The Effects of Chronic Conditions and Elderly Background on the Development of Elderly Mobility Function

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Abstract— **This study aims to analyze the influence of chronic conditions and chronic diseases on elderly mobility function in Indonesia using the panel data of IFLS 3, IFLS 4, and IFLS 5. The sample is a balanced panel of elderly aged 60 and above in IFLS 5, who have completed retrospective information and can be traced back since IFLS 3. This study uses the random-effects ordered logistic models. The self-assessed health status, marital status, residence area, working status, body mass index, education, gender, and age are used as covariates. The results suggest that the elderly probability of experiencing limited mobility function is increasing with age; while chronic conditions and chronic diseases such as diabetes, heart disease, and stroke significantly affect the impairment of mobility function of the elderly in Indonesia. Other covariates also have significant effects on elderly mobility function, except for residence area and marital status variables.**

Keywords— **Chronic Conditions, Chronic Diseases, Elderly, IFLS, Mobility Function, Panel Data, Random-effects ordered logistic models**

I. INTRODUCTION

As people get older, the experience starting from the womb, infants, toddlers, children, and adolescents will determine their physical and health conditions during their adulthood until older age [1] [2]. The lack of hearing, vision, mobility, and increased risk of non-communicable diseases will appear along with the aging process [3] [4]. The mobility function plays an important role in the healthy aging, closely related to the quality of life of the elderly [5]. The mobility function usually deteriorates in old age, but in a different course, extent and speed for each individual [6].

The mobility function is defined as the abilities to perform physical movements [7], and to move within an environment without any assistance [8]. The limitation of mobility function refers to the declining performance of individuals measured by a performance-based test or self-perceived difficulty in mobility [9]. Elderly with limited mobility function is more susceptible to physical and mental health problems, injuries, limited access to goods and services, social isolation, less able to take part in society [10], and inability to perform daily activities [8].

The longitudinal paths of the mobility limitations can be explained using the disablement process model [11]. A functional limitation (including mobility function), starts with the decreased functions of certain body parts caused by illness, injury, or risk factors (lifestyle, environment, psychological factors) and ends with disabilities on individuals [12].

Mobility impairments in the elderly is a pre-clinical stage in the disability process [13]. Several studies have shown that chronic conditions, including heart disease [14,], stroke [14] [15] [16], chronic respiratory diseases [17], diabetes [15] [18], arthritis [14] [15] [16], and cognitive impairment [19] may trigger mobility limitation in older age. Furthermore, comorbidity [20], age [21], gender [22], education [23], are closely related in increasing the mobility limitation.

The main impact of chronic conditions is a disability, which will engage in a personal long-term medical care needs [12], which would burden individuals, families, and governments with great social and economic costs [24].

Researches on mobility function in elderly using panel data in Indonesia are still limited. This study aims to examine the effects of chronic conditions on elderly mobility function by using three waves of the Indonesian Family Life Survey (IFLS) panel data, i.e. IFLS 3 (2000), IFLS 4 (2007), and IFLS 5 (2014). This study is expected to contribute to the discussion of the relationships between chronic conditions with mobility function in the elderly, which is still not widely practiced in Indonesia.

II. METHODS

This study uses the data from the third, fourth and fifth waves of the Indonesian Family Life Survey (IFLS 3, 4 and 5), conducted by Rand, Center for Population and Policy Studies (CPPS) and SurveyMETER. The surveys were conducted in 2000, 2007, and 2014 respectively. The analysis is limited to respondents aged 46 years or older in 2000 with a sample size of 8,465 individuals. In the 2007 wave, 2,600 respondents were lost to follow-up (died or not interviewed). With n = 5,865 in 2007 wave, 1,595 respondents were lost to follow-up (died or not interviewed) in the 2014 wave (n = 4,270). The 982 respondents were excluded due to missing information on relevant variables. The final balanced panel sample data included 3,288 respondents (consisting of 1,507 males and 1,781 females) aged 60 years or older in the 2014 wave.

III. MEASURES

A. Mobility Limitation

The mobility limitation was assessed using the self-reported questionnaire data collected in 2000, 2007, and 2014. The assessment of mobility limitation includes three questions on physical ability in daily activity (walking for 5 km, walking for 1 km, and carrying a pail of water for 20 meters). The score of each task was coded as 1 for those who were indicated having 'no difficulty', coded as 3 for those who were indicated having 'with difficulty', and code as 5 for those who were 'unable to do it'. These three questions represent the functionality of mobility for the overall levels of the body [6] in terms of walking, moving and carrying goods [11]. The sum results are categorized as follows: 1. for a sum of 3 is categorized as 'no difficulty in mobility function'; 2. for a sum of 5 or 7 is categorized as 'light difficulty in mobility function'; 3. for a sum of 9 or 11 is categorized as 'medium difficulty in mobility function' 4. for a sum of 13 or 15 is categorized as 'heavy difficulty in mobility function'.

B. Chronic Conditions

Chronic conditions identified whether the respondent had ever been told by a physician that he/she had hypertension, diabetes or high blood sugar levels, tuberculosis, asthma, other lung conditions, heart attack (including coronary heart disease, angina, or other heart problems), liver, stroke, cancer or malignant tumor, arthritis/rheumatism, high cholesterol, prostate illness, kidney disease, stomach or other digestive disease, emotional or psychiatric problems, and memory-related disease. For each wave, the respondents were categorized to 0 or 'no history of chronic conditions' if the respondent did not have any history of chronic condition a year before the enumeration. Furthermore, category 1 showed 'had a history of chronic condition' if the respondent had one history of chronic condition prior to the enumeration year; category 2 was addressed to 'had two chronic condition histories' if the respondent had two chronic condition histories a year before enumeration, and category 3 referred to 'had more than two chronic condition histories' if before the enumeration year the respondent had more than two histories of chronic conditions.

C. Chronic Disease

Chronic diseases observed in this study are diabetes, lung disease, cardio-vascular, stroke, and arthritis/rheumatism. For each condition in each wave, respondents were categorized as no disease (=0), and self-reported diagnosis as having a disease (=1).

D. Other Covariates

Sociodemographic information on respondents such as gender and level of education were obtained from the baseline year (IFLS 3 in 2000) and are assumed to be time-invariant. The level of education attained is classified into three categories: low (none or elementary school); middle (junior or senior high school); and high (diploma education or university). The age variable is a continuous variable which value was formed based on the last birthday of the respondents in the 2014 survey (IFLS 5). Marital status is identified as never married, married, and ever married (divorced/widowed). Employment status is categorized as 1) 'not working' for answers 'looking for work', 'schooling', 'retirement/old age', 'sickness', 'unhealthy', and 'others'; and 2) 'work' for answers 'work/seek to earn/help to obtain income/earning' and 'take care of the household'. The residence area is grouped into two categories (i.e. urban and rural), so is the self-assessed health status (i.e. good and poor). The body mass index (BMI, measured by weight in kilograms divided by height in square meters (kg/m^2)) is categorized based on BMI criteria as follows: underweight (BMI< 18.5), normal (BMI of 18.5-25.0), and overweight (BMI> 25.0). In addition, as a control of time where the individuals were observed, a year dummies variable is added. Age, marital status, working status, self-assessed health status, residence area, and body mass index are assumed as the time-variant.

E. Statistical Analysis

The random-effects ordered logistic models were used to investigate the associations between functional mobility limitation, chronic conditions, and chronic diseases. To identify the effect of chronic conditions on mobility function, the model that will be used is as follow:

$$Y_{it} = \alpha + \beta_1 rkk_{it} + \delta\ X_i + \gamma\ X_{it} + v_i + \eta_{it} \qquad (1)$$

To examine the effect of types of chronic conditions on mobility function, the model that will be used is as follow:

$$Y_{it} = \alpha + \beta_1 diabetes_{it} + \beta_2 paru\_kronis_{it} + \\ \beta_3 kardio_{it} + \beta_4 stroke_{it} + \beta_5 rematik_{it} \qquad (2) \\ + \delta\ X_i + \gamma\ X_{it} + v_i + \eta_{it}$$

Where i = 1, 2, …, N (individual); t = 1, 2, …, T (period of study); Y_{it} = Mobility function of the i-th individual at period t; rkk_{it} = Chronic conditions of individual i at period t; $diabetes_{it}$ = Diabetes disease of individual i at period t; $paru\_kronis_{it}$ = Lung disease of individual i at period t; $kardio_{it}$ = Cardio-vascular disease of individual i at period t;

$stroke_{it}$ = Stroke disease of individual i at period t; $rematik_{it}$ = Arthritis disease of individual i at period t; X_i is the time-invariant variables (i.e. gender and level of education); and X_{it} is the time-variant variables (i.e. age, marital status, employment status, residence area, self-assessed health status, body mass index, and year dummies).

The error variable consists of v_i and η_{it} which are both different. Variable v_i varies between individuals but does not change across the time (time-invariant), for example, psychosocial factors (among others: motivation, personality, self-assessment, belief, acceptance) that may affect the function of individual's mobility (dependent variable) but its values cannot be observed (unobserved).[1] Whereas η_{it} is different for each individual and every point of time.

IV. RESULTS AND DISCUSSION

Before discussing the empirical results, an overview of the respondents' characteristics based on the main independent variables used in this study, which are chronic conditions and chronic diseases, is presented. The majority of elderly (aged 60 or above) and pre-elderly (aged 46-59 years old) in the sample are individuals who did not have chronic conditions in 2000 (94.50%); but in 2014, there was about 40 percent increase in elderly who had chronic conditions. Based on the chronic diseases observed in this study, arthritis is the most common disease in elderly (9% in 2014), followed by diabetes (3.60% in 2014) and heart disease (2.60% in 2014). The prevalence of chronic disease is increasing along with the observation period.

Based on the control variables in 2014, 54.2 percent of panel data sample in this study were women, self-assessed as in good health (60.4%), the marital status was married (59.6%), lived in urban area (52.40%), had employment status (68.4%), the highest educational attainment was no education or graduated elementary school (82.1%), and from the younger-elderly age group, i.e. those aged 60-69 years old, (57.9%).

There was an increase in the functional mobility limitation for the pre-elderly (aged 46-59) and elderly (aged 60 or above) age groups during 2000-2014; that is, from 65.3 percent of those not having any mobility limitation in year 2000 increased to 64.8 percent of having mobility limitation issues in year 2014. This increase indicates that mobility limitation is increasing with age.

There are two models of random-effects ordered logistic regression used in this study. The first model (Model 1) is to examine the effects of chronic conditions on the functional mobility limitation, controlled by all other covariates. While the second model (Model 2) is to analyze the relationship between various chronic diseases and functional mobility limitation, which is also controlled by all other covariates.

Table 1 presents the marginal effect results for the first model (Model 1). The results of Model 1 show that the variable

of chronic conditions is statistically significant in influencing the probability of elderly to suffer from mobility limitations. Based on the marginal effects values, elderly with one, two, or more than two chronic conditions would have had a lower probability of not suffering from the mobility limitation by 4.4 percentage points, 12.7 percentage points, and 21.5 percentage points respectively compared to those who did not suffer from any chronic condition. Whereas elderly with more than two chronic conditions had a probability of having problems with moderate mobility limitation by 11.4 percentage points compared to those without any chronic condition. This suggests that the more chronic conditions possessed by the elderly, the higher the chance of elderly to suffer from limited mobility function. This finding is in line with previous studies, both cross-section [20] and long-term [26] studies, which stated that mobility limitation would increase along with the increase of chronic conditions.

Age is an important factor in mobility function [21]. The marginal effects in Table 1 suggest that as the elderly gets older, the probability of not suffering from any mobility limitation will be lower. While the probability of having mild, moderate, and severe mobility limitations will increase with age. This finding is in line with some previous studies, which suggested that the prevalence of mobility limitation would increase with age [22]. Moreover, the squared of age variable was found to be insignificant, indicating that the probability of having mobility limitation would increase, and would not decline, along with the increase in age. One explanation could be due to the fact that the sample in this study is limited to the old-age individuals (the elderly).

In terms of gender variable, the probability of women suffering from mild, moderate, and severe mobility limitations is higher than men at 20.6 percentage points, 13.6 percentage points, and 3.4 percentage points, respectively. This is in line with some previous studies [8] [22], which found that women had more perceptions of mobility limitation compared to men.

Table 1. *Marginal Effects at Means* for Model 1

Parameter	No difficulty	Light difficulty	Medium difficulty	Heavy difficulty
	dy/dx (S.E)	dy/dx (S.E)	dy/dx (S.E)	dy/dx (S.E)
(1)	(2)	(3)	(4)	(5)
Chronic Conditions (Base category: No Chronic Condition)				
1 Chronic Condition	-0.044[a] (0.019)	0.024[a] (0.010)	0.016[a] (0.007)	0.004[a] (0.002)
2 Chronic Condition	-0.127[b] (0.024)	0.059[b] (0.008)	0.055[b] (0.013)	0.014[b] (0.004)
> 2 Chronic Condition	-0.215[b] (0.030)	0.068[b] (0.006)	0.114[b] (0.025)	0.032[b] (0.009)
Age	-0.022[b] (0.007)	0.013[b] (0.004)	0.008[b] (0.003)	0.002[b] (0.001)
Age Squared	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Gender (Base category: Male)				
Female	-0.377[b] (0.014)	0.206[b] (0.010)	0.136[b] (0.007)	0.034[b] (0.002)
Other covariates [c]	YES	YES	YES	YES

a. $p < 0.05$

b. $p < 0.01$

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[1] Variable v_i is also commonly called as *unobserved heterogeneity variable* [25].

Employment status has a significant negative influence on the mild, moderate, and severe mobility limitations. A working elderly is less possible to suffer from mild, moderate, and severe mobility limitations than those who are not working. This result is in line with previous research [22] which suggested that unemployed individuals would likely be suffered from mobility limitation.

Elderly who self-assessed themselves as in good health have a higher probability to have no mobility limitation than the elderly who self-assessed themselves as in poor health. While the elderly with good health perception have lower probability to have a moderate mobility limitation compared to those having poor health perception. These results are in line with previous study [27] which suggested that moderate or poor self-assessed health is associated with mobility limitation.

Furthermore, elderly having overweight body mass index high-possibly suffer from mild, moderate, and severe mobility limitations than those having normal body mass index. This finding is in line with previous research [28] which suggested that individuals with obesity suffered from poor mobility limitation.

Based on educational attainment, elderly graduating from middle-level education less-possibly suffer from low, moderate and high mobility limitations compared to those with low-level of education. This is in line with previous research [29] which stated that elderly with a low education had lower mobility functions than elderly with higher education.

Although in this study there are many married-elderly who had mobility limitations (mild, moderate and severe), but the marital status variable was statistically found insignificant; this is in line with previous studies [29]. However, in general, the elderly who lived alone (not married, divorced, or widowed), especially men, highly risked to have mobility limitation [30]. Similarly, the residence area variable in this study statistically did not affect significantly the elderly mobility limitations; and it is also in line with several previous researches [5] [8].

In the second model (Model 2), results presented in Table 2 show that the variables of diabetes, heart, and stroke statistically affect significantly the elderly's probability to suffer from the mobility limitations. This suggests that there is a strong relationship between diabetes, heart, and stroke diseases variables and the elderly's tendency to suffer from mobility limitations after being controlled by other covariates.

Based on the marginal effects of the second model (see Table 2), the elderly with stroke disease have a lower probability of having no difficulty in mobility function by 24.6 percentage points compared to those who did not suffer from stroke. Similar findings were also found for elderly with diabetes and heart problems, where their probabilities of not having any mobility limitations are, respectively, lower by 6.6 and 15.3 percentage points relative to their counterparts who suffered from such health problems.

Table 2. *Marginal Effects at Means* **for Model 2**

Parameter	No difficulty	Light difficulty	Medium difficulty	Heavy difficulty
	dy/dx (S.E)	dy/dx (S.E)	dy/dx (S.E)	dy/dx (S.E)
(1)	(2)	(3)	(4)	(5)
Diabetes (Base category: No)				
Yes	-0.065 [a] (0.038)	0.032 [b] (0.017)	0.026 (0.017)	0.006 (0.004)
Lung Disease (Base category: No)				
Yes	0.029 (0.077)	-0.017 (0.046)	-0.010 (0.025)	-0.002 (0.006)
Cardio-Vasculer (Base category: No)				
Yes	-0.153 [c] (0.041)	0.059 [c] (0.007)	0.074 [c] (0.027)	0.020 [b] (0.008)
Stroke Disease (Base category: No)				
Yes	-0.246 [c] (0.038)	0.047 [b] (0.020)	0.152 [c] (0.041)	0.047 [c] (0.017)
Arthritis (Base category: No)				
Yes	-0.046 (0.030)	0.024 [a] (0.014)	0.018 (0.012)	0.004 (0.003)
Age	-0.024 [c] (0.008)	0.013 [c] (0.004)	0.008 [c] (0.003)	0.002 [c] (0.000)
Age Squared	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
Gender (Base category: Male)				
Female	-0.380 [c] (0.014)	0.208 [c] (0.010)	0.137 [c] (0.007)	0.035 [c] (0.002)
Other covariates [d]	YES	YES	YES	YES

a. $p < 0.1$

b. $p < 0.05$

c. $p < 0.01$

The results presented in Table 2 are in line with several long-term studies, which suggested that diabetes [15] [18], heart disease [14], and stroke [14] [16] are closely related to mobility limitation in elderly people.

The results of marginal effects of all other control variables such as age, subjective health perception, marital status, residence area, employment status, body mass index, education level, and gender show similar effects and the magnitudes do not vary much. Thus, it can be concluded that the variables for Model 2 are similar to that previously explained for Model 1.

V. CONCLUSION

The increasing number of elderly chronic conditions will increase their tendency to suffer from mobility limitation; mild, moderate, or severe. Diabetes, heart disease, and stroke significantly affect the elderly of having mobility limitations. As the elderly get older, they will be more vulnerable to suffer from having functional mobility limitations.

Besides the chronic conditions (diabetes, heart disease, and stroke) the results of elderly characteristics such as employment status, level of education, gender, self-assessed health, and body mass index show significant influence on the elderly's probability to have mobility limitations; whereas the

residence area and marital status variables do not significantly affect the elderly's probability to have mobility limitations.

This study uses the IFLS panel data, which provides rich information related to functional capacity, health and the elderly. However, this study only focuses on the mobility function of the elderly, and has not considered the sensory as well as cognitive functions. A combination of chronic diseases and healthy lifestyle behaviors are also not included in this study. In addition, the causal factors of chronic conditions are not studied further, thus this study may have an endogeneity issue regarding the chronic conditions variable.

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