

# The Intersectional Effects of Ethnicity/Race and Poverty on Health Among Community-Dwelling Older Adults Within Multi-Ethnic Asian Populace: A Population-Based Study

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## Research Article

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# Abstract

**Background:** Ethnicity/race and poverty are among determinants of health in older persons. However, studies involving intersectional effects of ethnicity/race and poverty on health of older adults within multi-ethnic Asian populace is limited. Hence, this study aimed to examine the intersectional effects of ethnicity/race and poverty on cognitive function, depressive symptoms, and multimorbidity among community-dwelling older adults in Malaysia.

**Methods:** Data were obtained from the first wave of a Peninsular Malaysia national survey - "Identifying Psychosocial and Identifying Economic Risk Factor of Cognitive Impairment among Elderly". Multivariate logistic regression was used to identify intersectional effects and associations between control variables and health outcomes. A comparison between Malay and non-Malay older adults within the same poverty group, as well as hardcore poor and non-hardcore poor older people within the same ethnicity groups, were conducted to understand the intersectional effects of ethnicity/race and poverty on health.

**Results:** Prevalence of cognitive impairment was highest among the hardcore poor group while risk of depression and multimorbidity were highest among non-Malays. Malay older adults were more prone to developing cognitive impairment regardless of their poverty status whereas non-Malay from the hardcore poor group had higher tendency for risk of depression and multimorbidity. Hardcore poor older adults residing alone were associated with higher depressive symptoms. But fewer older adults currently working reported multimorbidity.

**Conclusions:** Health outcomes of Malaysian older adults differ according to ethnicity and socioeconomic status. Given the importance of demographic characteristics on health outcomes, design of interventions targeting older adults within multi-ethnic settings must address specific characteristics, especially that of ethnicity and sociodemographic status so as to fulfil their needs. Several implications for future practice were discussed.

## Introduction

Contemporary discussion within the field of geriatrics lies significantly on the topic of health disparities among older adults. Health disparities is defined as differences in health outcome due to economic, social or environmental disadvantages (1). Problems associated with health disparity includes but is not limited to delayed healthcare utilisation, poor health status, and reduced cognitive vitality among older adults (2). Studies have reported ethnic diversity and poverty as undeniable causes of health disparities among older adults (2,3).

### *Poverty, Ethnicity, and Health Outcome*

Past studies deduces an association between old age poverty with disabilities, such as physical, mental, and sensory disability, especially in low- and medium-income countries (4). In terms of mental health disparities, poverty has been closely associated with cognitive impairment and depression. For example, a study has shown that higher current poverty index score in older adults was independently associated with poorer cognitive function, despite adjusting for educational attainment (5). Furthermore, a nine-year longitudinal study also showed that older adults of low socioeconomic status had higher incidences of depression (6).

Old age poverty is also linked to multimorbidity (7). A recent study from Brazil revealed older adults living in poverty had shorter life expectancy and higher prevalence of multimorbidity (8). The association between poverty and health could be attributed to several factors, including material conditions (e.g., food availability, healthcare utilisation), lifestyle practices, discriminatory practices, work conditions, community conditions, and government policies (9).

Levels of cognitive function was shown to differ ethnically. Diaz-Venegas et al. reported that older adults in the United States whom were Hispanics and non-Hispanic blacks had lower levels of cognitive function compared to non-Hispanic whites (10). Though cognitive functions differ according to ethnicity, education remains to be the most potent determinant of old age cognitive function (10,11). Studies also unveiled differences in prevalence of depression among older adults according to race and ethnicity. For example, prevalence of depression was higher among Mexicans, Puerto Ricans, Cubans, including other Hispanics or Latinos, compared to non-Hispanic whites (12). These differences might be due to differing perceptions of need for mental health service among ethnicities(13). Big data analysis of electronic medical records affirms that physical health may differ ethnically (14). According to St Sauver et al., incidence rates of multimorbidity drastically increased after 65 years old. Incidence of multimorbidity were higher among blacks and lower in Asian Americans in comparison to whites (15).

### ***Ethnicity and Poverty Distribution of Malaysian Older Adults***

Malaysia is a multi-ethnic nation. The population tally for 2019 consisted of 29.4 million citizens, with the ethnic majority being *Bumiputera* (69.3%), followed by Chinese (22.8%), Indians (6.9%), and other (1.0%) ethnic groups (16). *Bumiputera* in Peninsular Malaysia refers to Malays and indigenous peoples of Southeast Asia (17). Median age was 28.9 years old while percentage of population aged 65 years and above was 6.7% (2.2 million) in 2019. In terms of sex ratio, older adults aged 65 years old and over consisted of more females (1.2 million) than males (1.1 million) (16).

Where ethnicity and socioeconomic status among older adults were concern, a large number of Malays and indigenous people resided in rural areas and were more socioeconomically disadvantaged compared to ethnic Chinese and Indians (18). Most older Malays also had minimal or no education, were involved in traditional agriculture and earned lower compared to other ethnic groups. The same disadvantages applied to older women, whom rarely worked and had no other source of income, other than private transfers from their children (18,19).

### ***Healthcare System in Malaysia***

Healthcare services in Malaysia provides equal treatment to all, regardless of sex, socioeconomic status, and ethnicity. The Malaysian healthcare service is generally divided into two facets - government and private. Cost of treatment for Malaysians at government healthcare facilities is considerably cheap and affordable as due to heavy subsidisation by the government (20). In fact, the share of health expenditure in Malaysia's GDP for 2017 was 3.9 % (21). Most could afford government healthcare facilities, even those within the hardcore poor category, as registration costed only RM 1 (USD 0.25) for outpatient treatment and RM 5 (USD 1.24) for specialist treatment. Malaysian healthcare accessibility is also commendable as majority rural areas were equipped with community clinics and district hospitals. Emergency or referral cases from rural areas are usually referred to the nearest hospital. Private hospitals and general practitioners on the other hand are easily available in Malaysian urban vicinities. Cost of services at private health facilities are higher compared to government

facilities but its patrons (i.e., those of higher socioeconomic status and medical insurance holders) deem private facilities to have shorter waiting time and more comfortable ward environment.

### ***The Justification of the Study***

Researches on roles of poverty and ethnicity in older adults' health disparities lied heavily on developed countries. Findings from multi-ethnic nations about to attain the aged nation status remain scarce. Moreover, information relevant to the intersectional effects of ethnicity and poverty on health in a multi-ethnic Asian nation remain limited. The gap is one that requires crucial exploration as findings from multi-ethnic populations could help identify disadvantaged group associated towards a specific health condition, besides understanding differing health needs of ethnic groups. Findings obtained could be used to determine whether there is a need for improvement of current healthcare system or development of community-based healthcare facility, in line with achieving principle two of the Sustainable Development Goals - Leave No One Behind. The primary aim of this study was to identify the intersectional effect of ethnicity/race and poverty on health status among community-dwelling older Malaysian adults by examining disparities in cognitive function, depression status and multimorbidity. Given the general scarcity of studies relating intersectional effects of poverty and ethnicity on health in a multi-ethnic elder population, hypotheses were developed based on the fact that Malay older adults were more deprived socioeconomically compared to non-Malay in Malaysia. Hypotheses postulated were intersecting hardcore poor and Malay ethnicity would fare worse for cognitive impairment ( $H_1$ ), at risk of depression ( $H_2$ ), and multimorbidity ( $H_3$ ) compared to others.

## **Methods**

### ***Data source***

Baseline data of the longitudinal study, "Identifying Psychosocial and Identifying Economic Risk Factor of Cognitive Impairment among Elderly" were used. Data were collected from more than 2000 community-dwelling older adults in 2015 via population-based health survey of four states within Peninsular Malaysia. Multistage, proportional cluster, random sampling technique was used, involving face-to-face interview of one participant per household. Proportions of varying age groups, sex, and ethnicities of chosen sample was representative of community-dwelling older adults residing in Peninsular Malaysia. Detailed methodology of this study has been published separately (22).

### ***Measures***

*Ethnicity* was measured through the question "What is your race?". Answer options provided were Malay, Chinese, Indian, and others but these options were further dichotomised to Malay and non-Malay (Chinese, Indian, others).

*Poverty status* was determined via self-reported household income measures. Household income was defined as combined gross income of all occupants aged 15 and above within the same housing unit. Individuals classified under the hardcore poverty group were identified with reference to the Poverty Line Income (PLI). The PLI measures the household ability to meet minimum requirement of food and non-food consumption. For this study, the 2013 PLI level cut-off point was used, where households in Peninsular Malaysia with income less than MYR 460 (approximately USD 113) were considered hardcore poor (23).

*Depressive symptoms* were assessed via Geriatric Depression Scale-15 (24). The scale consists of 15 yes/no items, with score ranging from 0 to 15. Scores of 4 and above were indicative of “at risk of depression” (24).

*Cognitive function* was measured via Malay language Montreal Cognitive Assessment (25). Based on Che Din et al., score of 17/18 was a suitable cut-off point to detect mild cognitive impairment detection among Malaysian older adults with 68.2% sensitivity and 61.3% specificity (26). Therefore, participants with scores 18 and above were categorised as no cognitive impairment, whereas participants with a score of less than 18 were labelled as cognitively impaired.

*Multimorbidity* was measured based on self-reported medical history. Respondents were asked, “Has healthcare practitioner ever told you that you had ... that require ongoing medical attention and/or limit activities of daily living?” The list included twelve common geriatrics diseases. Older adults with two or more chronic diseases were categorised under multimorbidity. The complete list of diseases and studies utilising similar method to assess multimorbidity have been presented separately (27,28).

*Covariates* included were sex (men vs women), age (60-70-year vs > 71-year), marital status (married vs non-married), education level (no formal education vs primary education and higher), occupational status (currently working vs currently not working) and living arrangement (living alone vs living with others).

### ***Analytical Plan***

The original dataset consisted of 2322 respondents. However, current analyses involved respondents with household income information, resulting in a sample of 2196 with data on poverty status and ethnicity. No missing data was found for ethnicity. As showed in Table 1, this study involved four comparison groups - non-hardcore poor Malay ( $n = 877$ ), hardcore poor Malay ( $n = 503$ ), non-hardcore poor non-Malay ( $n = 521$ ), and hardcore poor non-Malay ( $n = 295$ ). Univariate analysis (i.e., frequency and percentage) was used to explore sample characteristics and examine mental and physical health across different groups. Bivariate analysis (i.e., chi-square statistic) was used to examine associations between poverty status and sex, age, marital status, education level, employment status, and living arrangement of Malay and non-Malay groups. Multivariate logistic regression was then used to examine influence of intersecting Malay ethnicity and poverty status on cognitive impairment, depression status, and multimorbidity. Logistic regression was also used to test effects of covariates on health outcomes.

## **Results**

### ***Background characteristics of the sample by poverty status and ethnicity***

Table 1 depicts demographic characteristics of sample according to poverty status and ethnicity. The study involved 1380 Malay respondents and 816 non-Malay respondents. Non-Malay sample consisted of Chinese ( $n = 708$ ) and Indian ( $n = 108$ ) ethnicity. Prevalence of hardcore poor among Malays and non-Malays were 36.4% and 36.2% respectively. Detailed demographic characteristics of the sample in use is available separately (29).

Gender distribution of men ( $n = 691$ , 50.1%) and women ( $n = 689$ , 49.9%) among the Malay ethnic group was almost equal. Most of the respondents within the Malay group were within the age group 60 – 70 years old ( $n = 892$ , 64.6%), were married ( $n = 912$ , 66.1%), received at least primary school education ( $n = 1102$ , 79.9%),

currently not working ( $n = 1017, 74.3\%$ ) and were living with others ( $n = 1239, 89.8\%$ ). As observed in Table 1, chi-square analysis found significant associations ( $P < 0.001$ ) between sex, age, marital status, education level, employment status, living arrangement with poverty status among Malays. It was also observed that hardcore poor were observed mostly among women, individuals aged 71 years and above, unmarried individuals, those with no formal education, those currently not working, and those living alone.

As for the non-Malays, more than half of were women ( $n = 466, 57.1\%$ ). Greater than 50% were aged between 60 – 70 years old ( $n = 488, 59.8\%$ ), married ( $n = 582, 71.3\%$ ), received at least primary education ( $n = 623, 76.3\%$ ), currently not working ( $n = 666, 82.2\%$ ) and lived with others ( $n = 719, 88.1\%$ ). Chi-square analysis revealed significant associations between sex ( $P < 0.001$ ), age ( $P < 0.001$ ), marital status ( $P = 0.031$ ), education level ( $P < 0.001$ ), employment status ( $P < 0.001$ ) with poverty status among non-Malays. Hardcore poor were observed mostly among women, individuals aged 71 years and above, unmarried individuals, those with no formal education and those currently not working. Though no association was found between living arrangements and poverty status among the non-Malays unlike Malays.

### ***The prevalence of cognitive impairment, at risk of depression, and multimorbidity***

Table 2 depicts prevalence of cognitive impairment, risk of depression, and multimorbidity within overall sample, hardcore poor, non-hardcore poor, Malays, and non-Malays, respectively. Prevalence of cognitive impairment, risk of depression, and multimorbidity among overall sample were 45.2%, 16.5%, and 50.4%, respectively. Hardcore poor older adults had highest prevalence of cognitive impairment (57.0%) but non-Malays were highly at risk of depression (21.5%) and had highest prevalence of multimorbidity (53.8%).

### ***The associations between poverty status, ethnicity, and cognitive function***

Table 3 shows the associations between poverty status and ethnicity on cognitive function. Prior to controlling for covariates, it was found that within the hardcore poor strata, Malay older adults were 2.187 times more likely to have cognitive impairment compared to non-Malay older adults (OR = 2.187,  $P < 0.001$ ). The relationship remained significant (OR = 2.713,  $P < 0.001$ ) even after controlling for covariates. However, no association was found between ethnicity and cognitive function (for both adjusted and non-adjusted model) among non-hardcore poor older adults. There were more older adults living in hardcore poor whom had cognitive impairment in both unadjusted (OR = 2.699,  $P < 0.001$ ) and adjusted model (aOR = 2.081,  $P < 0.001$ ) among the Malays. Upon controlling for covariates, it was found that Malay older adults whom were hardcore poor were 2.081 times more prone to cognitive impairment compared to the non-hardcore poor. In contrast, no association was found between poverty status and cognitive function among non-Malay older adults. Non-hardcore poor Malay women had a higher tendency for cognitive impairment. However, no significant association between sex and cognitive function as such was found in the hardcore poor and non-Malay group (see Table 3).

### ***The associations between poverty status, ethnicity, and depression status***

Table 4 reveals association between poverty status and ethnicity on depression status. Where hardcore poor is concerned, there were fewer Malay older adults whom were at risk of depression, for both in unadjusted (OR = 0.479,  $P < 0.001$ ) and adjusted model (aOR = 0.532,  $P = 0.001$ ). As a matter of fact, hardcore poor Malay older adults were 46.8% less prone towards risk of depression compared to hardcore poor non-Malay older adults upon controlling for covariates. Similar pattern was also found among non-hardcore poor, where Malay older

adults less likely to be at risk of depression (OR = 0.666,  $P = 0.009$ ; aOR = 0.630,  $P = 0.004$ ). Meaning non-hardcore poor Malay older adults were 37% less likely to be at risk of depression compared to hardcore poor non-Malay older adults. Hardcore poverty was found to be associated with depression status (OR = 1.409,  $P = 0.032$ ) among Malays. However, the relationship became non-significant upon controlling for covariates (aOR = 1.212,  $P = 0.264$ ). Based on the unadjusted model, it was observed that hardcore poor Malay older adults were 40.9% more prone to being at risk of depression compared to non-hardcore poor Malays. An association was also observed between ethnicity and depression status among non-Malays. More hardcore poor older adults were at risk of depression (OR = 1.960,  $P < 0.001$ ; aOR = 1.617,  $P = 0.011$ ) among the non-Malays. In specific, hardcore poor non-Malay older adults were 1.617 times more likely to be at risk of depression compared to non-hardcore poor non-Malays. An interesting observation among the hardcore poor depicts an association between marital status and depression status. Those whom were unmarried were 40.1% less likely to be at risk of depression (OR = 0.599,  $P = 0.027$ ). Besides that, hardcore poor older adults living alone also had higher risk of depression (OR = 1.740,  $P = 0.035$ ) (see Table 4).

### ***The associations between poverty status, ethnicity, and multimorbidity***

Table 5 depicts association between poverty status and ethnicity on multimorbidity. Presence of multimorbidity was lesser among hardcore poor Malay older adults compared to hardcore poor non-Malay individuals (OR = 0.640,  $P = 0.003$ ; aOR = 0.630,  $P = 0.003$ ). Based on the adjusted model of hardcore poor adults, Malays reported 37% lesser odds of multimorbidity compared to non-Malays. On the contrary, no association was found between ethnicity and multimorbidity among non-hardcore poor older adults. No association was also found between poverty and multimorbidity in both Malays and non-Malays. Interestingly, working status seemed to be associated with multimorbidity among the hardcore poor (OR = 1.560,  $P = 0.029$ ), non-hardcore poor (OR = 1.995,  $P < 0.001$ ), Malay (OR = 2.094,  $P < 0.001$ ), and non-Malay group (OR = 1.539,  $P = 0.023$ ). Older adults currently not working reported higher multimorbidity (see Table 5).

## **Discussion**

This study aimed to examine the intersectional effects of ethnicity and poverty on mental and physical health among Malaysian older adults.  $H_1$  postulated is partially supported, evidenced by presence of cognitive impairment in both hardcore poor and non-hardcore poor groups. Hence indicating that Malay older adults had higher tendency for cognitive impairment compared to other ethnicities, regardless of their poverty status. This finding is consistent with previously published Singaporean study, where Malays were almost twice more likely to have cognitive impairment compared to other ethnicities despite controlling for demographic characteristics and cardiovascular health status (30). Another population-based study in Malaysia also found that dementia in older adults were highly prevalent among the Malays (31). Findings from the study also found high prevalence of cognitive impairment among hardcore poor older adults. In line with these findings are that of longitudinal study in China, (32), where older adults living in poverty had 34% increased risk of developing cognitive impairment. The underlying reason for the association between ethnic Malay and cognitive impairment remains unknown as further analysis of the same dataset showed no significant difference in years of education between Malays and non-Malays. However, there could be a cultural factor at play. Malays tend to view cognitive impairment among older adults as part of the normal ageing process and seeking mental health treatment were often disregarded as unnecessary. There was a general stigma that existed within the community when seeking

mental health treatment in healthcare facilities. All of which could have created a barrier for older patients seeking treatment in healthcare facilities (33). Past studies also suggest old age poverty is strongly linked with cognitive impairment. Older adults living in poverty did not have the resources required to maintain high cognitive function, like access to healthcare facilities and nutritional benefits (34,35). Some researchers argue poverty itself is a cause for loss of cognitive capacity as poverty-related concerns may consume available mental resources, leaving less for tasks (30).

The second hypothesis, H<sub>2</sub> postulated by the study, however, were not supported when findings obtained revealed that Malays had reduced risk of depression despite their hardcore poor status. Contrarily, hardcore poor non-Malay older adults had an increased risk of depression. Risk of depression in general were more prevalent among non-Malays. These findings appear inconsistent with a Singaporean study that discovered that Malays and Indians, both of which are minority ethnics within the nation, were more prone to depression compared to Chinese (36). A cross-sectional study conducted in a northern state of Peninsular Malaysia found that prevalence of depression among older adults living in poverty was 19.2%. In fact, those whom were poor were 2.7 times likely to have severe depression compared to those who were not poor (38). The low prevalence of depression among Malays could be attributed to their religious practices. Malays in Malaysia are Muslims that firmly adhere to the Islamic spiritual practice. An important value brought forth from old Muslim practices is "*redha*", which means to wholeheartedly accept the decree of the Almighty. As a result, Malay older adults are generally happy and content with their lives though most live in poverty. This is validated through further analysis of the same dataset that reported higher intrinsic and extrinsic religiosity scores among Malay older adults compared to non-Malay older people. Religiosity has been shown by past research to protect against depression and improve well-being among older adults (28,37).

This study also revealed that hardcore poor older adults living alone has high risk of depression. Despite limited literature on the combined effects of poverty and living arrangement on old age depression, the association between living alone and depressive symptoms have been widely reported (38,39). Older adults whom were poor and lived alone had problems attaining basic needs and accessing healthcare services. Living alone also increases the risk of social isolation and loneliness, resulting in worsening of mental health, while concurrently dealing with challenges pertaining to poverty. These findings advocate the need for attention towards poor older adults living alone to prevent occurrence of depression.

Findings from the study also did not support H<sub>3</sub> postulated, when fewer hardcore poor Malay older adults reported multimorbidity, and no association was found between Malay ethnicity and multimorbidity among the non-hardcore poor. Further, prevalence of multimorbidity was highest among non-Malays. These findings indicate that Malay older adults living in poverty were less likely to report multimorbidity compared to non-Malays. Though these findings should be interpreted with caution due to the use of self-reported medical history. It is also important to bear in mind that some older Malay may not be aware of existing chronic medical conditions due inconsistent medical check-ups. Prior research claims that among Malaysians, Chinese are more health-conscious and utilise healthcare facilities more than Malay and Indian older adults (40).

The study acknowledges several limitations. Firstly, the use of self-reported measure to identify household income and multimorbidity. Consequently, the prevalence of hardcore poor may have been over-reported as respondents tend to under-report household income. Prevalence of multimorbidity may have also been under-reported as respondents tend to under-report existing chronic conditions due to social desirability bias. Hence,

future study should consider evaluating prevalence and incidences of multimorbidity across ethnicity via electronic medical record, which are more accurate. Next, this study is a cross-sectional study, disallowing corroboration of causal relationship. Future studies should consider longitudinal study design to examine the exact nature of interaction between changes in socioeconomic status with ethnicity to precisely determine health status. Lastly, this study was only conducted in Peninsular Malaysia. Therefore, results obtained could not be generalised to older adults residing in East Malaysia. Future study should perhaps include older people living in East Malaysia because there is a large population of *Bumiputera* (indigenous group) and poverty rate in East Malaysia higher compared to Peninsular Malaysia.

## Conclusion

These findings may help us to understand the intersectional effects of ethnicity and poverty on health among multi-ethnic community-dwelling older adults in Malaysia. Malay older adults, whom happen to be the majority, were more prone to cognitive impairment regardless of their poverty status. Conversely, non-Malay within the hardcore-poor strata had higher risk for depression and multimorbidity. The implications borne through these findings may be beneficial for future practice. For instance, implementation of ethnicity and poverty specific healthcare interventions. There is a clear need for programs focused on preventing cognitive impairment among Malay older adults irrespective of their poverty status. Likewise, healthcare initiatives that involve screening for cognitive impairment should also include more Malay older adults to delay or prevent dementia. Next, depression prevention program should be targeted towards non-Malay older adults living under poverty. In other words, design of future intervention programs should provide due consideration to specific ethnic-centred characteristics so as to meet their needs. Finally, there is a need to validate the association between ethnicity, poverty and multimorbidity via electronic medical records instead of self-reported measures.

## Declarations

### *Ethics approval and consent to participate*

The Medical Research Ethics Committee of Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, approved this study's protocol with IRB number: NMRR-13-1023-14660. The participants were provided with an information sheet and the study was explained to them verbally, providing an opportunity for them to discuss any concerns prior to providing written consent. Informed written consent was obtained for all participants before the start of the study. Confidentiality was maintained throughout the study. All methods were performed in accordance with the relevant guidelines and regulations (Declaration of Helsinki).

### *Consent for publication*

Not applicable

### *Availability of data and materials*

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

### *Competing interests*

The authors declare that they have no competing interests.

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### ***Author contributions***

TAH and FHF designed the study. FHF, RI and SAH analysed and interpreted the data. FHF was a major contributor in writing the manuscript. All authors read and approved the final manuscript.

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## Tables

**Table 1.** Demographic characteristics of the sample by poverty status and ethnicity

Demographic characteristics	Malay (n=1380)		Chi-square	P-value	Non-Malay (n=816)		Chi-square	P-value
	Non-hardcore poor (n=877)	Hardcore poor (n=503)			Non-hardcore poor (n=521)	Hardcore poor (n=295)		
	<i>n</i> (%)	<i>n</i> (%)			<i>n</i> (%)	<i>n</i> (%)		
<b>Sex</b>								
Men	478 (69.2)	213 (30.8)	18.901	<0.001	254 (72.6)	96 (27.4)	20.205	<0.001
Women	399 (57.9)	290 (42.1)			267 (57.3)	199 (42.7)		
<b>Age</b>								
60 – 70 years old	618 (69.3)	274 (30.7)	35.776	<0.001	339 (69.5)	149 (30.5)	16.607	<0.001
71 years and above	259 (53.1)	229 (46.9)			182 (55.5)	146 (44.5)		
<b>Marital status</b>								
Married	638 (70.0)	274 (30.0)	47.634	<0.001	385 (66.2)	197 (33.8)	4.664	0.031
Not married (never marry, widowed, divorced, separated)	239 (51.1)	229 (48.9)			136 (58.1)	98 (41.9)		
<b>Education level</b>								
Primary education and above	760 (69.0)	342 (31.0)	69.242	<0.001	449 (72.1)	174 (27.9)	77.154	<0.001
No formal education	117 (42.1)	161 (57.9)			72 (37.3)	121 (62.7)		
<b>Employment status</b>								
Currently working	256 (72.9)	95 (27.1)	18.850	<0.001	114 (79.2)	30 (20.8)	18.374	<0.001
Currently not working	610 (60.0)	407 (40.0)			401 (60.2)	265 (39.8)		

Living arrangement								
Living with others	823 (66.4)	416 (33.6)	43.235	<0.001	465 (64.7)	254 (35.3)	1.784	0.182
Living alone	54 (38.3)	87 (61.7)			56 (57.7)	41 (42.3)		

**Table 2.** The prevalence of cognitive impairment, at risk of depression, and multimorbidity among older adults in overall sample, hardcore poor, non-hardcore poor, Malay, and non-Malay group

	Cognitive impairment	At risk of depression	Multimorbidity
	Prevalence		
Overall	45.2	16.5	50.4
Hardcore poor	57.0	21.0	50.6
Non-hardcore poor	39.3	14.1	50.3
Malay	47.8	13.5	48.3
Non-Malay	41.2	21.5	53.8

**Table 3.** Test of poverty status and ethnicity on cognitive function

Mental health outcome 1 - Cognitive impairment (ref: normal cognitive function)	Test of hardcore poverty status				Test of ethnicity			
	Among hardcore poor		Among non-hardcore poor		Among Malay		Among non-Malay	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Unadjusted - Malay or hardcore poor (ref: non-Malay in test of hardcore poverty status and non-hardcore poor in test in ethnicity)	2.187***	1.628-2.939	1.057	0.845-1.324	2.699***	2.147-3.394	1.305	0.975-1.747
Adjusted - Malay or hardcore poor (ref: non-Malay in test of hardcore poverty status and non-hardcore poor in test in ethnicity)	2.713***	1.961-3.755	1.084	0.858-1.371	2.081***	1.629-2.660	1.043	0.758-1.434
Covariates								
Women (ref: men)	1.193	0.835-1.704	1.331*	1.026-1.726	1.378*	1.048-1.812	1.153	0.829-1.605
71 years old and above (ref: 60-70 years old)	1.484*	1.079-2.041	1.267	0.985-1.631	1.509**	1.163-1.958	1.113	0.820-1.511
Not married (ref: married)	0.977	0.671-1.424	1.332	0.993-1.787	1.275	0.944-1.720	0.987	0.682-1.430
No formal education (ref: primary education and above)	2.688***	1.887-3.829	2.542***	1.808-3.573	3.150***	2.256-4.399	2.125***	1.463-3.087
Currently not working (ref: currently working)	1.256	0.829-1.904	0.842	0.646-1.097	1.023	0.775-1.351	0.781	0.532-1.146

Living alone (ref: living with others)	1.418	0.887- 2.266	1.126	0.724- 1.751	1.017	0.661- 1.564	1.577	0.977- 2.546
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Note: OR, odd ratio; CI, confidence interval; \*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ .

**Table 4.** Test of poverty status and ethnicity on depression status

Mental health outcome 2 - At risk of depression (ref: no risk of depression)	Test of hardcore poverty status				Test of ethnicity			
	Among hardcore poor		Among non-hardcore poor		Among Malay		Among non-Malay	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Unadjusted - Malay or hardcore poor (ref: non-Malay in test of hardcore poverty status and non-hardcore poor in test in ethnicity)	0.479***	0.338-0.678	0.666**	0.490-0.905	1.409*	1.030-1.928	1.960***	1.392-2.760
Adjusted - Malay or hardcore poor (ref: non-Malay in test of hardcore poverty status and non-hardcore poor in test in ethnicity)	0.532**	0.370-0.766	0.630**	0.458-0.866	1.212	0.865-1.697	1.617*	1.117-2.340
Covariates								
Women (ref: men)	1.075	0.703-1.643	0.961	0.665-1.390	0.965	0.657-1.418	1.120	0.749-1.674
71 years old and above (ref: 60-70 years old)	0.981	0.675-1.427	1.191	0.845-1.679	1.060	0.743-1.512	1.110	0.772-1.596
Not married (ref: married)	0.599*	0.380-0.943	1.233	0.825-1.844	0.826	0.541-1.262	0.948	0.614-1.465
No formal education (ref: primary education and above)	1.978**	1.343-2.915	2.634***	1.757-3.948	2.672***	1.822-3.920	1.769**	1.163-2.689
Currently not working (ref: currently working)	0.998	0.603-1.651	0.918	0.634-1.329	0.989	0.674-1.453	0.952	0.595-1.524

Living alone (ref: living with others)	1.740*	1.040- 2.913	0.560	0.287- 1.094	0.973	0.554- 1.710	1.167	0.668- 2.039
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Note: OR, odd ratio; CI, confidence interval; \*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ .

**Table 5.** Test of poverty status and ethnicity on multimorbidity

Physical health outcome multimorbidity (ref: no multimorbidity)	Test of hardcore poverty status				Test of ethnicity			
	Among hardcore poor		Among non- hardcore poor		Among Malay		Among non- Malay	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Unadjusted - Malay or hardcore poor (ref: non- Malay in test of hardcore poverty status and non-hardcore poor in test in ethnicity)	0.640**	0.479- 0.855	0.909	0.732- 1.130	0.896	0.719- 1.116	1.274	0.955- 1.699
Adjusted - Malay or hardcore poor (ref: non- Malay in test of hardcore poverty status and non-hardcore poor in test in ethnicity)	0.630**	0.466- 0.851	0.945	0.756- 1.181	0.928	0.734- 1.173	1.132	0.831- 1.542
Covariates								
Women (ref: men)	0.902	0.645- 1.262	1.048	0.817- 1.343	1.007	0.777- 1.305	0.961	0.700- 1.319
71 years old and above (ref: 60-70 years old)	0.846	0.627- 1.143	1.147	0.899- 1.463	0.997	0.779- 1.277	1.099	0.817- 1.477
Not married (ref: married)	1.173	0.826- 1.666	0.933	0.700- 1.242	0.865	0.651- 1.149	1.367	0.954- 1.958
No formal education (ref: primary education and above)	0.871	0.632- 1.200	0.693*	0.497- 0.967	0.632*	0.468- 0.853	1.072	0.741- 1.549
Currently not working (ref: currently working)	1.560*	1.048- 2.322	1.995***	1.545- 2.575	2.094***	1.604- 2.733	1.539*	1.060- 2.232
Living alone (ref: living with others)	1.163	0.764- 1.770	0.983	0.638- 1.512	1.019	0.688- 1.508	1.160	0.720- 1.871

Note: OR, odd ratio; CI, confidence interval; \*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ .