnic group usually has better health outcomes than minority ethnic groups. Crimmins and Saito (2001) and Chan et al. (2016) both found that majority groups of Whites and Chinese have better health outcomes at old age as opposed to other ethnic groups. However, in the case of Malaysia, the health conditions of the Malay and Other Bumiputera are worse than some other ethnic groups, despite being the majority ethnic groups in the country, while the health outcomes of the Indian minority are the poorest. For example, the life expectancy of Chinese men and women was the highest of all ethnic groups in 2020, at 75.4 and 80.5 years, respectively. The life expectancies of Bumiputera men and women were 71.3 and 76.3 years, respectively, while for Indian men and women they were 68.4 and 76.2, respectively (Department of Statistic Malaysia, 2020). Being the smallest minority group in Malaysia, Indians also have a higher prevalence of physical inactivity that is associated with higher rates of NCD (Chan et al., 2019; Tan et al., 2011). This was also supported by Tan et al. (2013), who found those of Indian ethnicity had a higher prevalence of anaemia among expectant mothers than other ethnic groups in Malaysia. Yusof et al.

(2018) found that older adults of Malay and Indian ethnicities reported high cases of anaemia, hospitalisation and diabetes. Recent research by Iddrisu et al., (2020a, 2020b) indicated that illnesses among older adults were affected by health behaviours such as healthy eating, physical exercise and health responsibility, and ethnicity was quoted as one of the determinants of HPBs.

The apparent health promotion behaviour among ethnic groups is often the result of different cultural backgrounds and geographical areas. Due to vast geographical differences and cultural aspects, people in Central Java, Indonesia, for example, consumed more salty and fatty foods while those in Central Java eat more vegetables (Kandou, 2009). Asian Americans who are large portions of minorities and immigrants are reported to have poor physical health and lack social-behavioural interventions (Hu et al., 2021). A longitudinal study of Japanese older adults indicated that older persons' social background influenced their social participation, which indirectly influenced their health behaviour such as fruit or vegetable intake (Nishio et al., 2021). Socio-economic background such as education, gender and economic status, for instance, is a prominent influence in the health promotion behaviour of older adults in many countries such as Jamaica, Nepal and Taiwan (Bai et al., 2009; Bhandari et al., 2011; Eugene & Bourne, 2013).

This study addresses the knowledge gap by examining the influence of ethnic differences on health behaviour and health status among older Malaysians and aims to answer the following questions: (i) what are the type of HPBs adopted by older Malaysians? (ii) what are the health conditions of older Malaysians? (iii) how do ethnicity and other factors influence the HPBs of older Malaysians? and (iv) how do these behaviours differ across different ethnic groups? The following section of the paper begins with an overview of the methodology adopted, the data used for the statistical analysis and the conceptual framework for the analysis. The results are then presented based on the research questions set. The results are interpreted based on data and affirmed by past studies.

Methodology

This study uses data from the National Health and Morbidity Surveys (NHMS) for 2011 and 2015. These data are not longitudinal but two databases of the population based on the sampling frame of older adults aged 60 years and above, containing 2,721 and 3,790 observations for 2011 and 2015, respectively. The target population for the NHMS survey is non-institutionalised individuals residing in Malaysia for at least two weeks before data collection (Ministry of Health, 2011, 2015). The total sample size for 2011 was 9,528 and 10,428 for 2015. The response rate for 2011 was 93%, while the response rate for 2015 was 86.4%. The data were collected and monitored by the Ministry of Health. The sampling design for the survey ensure national representatives, in which the study adopted two-stage stratified random sampling. The two locations were the Primary location, which is made up of states of Malaysia, including Federal Territories, and the second location, which is made up of urban and rural locations formed within the primary location (Ministry of Health, 2011, 2015). The researchers did not participate in the data collection process but

only used the data that had been collected and cleaned by the Ministry. The data was collected face-to-face with 50 teams for the 2011 survey and 75 teams for the 2015 survey throughout Malaysia. Each team comprised of one Team Leader, three interviewers, one to two nurses and one driver (Ministry of Health, 2011, 2015). As such, the data received are limited to the variables approved to be shared with researchers. Researchers extracted the data concerning adults aged 60 years and above, in this study considered as older adults, who participated in the survey. Only variables that exist for the two comparative years were used for analysis. Hence, the study is limited by the existing variables that could affect the study findings and limit constructive policy recommendations. Although the data may be dated, findings from the data can provide a basic understanding of HPB among Malaysian older adults, and the role of ethnicity and other socioeconomic variables that might influence the behaviour and impact the health conditions of older adults.

Variables

The variables concerning HPB were limited to four: smoking behaviour, involvement in physical activity, fruit intake and vegetable intake. Based on the NHMS survey, intake of fruits and vegetables consumptions were based on Malaysian dietary guidelines. Respondents were asked to inform the number of servings of fruits and vegetables they consume per day. Two and more servings of fruits, three and more servings of vegetables, and five and more servings of fruits and/or vegetables are considered adequate. With regard to physical activity, respondents were asked about their physical activity for the past seven days on whether they have been inactive (no physical activity) or active (involved in moderate and high physical activity. Physical activity also includes the number of days per week that are used for walking of at least 10 min. Smoking habits recorded respondents current smoking status, past daily smoking status and past smoking status. If respondents recorded daily for current and past smoking status, respondents were asked to state the type of cigarettes smoked and the number of of cigarettes smoked per day.

The variables included to measure the health conditions of older persons were depression and medical conditions such as diabetes, hypertension and hypercholesterolemia. In 2011, the data used to measure depression was the number of respondents who reported symptoms of depression. Respondents were asked if they have experienced some level of anxiety, depression and suicidal. If respondents reported being anxious for the past six (6) months, they were asked to report other symptoms such as feeling restless, tired, and irritable, experienced muscle tension, and had difficulty in concentrating and sleeping. Respondents were also asked to report if they had ever felt depressed or down, and if this had affected their weight, appetite, and sleep pattern. Finally, respondents were asked if they had plan or have suicide method in mind and whether they had attempted suicide in the past. In 2015, the data used to measure depression was a score on mental health conditions based on a 12-item General Health Questionnaire (GHQ-12), in which respondents with a score of 3 and above were considered a case exhibiting mental health problems. The diabetes data for 2011 refers to self-reporting of known diabetes, after being

diagnosed by a doctor or assistant medical officer, while diabetes data for 2015 refers to respondents who are not classified as having impaired fasting glucose.

