ASM Sc. J., 13, Special Issue 5, 2020 for APRU2018, 75-82

Longitudinal Association Between Chronic Pain and Physical Disability Among Rural Community Dwelling Older Adults in Malaysia

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Chronic pain is common in older adults and has negative consequences on their health. There have been some cross-sectional studies of chronic pain and physical disability but limited longitudinal studies, especially from low and middle-income countries. This study aimed to examine the longitudinal association between chronic pain and physical disability. A cohort study was conducted among older adults in Kuala Pilah, a rural district in Negeri Sembilan. A total of 2404 respondents at baseline and 1889 respondents at 12 months follow-up responded to this study. Physical disability was assessed using the Katz Index of Independence in Activity of Daily Living. Generalised Estimating Equation was used to measure the longitudinal association between chronic pain and physical disability presented as relative risk (RR) and its 95% confidence interval. The response rate was 96.4% at baseline. The prevalence of physical disability was 5.16% (95%CI 4.30, 6.18) and 1-year incidence was 4.49% (95% CI 3.59, 5.60). In unadjusted analysis, respondents with chronic pain demonstrated a significant higher risk of physical disability than those without pain (RR 3.10; 95%CI 1.95, 4.95). After adjusting for covariates, chronic pain remained as a significant predictor and increased 2.08 times the risk of physical disability (RR 2.08; 95%CI 1.31, 3.32). Our study shows that chronic pain, older age group and low physical activity were associated with a higher risk of physical disability among community dwelling older adults. Hence, early intervention of chronic pain and higher physical activity level should be recommended in the geriatric population to prevent physical disability.

Keywords: older adults; chronic pain; physical disability

I. INTRODUCTION

Chronic pain is an underestimated illness affecting population from all walks of life in terms of neurologic and physiologic experience. It is defined as pain that has lasted for at least three months or pain that persists beyond normal tissue healing (Merskey, 1986). Pain specialists proposed to consider chronic pain as a disease and not merely a symptom (Siddall and Cousins, 2004). Globally, 30.3% of the adult population is suffering from chronic pain (Elzahaf *et al.*, 2012). In the geriatric population, the prevalence of chronic pain ranges from 35% to 52.9% in developed countries (Fayaz *et al.*, 2016; Kozak-Szkopek *et al.*, 2017; Larsson *et al.*, 2017; Patel *et al.*, 2013). A systematic review reported that the prevalence of chronic pain in Asian countries ranges from 42-90.8% (Zaki and Hairi, 2015).

Chronic pain can result in very detrimental consequences if left untreated. In 2013, the Global Burden of Disease Study reported that chronic low back pain was the single greatest cause of "years lived with disability" (YLDs), which was

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estimated to cost more than 146 million YLDs (Rice *et al.*, 2016). Pain is a common illness for older adults, and it is found to increase as one gets older. Older adults tend to suffer from chronic pain more than their younger counterparts. The world's geriatric population is postulated to increase twofold between 2015 and 2050 (Eggermont *et al.*, 2014). Similarly, the proportion of the geriatric population in Asia is projected to increase more than twofold from 7.9% to 18.8% within a similar period (He *et al.*, 2016). Consequently, the prevalence and burden of chronic pain could increase.

Evidence suggests that chronic pain has negative consequences on physical health (Bryant *et al.*, 2007; Hairi *et al.*, 2013), mental health (Cabak *et al.*, 2015), quality of life (Willman *et al.*, 2013) and increases the risk of premature mortality (Smith *et al.*, 2014). Several cross-sectional studies have demonstrated the association between chronic pain and physical disability (Baker, 2005; Hairi *et al.*, 2013; Pereira *et al.*, 2014). Longitudinal studies have also reported that chronic pain increases the risk of physical disability (Bryant *et al.*, 2007; Eggermont *et al.* 2014; Kaiho *et al.*, 2017; Makino *et al.*, 2019). Nevertheless, these studies were conducted in high-income countries and there are limited longitudinal studies from low- and middle-income countries. Therefore, this is the first study aimed to examine the longitudinal association between chronic pain and physical disability in Malaysia.

II. MATERIALS AND METHOD

A. Study Design and Setting

This was a cohort study conducted in Kuala Pilah, a district in the state of Negeri Sembilan, Malaysia. Kuala Pilah is a rural district located about 100km from Malaysia's capital city, Kuala Lumpur. Baseline assessments were conducted from November 2013 until February 2014. Follow up data were collected from December 2014 until February 2015. The study population were older adults aged 60 and above residing in the Kuala Pilah district for a minimum period of 12 months before data collection. Respondents were excluded if they were not Malaysian citizens, residing in nursing homes, admitted to hospital during the interview or refused to participate. Sampling was carried out by the Department of Statistics Malaysia using a stratified 2-stage sampling design. First, Kuala Pilah was divided into 254 Enumeration Blocks (EBs). Each EB consists of 80-120 living quarters (LQs). A total of 156 EBs were randomly selected in the first stage sampling. Subsequently, 16 LQs were randomly selected from each selected EB. Weight was applied to the living quarters that were selected in each enumeration block. Baseline data and follow up data at twelve months were collected via face to face interviews at respondents' houses by trained research assistants. The details of study methods have been previously published (Ismail, 2016). Figure 1 illustrates the study flow chart.

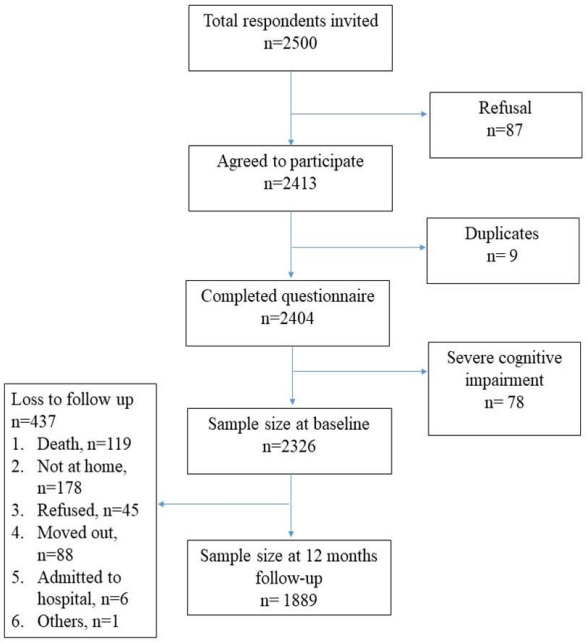

Figure 1. Study flow chart

B. Study Variables

1. Independent variables

The diagnosis of chronic pain was established by asking the respondents "In the past 6 months, have you experienced persistent pain in any part of the body for 3 months or more?". The responses were either yes or no. Three months is the most commonly used chronic pain cut off adopted in Asian countries, which is also consistent with the International Association for the Study of Pain definition (Zaki and Hairi, 2015). This question has been validated among older

Malaysians and has been used in numerous large epidemiological studies (Ismail, 2016; Rafidah and Zaki, 2016).

2. Outcomes

The outcome of physical disability was assessed using the Katz Index of Independence in Activities of Daily Living. Katz ADL Index is one of the most frequently used tools to measure disability in the geriatric population (Yang *et al.*, 2014). Katz ADL Index assesses physical performance in the six functions of bathing, dressing, toileting, transferring, continence, and feeding. There were three options for each function: without assistance, partial assistance and full assistance. Respondents were categorised as physically disabled if they needed partial or full assistance in at least one of the six functions. Respondents were categorised as physically competent if they were able to perform all six functions without assistance.

3. Covariates

Covariates included were age, sex, education, ethnicity, monthly household income, multimorbidity, depression, cognitive function, self-rated health, social support, physical activity and obesity. Age was categorised into two groups: age 60-69, and age 70 and above. Education was categorised into 3 categories: low (no formal education), medium (primary education) and high (secondary or tertiary education). Ethnicity was grouped into Malay, Chinese, Indian and others. Monthly household income was categorised into 3 categories: low (<RM500), medium (RM500-999) and high (≥1000). The presence of seven chronic diseases was asked: diabetes, hypertension, hyperlipidaemia, myocardial infarction, chronic lung diseases, stroke and arthritis. Chronic diseases were categorised into multimorbidity. The responses of multimorbidity were either yes or no. Multimorbidity is defined by the World Health Organization (WHO) as the coexistence of two or more chronic conditions (Mercer *et al.*, 2016). Depression status was assessed using the Geriatric Depression Scale (GDS). The cognitive function of study respondents was assessed using the Mini-Mental state Examination (MMSE). Self-rated health was classified into good and poor. Duke Social Support Index (DSSI) was used to assess social support of study respondents. Physical activity level was measured using the physical activity scale for the elderly (PASE).

The PASE questionnaire has been tested and validated among community dwelling older adults in Malaysia (Ismail *et al.*, 2015). Obesity was categorised as obese (BMI ≥27.5) and not obese (BMI <27.5) according to the Malaysian Clinical Guidelines on Management of Obesity 2004 (Zainudin *et al.*, 2014).

C. Statistical Analysis

Categorical data were described as frequencies and percentages. Sociodemographic characteristics of respondents at baseline were stratified and described according to physical disability status. The associations between categorical variables were examined using chi-square tests. For variables with missing data of more than 5%, multiple imputations by chained equation (MICE) based on 20 sets of imputation models were used to attenuate biased estimates. The covariates with missing data of more than 5% were social support, physical activity and obesity.

The longitudinal associations between chronic pain at baseline and physical disability were assessed using Generalised Estimating Equations (GEE) analysis. To ensure all respondents were free from the outcome of interest, respondents with a physical disability at baseline were excluded from the longitudinal analysis. In GEE analysis, a modified Poisson regression approach was adopted for estimating relative risks (Yelland *et al.*, 2011). The distribution of the outcome variable was set as Poisson and the link function as log. The working correlation structures (exchangeable, independence, unstructured and autoregressive 1) in GEE were tested to see which gave the lowest quasi-likelihood under the independence model criterion value. Unstructured correlation structure was selected to allow for all possible correlations. Univariable associations were first tested for chronic pain and other covariates with a physical disability. After that, covariates with a p-value of less than 0.25 were included in the multivariable GEE models together with chronic pain. Sex and age group were forced into the multivariable models due

to their clinical significance. In multivariable analysis, variables that were not significant were removed until we obtained a final model. We applied weightage to account for the complex sampling design of this study. All analyses were conducted at 5% significant level using STATA Version 14.

III. RESULT

A. Respondent Characteristics

A total of 2500 older adults were invited to participate in this study and 2404 responded giving a response rate of 96.2% at baseline. However, 78 respondents were excluded from baseline analysis due to severe cognitive impairment (MMSE<9) resulting in 2326 respondents at baseline. At twelve months follow-up, 1889 respondents participated (response rate of 81.2%). The overall prevalence of chronic pain and physical disability were 21.05% (95%CI 19.39, 22.80) and 5.16% (95%CI 4.30, 6.18) respectively. One-year incidence of physical disability was 4.49% (95% CI 3.59, 5.60). Of those suffering from chronic pain, 11.08% (95%CI 8.49, 14.34) reported having a physical disability. Table 1 presents the baseline characteristics of study respondents according to physical disability status.

Table 1. Baseline characteristics of study respondents according to physical disability status

Variables	Total, n (%)	Physical disability present, n (%)	Physical disability absent, n (%)	Chi Square Value	P-value
Age group					
60-69	1110 (47.89)	23 (19.01)	1087 (49.48)	42.66	<0.001
≥ 70	1208 (52.11)	98 (80.99)	1110 (50.62)		
Sex					
Male	885 (38.18)	47 (38.84)	838 (38.14)	0.02	0.877
Female	1433 (61.82)	74 (61.16)	1359 (61.86)		
Education					
Low	348 (15.06)	30 (24.79)	318 (14.52)	17.21	<0.001
Medium	1417 (61.32)	78 (64.46)	1339 (61.14)		
High	546 (23.63)	13 (10.74)	533 (24.34)		
Race					
Malay	2225 (95.99)	117 (96.69)	2108 (95.95)	1.71	0.636
Chinese	40 (1.73)	3 (2.48)	37 (1.68)		
Indian	43 (1.86)	1 (0.83)	42 (1.91)		
Others	10 (0.43)	0	10 (0.46)		
Marital status					
Married	1449 (62.89)	65 (54.17)	1384 (63.37)	10.51	0.015
Divorced	47 (2.04)	0	47 (2.15)		
Widowed	761 (33.03)	54 (45.00)	707 (32.37)		
Single	47 (2.04)	1 (0.83)	46 (2.11)		
Living arrangements					
Living with spouse and/or children	1880 (81.46)	107 (89.17)	1773 (81.03)	7.02	0.030
Living alone					
Living with others	297 (12.87)	6 (5.00)	291 (13.30)		
	131 (5.68)	7 (5.83)	124 (5.67)		
Monthly household income				13.82	0.001
Low	804 (35.14)	61 (50.83)	743 (34.27)		
Medium	694 (30.33)	26 (21.67)	668 (30.81)		
High	790 (34.53)	33 (27.50)	757 (34.92)		
Multimorbidity					
Yes	996 (44.17)	61 (52.14)	935 (43.73)	3.18	0.075
No	1259 (55.83)	56 (47.86)	1203 (56.27)		
GDS depression					
No	1507 (66.65)	63 (53.39)	1444 (67.38)	9.85	0.002
Yes	754 (33.35)	55 (46.61)	699 (32.62)		

Table 1. Baseline characteristics of study respondents according to physical disability status (continued)

Variables	Total, n (%)	Physical disability present, n (%)	Physical disability absent, n (%)	Chi Square Value	P-value
Cognitive status					
No cognitive impairment	1275 (56.04)	28 (24.78)	1247 (57.68)	47.18	<0.001
Mild cognitive impairment	1000 (43.96)	85 (75.22)	915 (42.32)		
Self-rated health					
Good	1476 (63.95)	44 (36.36)	1432 (65.48)	42.16	<0.001
Poor	832 (36.05)	77 (63.64)	755 (65.48)		
Social support					
High	1702 (79.13)	71 (62.83)	1631 (80.03)	19.17	<0.001
Low	449 (20.87)	42 (37.17)	407 (19.97)		
Physical activity	1766 (81.91)	27 (24.32)	1739 (85.04)	261.92	<0.001
High	390 (18.09)	84 (75.68)	306 (14.96)		
Low					
Obesity					
No	1307 (63.63)	46 (69.70)	1324 (63.44)	1.08	0.298
Yes	783 (36.37)	20 (30.30)	763 (36.56)		

*Percentages add up to 100 vertically

B. Longitudinal Analysis Between Chronic Pain and Physical Disability

GEEs were conducted on both complete case and imputed data. Before running GEEs, respondents with a physical disability at baseline were excluded to ensure all respondents were free from the outcome of interest. There was no multicollinearity of independent variables detected using the variance inflation factor (VIF) test. Comparison of the complete case and imputed data results were conducted. Both analyses showed consistent results. GEE results of imputed data were described in the result section and GEE results of complete case data were presented in appendix 1.

Table 2 presents the GEE results of imputed data. In unadjusted GEE analysis, six variables were found to be associated with a higher risk of physical disability. These were chronic pain (RR 3.10; 95%CI 1.95, 4.95), age group ≥70 (RR 3.06; 95%CI 1.80, 5.21), low monthly household income (RR 2.61; 95%CI 1.40, 4.85), mild cognitive impairment (RR 2.05; 95% 1.28, 3.29), poor self-rated health (RR 2.16; 95%CI 1.36, 3.46) and low physical activity (RR 7.77; 95%CI 4.85, 12.43).

Subsequently, variables with a p-value of less than 0.25 were included in the multivariable GEE models together with chronic pain. Variables sex and age group were forced into the multivariable models due to their clinical significance (Bartley and Fillingim, 2013; Eltumi and Tashani, 2017). Variables that were not significant were removed until we obtained a final model. In the fully adjusted model, three variables remain associated with a higher risk of physical disability - chronic pain (RR 2.08; 95%CI 1.31, 3.32), age group ≥70 (RR 1.84; 95%CI 1.06, 3.22) and low physical activity (RR 5.64: 95%CI 3.39, 9.49). Possible interaction between chronic pain and sex were tested and the result did not show any significant interaction (RR 0.82; 95%CI 0.32, 2.10).

Table 2. Unadjusted and adjusted GEE analysis for longitudinal associations between chronic pain and physical disability using imputed data

Variable	Unadjusted model		Fully adjusted model	
	RR (95%CI)	P-value	RR (95%CI)	p-value
Chronic pain				
No	1		1	
Yes	3.10 (1.95, 4.95)	<0.001	2.08 (1.31, 3.32)	0.002
Age group				
60-67	1		1	
≥70	3.06 (1.80, 5.21)	<0.001	1.84 (1.06, 3.22)	0.030
Sex				
Male	1		1	
Female	1.25 (0.76, 2.03)	0.373	1.21 (0.75, 1.95)	0.437
Education				
High	1			
Low	2.23 (0.97, 5.05)	0.060		
Medium	1.57 (0.78, 3.19)	0.206		
Monthly household income				
High	1			
Low	2.61 (1.40, 4.85)	0.002		
Medium	1.62 (0.83, 3.16)	0.164		
Multimorbidity				
No	1			
Yes	1.20 (0.75, 1.92)	0.451		
GDS Depression				
No	1			
Yes	1.39 (0.85, 2.25)	0.184		
Cognitive status				
No cognitive impairment	1			
Mild cognitive impairment	2.05 (1.28, 3.29)	0.003		
Self-rated health				
Good	1			
Poor	2.16 (1.36, 3.46)	0.001		
Social support				
High	1			
Low	1.39 (0.78, 2.48)	0.264		
Physical activity				
High	1		1	
Low	7.77 (4.85, 12.43)	<0.001	5.64 (3.39, 9.49)	<0.001
Obese				
No	1			
Yes	1.06 (0.64, 1.75)	0.814		

*Weightage has been applied to the percentages to adjust for the complex sample design.

IV. DISCUSSION

This study aimed to examine the longitudinal association between chronic pain and physical disability. Our findings showed that older adults with chronic pain were at higher risk of physical disability, and the risk remained after adjusting for covariates.

The prevalence of chronic pain among rural community dwelling older adults in this study was 21%. This is higher than another study conducted in Malaysia (Zaki and Hairi, 2014). This could be due to the difference in respondents recruited in the study. Respondents from the previous study were recruited regardless of locality, while respondents

recruited in this study were mainly from a rural community. Previous studies demonstrated that chronic pain is more prevalent in rural residents (Dahlhamer *et al.*, 2018; Docking *et al.*, 2015; Hoffman *et al.*, 2002). On the other hand, the prevalence of chronic pain found in this study is lower compared to high-income countries (35%-52.9%) (Fayaz *et al.*, 2016; Kozak-Szkopek *et al.*, 2017; Larsson *et al.*, 2017; Patel *et al.*, 2013). It could be argued that the prevalence of chronic pain would be higher in these high-income countries where individuals have a longer life expectancy.

From the unadjusted analysis, respondents with chronic pain were found to be at higher risk of physical disability (RR 3.10; 95%CI1.95, 4.95). After adjusting for covariates, chronic pain remained a significant predictor that increased risk of physical disability (RR 2.08; 95%CI 1.31, 3.32). Similar findings were reported in previous studies (Bryant *et al.*, 2007; Eggermont *et al.*, 2014; Makino *et al.*, 2019). Older adults experiencing pain were found to have an increased risk of developing physical disability in an 18 months cohort study (Eggermont *et al.*, 2014). In a cohort study conducted over approximately 22 months follow up, the effect of chronic pain on physical disability remains after adjusting for multiple comorbidities (Bryant *et al.*, 2007). Another cohort study conducted for 24 months reported that severe pain remained as a significant predictor of physical disability after adjusting for covariates (Makino *et al.*, 2019). However, a prospective cohort study over 10 years found that respondents with pain were not at risk of physical disability after adjustment for confounders (Andrews *et al.*, 2013). The inconsistencies of findings may suggest that pain may affect physical function in the short term, or some physical limitations may have a reversible course.

Our data showed that older age group significantly increased the risk of physical disability in the fully adjusted analysis. This finding is in line with results from previous studies (Nunes *et al.*, 2017; Taş *et al.*, 2007). Low physical activity was also found to increase the risk of physical disability. Similar findings were also found from several cohort studies (Balzi *et al.*, 2009; Matsunaga *et al.*, 2017). An interventional study demonstrated that the magnitude of change in physical activity was related to the reduction in the onset of major mobility disability (Fielding *et al.*, 2017).

In contrast, multimorbidity was not found to increase the risk of physical disability. This result contradicts a prior study. This could be due to the definition used by the previous study which defined multiple comorbidities as ≥3 chronic conditions (Bryant *et al.*, 2007) while this study used the WHO definition of multimorbidity which is ≥2 chronic conditions. Social support was also not shown to be a significant predictor of physical disability. The findings of a qualitative study demonstrated that older adults suffering from chronic pain were contented with social support received from friends (Rodríguez *et al.*, 2019). Perhaps among our respondents who experienced chronic pain, they still receive satisfactory social support from their family and friends.

There are several strengths to this study. To the best of authors' knowledge, this is the first study examining the longitudinal association of chronic pain and physical disability in Southeast Asia. The second strength is the prospective cohort study design of this study that allows us to draw causal inferences. Also, the sample size of rural older adults recruited in the study was relatively large. However, this study is not without limitations. The self-reported data collection method of this study was our greatest concern. Self-reported data collection might introduce recall bias to the study. One of the methods adopted to reduce recall bias was we excluded respondents with severe cognitive impairment from the analysis. Another limitation was the relatively short follow up period. Hence, we were not able to observe the long-term effects of chronic pain on physical disability.

V. CONCLUSION

In conclusion, our study shows that chronic pain was associated with a higher risk of physical disability among community dwelling older adults in Malaysia. Also, older age group and low physical activity were found to be risk factors for physical disability. Hence, early intervention of chronic pain and higher physical activity level should be recommended in the geriatric population to prevent physical disability.

VI. ACKNOWLEDGEMENT

This study is funded by the University of Malaya Grand Challenge Project (GC001A- 14HTM, Prevent Elder Abuse and NegleCt InitiativE (PEACE).

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