Hypertension and hypercholesterolemia conditions were measured based on self-reported data and medical assessment. The self-report data recorded “known hypertension”, in which respondents reported that they were informed to have hypertension by a doctor or a medical assistant. Measurement of blood pressure was conducted to measure the “undiagnosed hypertension” if respondents had a systolic blood pressure of 140 mmHg or more and/or diastolic blood pressure of 90 mmHg or more. Similarly, "known hypercholesterolemia" is recorded if respondents reported that they were informed of having hypercholesterolemia by a doctor or a medical assistant. "Undiagnosed hypercholesterolemia" was reported for respondents who had total blood cholesterol of 5.2 mmol/L or more.

Other variables that were included for the analysis represent socio-demographic and economic variables: age, gender, education, location, ethnicity, family role, marital status and income.

Conceptual Framework

Figure 1 provides the conceptual framework of the study. HPB follows Rubinelli and Diviani (2020), who indicate that health behaviour is influenced by factors

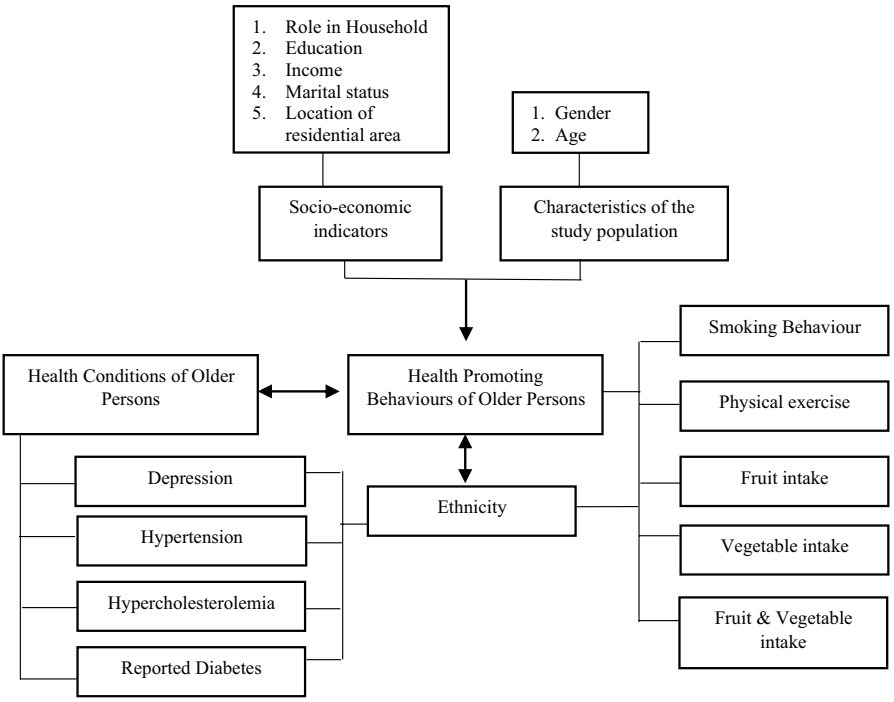

Fig. 1 Conceptual framework of the study

within the skin (biological and psychological) as well as outside the skin (interpersonal, environmental and policy). The population characteristics and psychological factors are described by the socioeconomic indicators and characteristics of the study population, while interpersonal, environmental and policy are replaced by solely ethnicity due to the limited data availability and the fact that different ethnic behaviours are also affected by the environment and policies (Table 1).

The HPB of older adults is divided into five categories, which are smoking behaviour, involvement in physical exercise, fruit intake, vegetable intake and the combination of both fruit and vegetable intake. As shown in Table 2, not all older adults engage in all HPBs, we then measure the number of HPBs undertaken by the older adults. Based on the available data, the health conditions of older adults in this study have four categories, which are experienced some level of depression or reported mental health issues, reported hypertension, reported hypercholesterolemia and reported diabetes.

Table 1 Variables included in the multinomial regression function

Variables	Notation	Explanation
Dependent Variables		Number of health-promoting behaviours engaged by elderly. The behaviours are as shown in Fig. 1
1 – older persons do not engage in HPB	No HPB	
2 – older persons engaged in one HPB	1 HPB	
3 – older persons engaged in two types of HPB	2 HPB	
4 – older persons engaged in more than 2 types of HPB	$\geq$3 HPB	
Ethnicity	ETH	1 – Malay (reference group) 2 – Chinese 3 – Indian 4 – Other Bumiputera 5 – Others
Characteristics of the study population		
Age	AGE	Age of elderly
Gender	GEN	1 – Male 2 – Female
Education	EDU	1 – Informal education (reference group) 2 – Primary education 3 – Secondary education 4 – Post-secondary education 5 – Unclassified
Socio-economic Indicators		
Location	STR	1 – Urban (reference group) 2 – Rural
Role in household	FAM	1 – Head of household (reference group) 2 – Member of household
Marital status	MAR	1 – Married (reference group) 2 – Single / Widow / widowed
Income	INC	Continuous variable

Table 2 Health-promoting behaviours of older persons for 2011 and 2015 (percentage)

Health-promoting behaviours of older persons	2011							2015						
	Overall	M	OB	C	I	O	χ^2	Overall	M	OB	C	I	O	χ^2
Active smoker	15.88	19.73	17.65	9.81	7.04	25.58	0.000	14.50	17.33	17.05	7.62	7.33	8.93	0.000
Participated in physical activity	49.48	47.88	53.50	53.06	43.43	48.84	0.045	52.73	54.13	51.79	52.54	39.57	53.70	0.001
Consumed adequate fruits	0.85	0.60	0.98	1.15	1.51	0.00	0.504	11.27	9.80	9.41	17.53	6.47	9.41	0.000
Consumed adequate vegetables	1.00	0.67	0.50	1.40	2.51	0	0.076	10.80	8.5	23.92	15.19	5.17	10.71	0.000
Consumed adequate fruits and vegetables	7.61	6.91	4.41	10.19	6.03	6.98	0.016	6.46	5.24	12.94	9.23	1.72	8.93	0.000

Note: M = Malay, OB = Bumiputera refers to Malay while Other Bumiputera refers to other Bumiputera in Sabah and Sarawak. C = Chinese, I = Indian, O = Other ethnic groups including non-Malaysians

Statistical Analysis

The study analyses both data sets separately as the data was not longitudinal and does not represent the same sample for both years. The study employs descriptive statistics and multinomial logistic regression (MNL) to answer the four research questions above. Chi-square analysis (χ^2) was performed to test the associations of HPBs and health conditions of older adults with their ethnicity. In performing the MNL, there are four dependent variables: 1 = elderly who are not involved in HPB, 2 = elderly involved in one HPB, 3 = elderly involved in two types of HPB and 4 = elderly involved in more than 2 types of HPB. Analysis was done using STATA package 15 and three p-values considered for significance are at 10 ($p \leq 0.10$), 5 ($p \leq 0.05$) and 1 ($p \leq 0.001$) percent, respectively.

The independent variables are as shown in Fig. 1. A summary of the variables involved in the MNL is shown in Table 1.

Results

The results begin by providing the types of HPBs adopted by older adults in Malaysia. Then a discussion on the health conditions of the different ethnic groups of older adults in Malaysia is presented. This is followed by the multinomial regression analysis to understand the influence of ethnicity and other factors that affect the HPB of older adults in Malaysia.

Health-Promoting Behaviours Adopted by Older Adults

Table 2 shows that older adults' HPBs was higher in 2015. HPBs are found to be significantly associated with ethnicity, all with $p \leq 0.001$ for 2015 and $p < 0.10$ for 2011, except for the consumption of adequate fruits. These results are supported by previous studies, which have indicated that increasing age enhances HPBs (Hulme et al., 2003; Al-Kandari & Vidal, 2007; Chen et al., 2007; Hong, 2007; Huang et al., 2010). Improvement in HPB is a result of strong health promotion practices in the government and private sectors as advocated by the Ministry of Health, which include health campaigns and health materials that enhance individuals' knowledge on health and disease prevention practice (Mathialagan, et al., 2018). This includes promoting health awareness through web-based material (Noman, et al., 2020).

Besides that, the percentage of older adults engaging in HPBs concerning physical activity, fruit intake, and vegetable intake was higher in 2015. Nevertheless, there was a slight decrease in the combination of fruit and vegetable intake. This result is similar to that of previous studies (Li et al., 2012; Riediger & Moghadasian, 2008; Salehi et al., 2010; Tamers et al., 2009), which showed that low fruit and vegetable consumption tended to increase with age. In many cases, older adults have more difficulties in acquiring and preparing fruit and vegetables in their everyday lives, for example, because of loss of chewing capacity and dental problems (Brennan et al., 2010), inability to travel

to markets to purchase fresh fruit and vegetables, and a lack of understanding about recommended foods (Appleton et al., 2009; Haynes-Maslow et al., 2013).

In the context of ethnicity, 'Other ethnic groups including non-Malaysians' showed an improvement in HPBs in all five categories. They showed a significant decrease of 16.65% in active smokers in 2015. People of the Malay ethnicity are more likely to smoke than other ethnicities for both years. Other Bumpitera also showed a relatively high percentage of smoking behaviour for both years with a marginal reduction in 2015. The other ethnic groups reported less than 10% of involvement in smoking behaviour. It is also interesting to note that there was a remarkable reduction in the percentage of other ethnic groups on smoking behaviour, a reduction from 26% in 2011 to 9% in 2015. These outcomes are consistent with the earlier studies of Cheah & Naidu (2012) and Tan et al. (2009). Nevertheless, this finding was different from the study by Lim et al., (2015a, 2015b) and Pan and Hu (2008) who indicated that the percentage of smoking among older adults was higher and that more likely to smoke as they aged.

Other Bumiputera ethnicity showed an improvement in four categories (active smoker, consumed adequate fruits, consumed adequate vegetables, consumed adequate fruits and vegetables). The results also indicate a significant improvement in consuming adequate vegetables (23.42%) and consuming adequate fruits and vegetables (8.53%) in the Other Bumiputera ethnicity. Similar results were also found by Yen et al. (2015). The Malay ethnicity shows an improvement in the categories of an active smoker, participated in physical activity, consumed adequate fruits and consumed adequate vegetables. The Chinese ethnicity shows an increasing trend in the percentage of consumed adequate fruits, consumed adequate vegetables and consumed adequate fruits and vegetables. A drastic improvement of 16.38% in consumed adequate fruits was seen among the Chinese between the four years interval. Similar findings were found in the previous study by Yen et al. (2015), where the Chinese ethnic group displays higher likelihoods of fruit consumption compared to other ethnicities in Malaysia. Indian older adults, however, show an improvement in only two categories: consumed adequate fruits and consumed adequate vegetables. A national representative study to identify the factors associated with inadequate fruit and vegetable consumption among older adults in Malaysia is still not available (Cheong et al., 2017).

The findings also show that Other Bumiputera, Chinese and Indian ethnicities had a slight decrease in physical activity participation over the four years, with 1.71%, 0.52% and 3.86% declines, respectively. The findings were similar in Kaur et al. (2015), who showed that the Other Bumiputra ethnic group of East Malaysia had the highest levels of physical inactivity. A study by Chan et al. (2019) also highlighted that physical inactivity among Malaysian older adults was generally high, particularly in older adults of Indian ethnicity, supporting the findings in this study.

Health Conditions of Older Adults

Table 3 shows the results of the health conditions of older adults. Health conditions of older adults are found to be significantly associated with ethnicity, all with $p \leq 0.10$ for 2011 and 2015, except for reported diabetes in 2015.

The table shows that almost 25% of older adults reported symptoms of mental health issues, with most cases reported by the Other Bumiputera and other ethnic groups. Nevertheless, in 2011, more Indian older adults were reported to experience some level of depression than other ethnic groups. By using the same data sets for 2011, this study confirms the earlier findings of Cheah et al. (2019) that Chinese and Malay older adults have a lower likelihood of experiencing mental health disorders compared to older adults of Indian and other ethnicities. A study by Khalid et al. (2021) showed that Malay older adults are more susceptible to experiencing depression compared to other ethnic groups. As religion is part of defining one's ethnicity in Malaysia, the study by Tan et al. (2021) showed that there were ethnic variations in the associations between religion and mental health. The study found that Chinese older adults are more prevalent in reporting depression compared to other ethnic groups due to their religious importance. The differences in findings are attributable to the area of study, as this study focuses on older adults in the whole of Malaysia while Khalid et al. (2021) focused on Northwest Malaysia, and Tan et al. (2021) focused on Southeast Asia Community Observatory site in the district of Segamat, Johor, West Malaysia.

The prevalence of hypertension, hypercholesterolemia and diabetes are high among older adults. The highest cases reported were in diabetes and hypertension for 2015 and 2011, respectively. A high case of diabetes and hypertension was also reported from a study by Bani et al. (2018) for the former and Koris et al. (2017) for the latter. While hypertension cases were high among Malay older adults in 2011, the cases were the highest among Indian older adults in 2015. Reported cases for hypercholesterolemia were high among Malay older adults for the two years under investigation. The reported cases for diabetes were higher among Other Bumiputera older adults in 2015 and Malay older adults in 2011. In analysing the relationship between NCBs and ethnicity, Iddrisu et al., (2020a, 2020b) found that the Indian older adults reported the highest percentage of diabetes and hypertension based on a survey of older adults from three states of Malaysia. Health problems among Malaysians, especially diabetes are correlated with the lifestyle of Malaysians, especially food. Malaysians food are high in carbohydrate, especially with rice being its staple food, consumed at least twice a day. Based on the study by Ali et al. (2021) Indian ethnicity was reported to have the highest carbohydrate in their daily diet.

The results provided significant implications on the health conditions of older persons, in which, self-reported measures may be understated the actual situation. Prevalence of depression and diabetes for 2011 that was based on self-reported measures were much lower than the prevalence of depression and diabetes for 2015 based on depression scale and blood test. This indicates that a more systematic measure of depression is needed to measure the prevalence of depression as many are still unaware and not fully exposed to the symptoms and occurrence of depression as well as denial in experiencing diabetes.

Multinomial Regression Analysis

As the coefficients of the MNL do not provide direct interpretation, the discussion is based on margin analysis. Based on Table 4, if an older person is male, the

Table 3 Health Condition of Older Persons for 2011 and 2015 (percentage)

Health conditions of older persons	2011							2015						
	Overall	M	OB	C	I	O	χ^2	Overall	M	OB	C	I	O	χ^2
Experienced some level of depression or reported mental health issue	1.54	1.48	1.96	0.89	4.02	2.33	0.030	23.37	24.24	41.18	16.94	22.43	35.71	0.001
Reported hypertension	71.19	72.68	77.45	67.52	69.35	65.12	0.019	69.37	70.47	69.11	65.64	72.84	62.50	0.055
Reported hypercholesterolemia	54.33	57.16	47.24	51.67	52.76	45.24	0.013	65.07	67.38	54.44	61.10	64.66	73.21	0.000
Reported diabetes / impaired fasting glucose	35.04	36.57	24.26	31.16	52.26	23.81	0.000	94.25	93.78	96.14	95.34	93.53	92.86	0.299

Note: M = Malays, OB = Bumiputera refers to Malays while Other Bumiputera refers to other Bumiputera in Sabah and Sarawak. C = Chinese, I = Indians, O = Other ethnic groups including non-Malaysians

probability of being involved in no HPB is 15% (2011) and 11% (2015). In 2011, the probability of being involved in 1 HPB was 49%, and 30% and 4% for 2 HPB and ≥ 3 HPB, respectively. In 2015, the probability of being involved in 1 HPB was 47%, and 31% and 10% for 2 HPB and ≥ 3 HPB, respectively. In 2011, older men reported higher rates for no HPB, 1HPB and ≥ 3 HPB than older women, while for 2

Table 4 Predicted probabilities of older persons' engagement in health-promoting behaviour 2011 and 2015

	No HPB		1 HPB		2HPB		≥ 3HPB	
	2011	2015	2011	2015	2011	2015	2011	2015
Ethnicity								
Malay	0.0750	0.0625	0.5286	0.4522	0.3565	0.3864	0.0398	0.0988
Chinese	0.0526	0.0633	0.4240	0.3326	0.4591	0.4186	0.0643	0.1856
Indian	0.0553	0.0585	0.5069	0.5099	0.3973	0.3846	0.0406	0.0470
Other Bumiputera	0.0579	0.0723	0.4477	0.3303	0.4503	0.3928	0.0440	0.2046
Others	0.1427	0.0314	0.4830	0.4206	0.3384	0.4154	0.0359	0.1326
Age (Mean value of 68.68)	0.0685	0.6431	0.4921	0.4202	0.3928	0.3935	0.0466	0.1220
Gender								
Male	0.1506	0.1110	0.4916	0.4747	0.3091	0.3152	0.0488	0.0990
Female	0.0144	0.0217	0.4662	0.3719	0.4748	0.4635	0.0445	0.1429
Education level								
No / Informal education	0.1059	0.0911	0.5521	0.4528	0.3235	0.3625	0.0186	0.0937
Primary education	0.0635	0.0611	0.4842	0.4286	0.4081	0.3948	0.0442	0.1154
Secondary education	0.0493	0.0532	0.4140	0.3941	0.4615	0.4070	0.0752	0.1458
Post secondary education	0.0374	0.0306	0.2728	0.2937	0.5415	0.4924	0.1483	0.1834
Unclassified	0.0871	0.1552	0.6622	0.4998	0.2228	0.2202	.0278878[a]	0.1249
Location								
Urban	0.0614	0.0583	0.5212	0.4417	0.3710	0.3824	0.0464	0.1176
Rural	0.0721	0.0667	0.4595	0.4019	0.4186	0.4059	0.0497	0.1254
Relationship of household								
Head of household	0.0679	0.1326	0.4579	0.3757	0.4292	0.4313	0.0450	0.1281
Member of household	0.0669	0.0577	0.5291	0.4826	0.3516	0.3477	0.0525	0.1120
Marital status								
Married	0.0633	0.0633	0.4722	0.3953	0.4172	0.4089	0.0473	0.1325
Single / Widow	0.0862	0.0623	0.5164	0.4740	0.3478	0.3662	0.0496	0.0975
Household income (Mean = RM 2,370.41)	0.067	0.061	0.4907	0.4220	0.3961	0.3959	0.0459	0.1211

Note: All variables are statistically significant at 1 significance level unless otherwise stated

[a]Not statistically significant

Fit stat analysis for 2011 LR(42): 436.650

Prob > LR: 0.000

Fit stat analysis for 2015 LR(42): 514.530

Prob > LR: 0.000

HPB female older adults reported higher rates than male older adults. In 2015, there were more male older adults with 2 or more HPBs than with no or 1 HPB. This study is consistent with that of Mofrad et al. (2016), which found that HPB among female older adults was higher than male older adults. Yeom (2014) argued that with increasing age, older women were more likely to have negative beliefs about their healthcare. Ainy and Azizi (2007) stated that the reduction of women involved in HPB was due to their household duties, unhealthy diets, limited physical activity and lack of attention to personal health.

If an older person had no education, the probability of being involved in no HPB was 10% and 9% in 2011 and 2015, respectively. In 2011, older adults with no education being involved in no HPB or 1HPB was higher when compared to other education levels. For older adults with post-secondary education, 54% were involved in 2 HPB and 14% in ≥ 3 HPB. In 2015, older adults with no education were more likely to be involved in no HPB (9%) and 1HPB (45%) compared to other education levels, while older adults with post-secondary education were more likely to be involved in 2 HPB (49%) and ≥ 3 HPB (18%). These findings are similar to those of Chung and Hwang (2008), indicating that older people with a post-secondary education level tend to have more positive perceptions about ageing and health care. Lim et al., (2015a, 2015b) also reported that the education level of older adults is a significant predictor of HPBs. Based on these findings, it is possible to conclude that a higher level of education serves as an important determinant of HPB among older adults in Malaysia.

If an older person lives in an urban area, the probability of being involved in no HPB was 6% and 5% in 2011 and 2015, respectively. In 2011, older adults who lived in urban areas were most likely to be involved in 1 HPB (52%), while the probability for older adults who lived in rural areas was higher in no HPB (7%), 2HPB (41%) and ≥ 3 HPB (5%). This was similar to 2015, when the probability of involvement in 1 HPB for older adults who lived in urban areas was 44%, while for the older adults who lived in rural areas was higher in no HPB (7%), 2 HPB (41%) and ≥ 3 HPB (5%). The findings were supported by previous research by Lim et al., (2015a, 2015b), who found that older adults from rural areas showed higher levels of HPBs compared to older adults from urban areas. The findings are also similar to Lee et al. (2006), who found that older adults from rural communities showed lower levels of HPBs compared to older adults from urban communities.

If an older person is Malay, the probability of being involved in no HPB is 7% for 2011. The probability of being involved in 1 HPB, 2 HPB and ≥ 3 HPB is 52%, 35% and 4%, respectively. In 2015, the probability of being involved in no HPB is 6%. The probability of being involved 1 HPB, 2 HPB and ≥ 3 HPB is 45%, 38% and 10%, respectively. Older Malay adults had a higher probability than other ethnicities in being involved in 1 HPB in 2011 (52%) and 2015 (45%), while older Chinese adults had a higher probability of being involved in 2 HPB in 2011 (45%) and 2015 (41%) in 2015. Older Chinese adults (6%) in 2011 and Other Bumiputera (20%) in 2015 had a higher probability than other older adults of being involved in ≥ 3 HPB. This finding relates to Malaysia's NHMS report that non-Malay Bumiputera, the Malay, and the Chinese are the highest users of outpatient care. Furthermore, Malays and non-Malay Bumiputera have higher hospitalisation rates (Institute of Public Health

2011). Regardless of which ethnic groups are more inclined to participate in more HPBs, the overall probability of participating in HPBs in 2015 was lower than in 2011, except for participation in three or more HPBs, although the increase was negligible. The overall probability of participating in HPBs was approximately 50%, which means more needs to be done to encourage older adults' participation in HPBs. It has been shown that participating in any form of HPB, such as physical activity, could reduce an older person's risk of NCDs (Basheti et al., 2019; Rutherford & Mark, 2017; Colberg et al., 2010).

In 2011, if an older person is head of household, they are more likely to be involved in either no HPB (6%) or 2 HPB (42%), compared to members of households, while members of households were more likely to be involved in 1 HPB (52%) and ≥ 3 HPB (35%) compared to heads of household. In 2015, the probability of heads of households being involved in no HPB (13%), 2 HPB (43%) and ≥ 3 HPB (12%), was higher than members of households. The findings show that heads of households participate more in HPB than members of households. This can be associated with the important role played by the heads of households as they are leaders in a family, key decision-makers and role models of good healthcare behaviour. Srivastava et al. (2021) concluded in their studies that older persons with active participation in household decision making have better health conditions and higher participation in social activities, including health behaviour.

If an older person was married, the probability of the older person being involved in no HPB (6%), 2HPB (40%) and ≥ 3 HPB (13%), was higher than for singles/widows. Our findings confirmed the findings of Hilz and Wagner (2018) who concluded that being married and having a partner enhance health behaviour and lead to a better health outcome. This fact was earlier confirmed by a few researchers (Becker et al., 2019; Hammersmith, 2018; Peltonen et al., 2017) that being married provide various health benefits. This is related to the concept of social support that close social relationship is seen as supportive behaviours by partners that influence health-promoting behaviours (Heaney & Israel, 2008).

Limitations

The limitations of this research include the years of analysis, as newer data will be needed to assess the current situation. The limited variables also prevent the study from assessing other possible factors that could influence the decision of older adults to actively participate in HPB. As the study uses two different data sets, the conclusion is limited to the behaviour of older populations in that year. The survey is highly reliant on self-reported data that has its limitations and subject to biases. In some instances, respondents may not report or tell the truth of their health condition. Respondents might choose a more socially acceptable answer to avoid being marginalized or negatively perceived by the society. In other instances, respondents may not be able to assess and evaluate their health conditions accurately as they might not fully understood their health or the survey questions. Hence, conclusions on whether health behaviour and health status have improved over the years cannot be determined empirically. The results have to be interpreted with caution as the

data extracted from a sample of the population although measures have been taken to ensure that the sample is representative.

Conclusion, Implications and Future Research

The present study reveals some important findings concerning HPB and the health status of older adults in Malaysia. The study found that the older Malaysians engaged in various forms of health-promoting behaviours such as reduced smoking, participation in physical activities, consumption of adequate fruits, consumption of adequate vegetables and consumption of adequate fruits and vegetables. These behaviours were found to be significantly different from ethnic groups. The majority of Malay ethnicity were active smokers, Chinese ethnicity participated more in physical activity. Overall, the Chines ethnicity also reported a higher percentage of consumption of adequate fruits and vegetables. With an exception to hypertension, it could be concluded that the health conditions of older adults in 2015 were generally lower than the previous year of analysis.

The study found various factors that affect older persons' participation in HPB. Male older persons, higher education, older persons from the rural area, Malay ethnicity older persons, head of households and married older persons were found to have a significant positive relationship with HPB. In encouraging and promoting positive health behaviour among older persons, programmes and activities should include groups beyond these people to ensure that the benefit of health-promoting behaviours could be realised by a wider older population. Importantly, awareness and enhanced HPB should start in younger age groups and not wait until individuals reach old age. It is possible that facilitating and encouraging HPB at a younger age could lead to improved lifestyles with continued positive health engagement, better health conditions at old age and reduced NCDs.

Findings from this study provide a basis for future research to replicate the study with new data sets. although the study provides an adequate basis for future research to validate the findings and examine if there is a change in older adults' health behaviour. While the prevalence of health conditions of older adults has increased in 2015 as compared to 2011, the prevalence of depression or reported mental health issues was higher in 2015. The overall percentage of mental health issues is almost 25% and highest among Other Bumiputera and other ethnic groups. This situation needs to be further investigated to understand the underlying factors that cause depression and mental health issues among older adults. Health care providers and appropriate agencies need to care for the mental state of older adults, and older adults and the community ought to be informed and educated. Public authorities should acknowledge that mental health issues among older adults are a problem, which, if not tackled, could further harm the health status of older adults.

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Declarations

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References

Abu Bakar, H., Bahtiar, M., Halim, H., Subramaniam, C., & Choo, L. S. (2018). Shared cultural characteristics similarities in Malaysia's multi-ethnic society. *Journal of Intercultural Communication Research, 47*(3), 243–267.

Ainy, E., & Azizi, F. (2007). Women, occupation and cardiovascular risk factors: Findings from the Tehran Lipid and Glucose Study. *Public Health, 121*(12), 950–953.

Ali, A., Margetts, B. M., & Zainuddin, A. A. (2021). Exploration of the principal component analysis (PCA) approach in synthesizing the diet quality of the Malaysian population. *Nutrients, 13*(1), 70.

Al-Kandari, F., & Vidal, V. L. (2007). Correlation of the health-promoting lifestyle, enrollment level, and academic performance of College of Nursing students in Kuwait. *Nursing & Health Sciences, 9*(2), 112–119.

Appleton, K. M., McGill, R., & Woodside, J. V. (2009). Fruit and vegetable consumption in older individuals in Northern Ireland: Levels and patterns. *British Journal of Nutrition, 102*(07), 949–953.

Bani, N. A., Hassan, M. Z., Kaidi, H. M., Hashim, N. F. M., Dziyauddin, R. A., Musa, R., ... & Mas' ud, A. A. (2018). Assessment of Health Status of the Elderly and Pre-elderly at a Malaysia Elderly Care Centre. *International Journal of Integrated Engineering*, *10*(7).

Bai, Y. L., Chiou, C. P., & Chang, Y. Y. (2009). Self-care behaviour and related factors in older people with Type 2 diabetes. *Journal of Clinical Nursing, 18*(23), 3308–3315.

Basheti, I. A., Ayasrah, S. M., & Ahmad, M. (2019). Identifying treatment-related problems and associated factors among hospitalized post-stroke patients through medication management review: A multi-centre study. *Saudi Pharmaceutical Journal, 27*(2), 208–219.

Becker, C., Kirchmaier, I., & Trautmann, S. T. (2019). Marriage, parenthood and social network: Subjective well-being and mental health in old age. PloS one, 14(7).

Bhandari, B., Bhattarai, M., Bhandari, M., & Jha, N. (2011). Awareness of disease and self care among hypertensive patients attending Tribhuvan University Teaching Hospital, Kathmandu, Nepal. *Journal of Nobel Medical College*, *1*(2), 29-35.

Brennan, D. S., Singh, K. A., Liu, P., & Spencer, A. (2010). Fruit and vegetable consumption among older adults by tooth loss and socio-economic status. *Australian Dental Journal, 55*(2), 143–149.

Chan, A., Malhotra, R., Matchar, D. B., Ma, S., & Saito, Y. (2016). Gender, educational and ethnic differences in active life expectancy among older Singaporeans. *Geriatrics & Gerontology International, 16*(4), 466–473.

Chan, Y. Y., Sooryanarayana, R., Kasim, N. M., Lim, K. K., Cheong, S. M., Kee, C. C., ... & Hairi, N. N. M. (2019). Prevalence and correlates of physical inactivity among older adults in Malaysia: Findings from the National Health and Morbidity Survey (NHMS) 2015. *Archives of gerontology and geriatrics*, *81*, 74-83.

Chang, K. S., Tsai, W. H., Tsai, C. H., Yeh, H. I., Chiu, P. H., Chang, Y. W., ... & Lee, S. C. (2017). Effects of Health Education Programs for the Elders in Community Care Centers–Evaluated by Health Promotion Behaviors. *International Journal of Gerontology*, *11*(2), 109-113.

Chen, C. M., Kuo, S. F., Chou, Y. H., & Chen, H. C. (2007). Postpartum Taiwanese women: Their postpartum depression, social support and health-promoting lifestyle profiles. *Journal of Clinical Nursing, 16*(8), 1550–1560.

Chung, Y. C., & Hwang, H. L. (2008, September). Education for Homecare Patients with Leukemia Following a Cycle of Chemotherapy: An Exploratory Pilot Study. In Oncology nursing forum (Vol. 35, No. 5).

Cheah, Y. K., & Naidu, B. M. (2012). Exploring factors influencing smoking behaviour in Malaysia. *Asian Pacific Journal of Cancer Prevention, 13*(4), 1125–1130.

Cheah, Y. K., Omar, M. A., Phang, S. N., & Abd Manaf, N. H. (2019). Determinants of Mental Health Disorder Among Adults in Malaysia. In *Proceedings of the Second International Conference on the Future of ASEAN (ICoFA) 2017-Volume 1*(pp. 229–238). Springer, Singapore.

Cheah, Y. K. (2018). The utilization of diagnostic tests among the elderly: Evidence from Malaysia. *Socio-Economic Planning Sciences, 62*, 121–128.

Cheong, S. M., Jasvindar, K., Lim, K. H., Surthahar, A., & Ambigga, D. (2017). Prevalence and factors influencing fruit and vegetable consumption among Malaysian elderly. *International Journal of Public Health and Clinical Sciences, 4*(1), 41–52.

Colberg, S. R., Sigal, R. J., Fernhall, B., Regensteiner, J. G., Blissmer, B. J., Rubin, R. R., ... & Braun, B. (2010). Exercise and type 2 diabetes: The American College of Sports Medicine and the American diabetes association: Joint position statement executive summary. *Diabetes Care, 33*(12), 2692–2696

Crimmins, E. M., & Saito, Y. (2001). Trends in healthy life expectancy in the United States, 1970–1990: Gender, racial, and educational differences. *Social Science & Medicine, 52*(11), 1629–1641.

Department of Statistics Malaysia. (2020). Demographic Statistics Fourth Quarter 2019, Malaysia. https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=430&bul_id=UDc0eVJ4WEJiYmw0Rmt5cjYvWHFkdz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09

Enjezab B, Farajzadegan Z, Taleghani F and Morowatisharifabad MA (2012) Health promoting behaviors in a population-based sample of middle-aged women and its relevant factors in Yazd, Iran. *International Journal of Preventive Medicine* 3, 191–198. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3399308/

Eugene, V., & Bourne, P. A. (2013). Hypertensive patients: Knowledge, self-care management practices and challenges. *Journal of Behavioral Health, 2*(3), 259–268.

Heaney, C. & Israel, B. A. (2008) Social Networks and Social Support. In: Glanz, Karen; Rimer, Barbara K.; Viswanath, K. (Eds.): Health behavior and health edu-cation. Theory, research, and practice. San Francisco, CA: Jossey-Bass: 189–210.

Hong, J. F. (2007). Health-promoting lifestyles of nursing students in Mahidol University. *Journal of Public Health Dentistry, 5*, 27–40.

Huang, S. L., Li, R. H., & Tang, F. C. (2010). Comparing disparities in the health-promoting lifestyles of Taiwanese workers in various occupations. *Industrial Health, 48*(3), 256–264.

Hulme, P. A., Walker, S. N., Effle, K. J., Jorgensen, L., McGowan, M. G., Nelson, J. D., & Pratt, E. N. (2003). Health-promoting lifestyle behaviors of Spanish-speaking Hispanic adults. *Journal of Transcultural Nursing, 14*(3), 244–254.

Iddrisu, M. A., Senadjki, A., SPR, C. R., Yong, H. N. A., Yew, K. T., & Poulsaeman, V. (2020a). Factors of Health Promotion Behaviour (HPB) and Elderly Health Diseases in Malaysia. *Journal of Population Ageing*, 1–31.

Institute for Public Health. (2011). National health and morbidity survey 2011: Non-communicable diseases. Putrajaya: Ministry of Health, Malaysia.

Hammersmith, A. M. (2018, April). Marital Biography Interdependence and Health in Later Life. In PAA 2018 Annual Meeting. PAA.

Haynes-Maslow, Lindsey, Parsons, Sarah E, Wheeler, Stephanie B, & Leone, Lucia A. (2013). Peer Reviewed: A Qualitative Study of Perceived Barriers to Fruit and Vegetable Consumption Among Low-Income Populations, North Carolina, 2011. *Preventing chronic disease, 10*.

Hilz, R., & Wagner, M. (2018). Marital status, partnership and health behaviour: Findings from the German ageing survey (DEAS). *Comparative Population Studies-Zeitschrift Für Bevölkerungswissenschaft, 43*, 65–97.

Hu, M., Ma, C., Sadarangani, T., & Wu, B. (2021). Social-behavioral Interventions for Asian and Hispanic American Dementia Caregivers: An Integrative Review. *Aging and Health Research*, 100027.

Iddrisu, M. A., Senadjki, A., Mohd, S., Yip, C. Y., & Lau, L. S. (2020b). The Impact of HPB on Elderly Diseases (Diabetes Mellitus, Hypertension, Hypercholesterolemia, Minor Stroke, Kidney Failure and Heart Problem): a Logistic Analysis. *Ageing International*, *45*(2).

Isajiw, W. W. (1993). Definition and Dimensions of Ethnicity. In *A Theoretical Framework. Challenges of Measuring an Ethnic World: Science, politics and reality: Proceedings of the Joint Canada-United States Conference on the Measurement of Ethnicity April* (Vol. 13, No. 1992, pp. 407–427).

Ji, L. L. (2001). Exercise at old age: Does it increase or alleviate oxidative stress? *Annals of the New York Academy of Sciences, 928*(1), 236–247.

Kandou, G. D. (2009). Makanan etnik Minahasa dan kejadian penyakit jantung koroner. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*, *4*(1), 42–48.

Kaur, J., Kaur, G., Ho, B. K., Yao, W. K., Salleh, M., & Lim, K. H. (2015). Predictors of physical inactivity among elderly Malaysians: Recommendations for policy planning. *Asia Pacific Journal of Public Health, 27*(3), 314–322.

Khalid, K., Ang, W. C., Hashim, A. F., Hat, S. Z. C., & Jamaluddin, R. (2021). Ageing and Mental Health: A 3-Year Analysis on Elderly Psychopathology in Northwest Malaysia. *Depression, 58*, 24–29.

Koris, R., Nor, N. M., Haron, S. A., Ismail, N. W., Junid, S. M. A. S., Nur, A. M., ... & Maimaiti, N. (2017). Socio-demographic, Cognitive Status and Comorbidity Determinants of Catastrophic Health Expenditure among Elderly in Malaysia. *International Journal of Economics & Management*, *11*.

Laws of Malaysia. Federal Constitution. 1963.

Lee, T. W., Ko, I. S., & Lee, K. J. (2006). Health promotion behaviors and qualityof life among community-dwelling elderly in Korea: A cross-sectional survey. *International journal of nursing studies, 43*(3), 293–300.

Li, Yang, Li, Dan, Ma, Cheng-yuan, Liu, Chao-Ying, Hui, Ding, Wen, Zhong-Mei, & Peng, Li-ping. (2012). Consumption of, and factors influencing consumption of, fruit and vegetables among elderly Chinese people. *Nutrition, 28*(5), 504–508. http://www.sciencedirect.com/science/article/pii/S0899900711002565 https://doi.org/10.1016/j.nut.2011.07.023

Lim EJ, Noh JH & Kim EY (2015) A Study of Factors Affecting Health-Promoting Behaviors to Young-Elderly Adults in Urban and Rural Communities. *International Journal of Bio-Science and Bio-Technology. Bio-Science and Bio-Technology* 7, 5, 367–374.

Lim, E. J., Noh, J. H., & Kim, E. Y. (2015b). A study of factors affecting health-Promoting behaviors to young-elderly adults in urban and rural communities. *International Journal of Bio-Science and Bio-Technology, 7*(5), 367–374.

Loeb, S. J. (2003). The older men's health program and screening inventory: A tool for assessing health practices and beliefs. *Geriatric Nursing, 24*(5), 278–285.

Mathialagan, A. G., JA JA, D. M., Azra, N., Selvaganapathi, G., Harikrishnan, T., Kohila, J. R., ... & Vikneswaran, S. (2018). Patient attitudes and health information features as predictors of health promotion in Malaysia. *Journal of Advanced Pharmacy Education & Research| Apr-Jun*, *8*(2).

Ministry of Health Malaysia (2011) National Health & Mordibility Survey. Methodology & General Findings. Volume 1. Published by Institute for Public Health, National Institutes of Health, Ministry of Health Malaysia. Retrieved from http://iku.moh.gov.my/images/IKU/Document/REPORT/NHMS2011-VolumeI.pdf.

Ministry of Health Malaysia (2015) National Health & Mordibility Survey. Methodology & General Findings. Volume 1. Published by Institute for Public Health, National Institutes of Health, Ministry of Health Malaysia. Retrieved from http://iku.moh.gov.my/images/IKU/Document/REPORT/nhmsreport2015vol2.pdf.

Mofrad, Z. P., Jahantigh, M., & Arbabisarjou, A. (2016). Health promotion behaviors and chronic diseases of aging in the elderly people of Iranshahr*-IR Iran. *Global Journal of Health Science, 8*(3), 139.

Mirghafourvand, M., Baheiraei, A., Nedjat, S., Mohammadi, E., Charandabi, S. M., & Majdzadeh, R. (2015). A population based study of health-promoting behaviors and their predictors in Iranian women of reproductive age. *Health Promotion International, 30*(3), 586–594.

Nishio, M., Takagi, D., Shinozaki, T., & Kondo, N. (2021). Community social networks, individual social participation and dietary behavior among older Japanese adults: Examining mediation using nonlinear structural equation models for three-wave longitudinal data. *Preventive Medicine*, *149*, 106613.

Noman, M., Koo, A. C., Tee, S. H., & Krishnan, M. (2020). Web elements for health promotion in Malaysia. *Health Promotion International, 35*(3), 458–469.

Ntuli, P. P. (2002). Indigenous knowledge systems the African renaissance. In C. A. OdoraHoppers (Ed.), *Indigenous Knowledge and the Integration of Knowledge Systems* (pp. 53–67). New Africa Books.

Pan, Z., & Hu, D. (2008). Multilevel analysis of individual and community predictors of smoking prevalence and frequency in China: 1991–2004. *Journal of Public Health Policy, 29*(1), 72–85.

Peltonen, R., et al. (2017). Contribution of smoking-attributable mortality to life expec-tancy differences by marital status among Finnish men and women, 1971–2010. *Demographic Research, 36*(8), 255–280.

Pender, N. J., Murdaugh, C. I., & Parsons, M. A. (2006). *Health Promotion in Nursing Practice* (5th ed.). Pearson Prentice Hall.

Riediger N and Moghadasian M. (2008). Patterns of Fruit and Vegetable Consumption and the Influence of Sex, Age and Socio-Demographic Factors among Canadian Elderly. Journal of the American College of Nutrition 27, 2, 306–313. Retrieved from https://www.researchgate.net/publication/23158322_Patterns_of_Fruit_and_Vegetable_Consumption_and_the_Influence_of_Sex_Age_and_Socio-Demographic_Factors_among_Canadian_Elderly

Rubinelli, S., & Diviani, N. (2020). The bases of targeting behavior in health promotion and disease prevention. *Patient Education and Counseling, 103*(12), 2395–2399.

Rutherford, E., & Mark, P. B. (2017). What happens to the heart in chronic kidney disease? *The Journal of the Royal College of Physicians of Edinburgh, 47*(1), 76–82.

Salehi, L., Eftekhar, H., Mohammad, K., Tavafian, S. S., Jazayery, A., & Montazeri, A. (2010). Consumption of fruit and vegetables among elderly people: A cross sectional study from Iran. *Nutrition Journal, 9*(1), 1–9.

Sonmezer, H., Cetinkaya, F., & Nacar, M. (2012). Healthy life-style promoting behavior in Turkish women aged 18–64. *Asian Pacific Journal of Cancer Prevention, 13*(4), 1241–1245.

Srivastava, S., Singh, S. K., Kumar, M., & Muhammad, T. (2021). Distinguishing between household headship with and without power and its association with subjective well-being among older adults: An analytical cross-sectional study in India. *BMC Geriatrics, 21*(1), 1–12.

Tamers, S. L., Agurs-Collins, T., Dodd, K. W., & Nebeling, L. (2009). US and France adult fruit and vegetable consumption patterns: An international comparison. *European Journal of Clinical Nutrition, 63*(1), 11–17.

Tan, M. M., Su, T. T., Ting, R. S. K., Allotey, P., & Reidpath, D. (2021). Religion and mental health among older adults: ethnic differences in Malaysia. *Aging & mental health*, 1–8.

Tan, A. K., Dunn, R. A., & Yen, S. T. (2011). Ethnic disparities in metabolic syndrome in Malaysia: An analysis by risk factors. *Metabolic Syndrome and Related Disorders, 9*(6), 441–451.

Tan, A. K. G., Yen, S. T., & Nayga, R. M. (2009). Role of education in cigarette smoking: An analysis of Malaysian Household Survey Data. *Asian Econ J, 23*, 1–17.

Tan, A. C. C., Leong, E. W. K., Chua, A. C., & Moy, F. M. (2013). Racial variations in booking haemoglobin of primigravidae in Malaysia: A prospective study. *BMC Research Notes, 6*(1), 1–5.

Taylor, D. (2014). Physical activity is medicine for older adults. *Postgraduate Medical Journal, 90*(1059), 26–32.

Walker, A. (2002). Growing old: An ESRC research programme. *Quality in Ageing and Older Adults, 3*(4), 12.

World Health Organization (2018) Antimicrobial resistance and primary health care (No.WHO/HIS/SDS/2018.56). World Health Organization.

Wu, F., Guo, Y., Chatterji, S., Zheng, Y., Naidoo, N., Jiang, Y., & Kowal, P. (2015). Common risk factors for chronic non-communicable diseases among older adults in China, Ghana, Mexico, India, Russia and South Africa: the study on global AGEing and adult health (SAGE) wave 1. *BMC public health, 15*(1), 1–13.

Yeom, H. E. (2014). Association among ageing-related stereotypic beliefs, self-efficacy and health-promoting behaviors in elderly Korean adults. *Journal of Clinical Nursing, 23*(9–10), 1365–1373.

Yen, S. T., Tan, A. K., & Feisul, M. I. (2015). Consumption of fruits and vegetables in Malaysia: profiling the daily and nondaily consumers. *Asia Pacific Journal of Public Health*, *27*(2), NP2635-NP2650.

Yusof, M., Awaluddin, S. M., Omar, M., Ahmad, N. A., Abdul Aziz, F. A., Jamaluddin, R., ... & Tan, M. P. (2018). Prevalence of Anaemia among the elderly in Malaysia and its associated factors: does ethnicity matter?. *Journal of environmental and public health*, *2018*.

Zhang, T., Shi, W., Huang, Z., Gao, D., Guo, Z., & Chongsuvivatwong, V. (2016). Gender and ethnic health disparities among the elderly in rural Guangxi, China: Estimating quality-adjusted life expectancy. *Global Health Action, 9*(1), 32261.

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Authors and Affiliations

Saidatulakmal Mohd[1] · Abdul Rais Abdul Latiff[2] · Radieah Mohd Noor[3] · Sharifah Nurlaili Farhana Syed Azhar[3]

Abdul Rais Abdul Latiff
abdulrais@usm.my

Radieah Mohd Noor
radieah@usm.my

Sharifah Nurlaili Farhana Syed Azhar
sh.nurlaili@usm.my

1 USM - RIKEN International Centre for Ageing Science (URICAS), School of Social Sciences & Centre for Global Sustainability Studies (CGSS), Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia

2 School of Social Sciences, Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia

3 Centre for Global Sustainability Studies (CGSS), Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia