Health and Behavioral Influences on Frailty among Elderly in Indonesia

Akhmad Azmiardi[1*]

[1]*Faculty of Public Health, Universitas Mulawarman, East Kalimantan, Indonesia*

ABSTRACT

Background: Frailty is a geriatric syndrome that is influenced by various stressors that can accelerate deterioration, morbidity and mortality and it is associated with fatigue, weight loss, muscle weakness, and decreased function.

Objective: This study aimed to determine Health and Behavioral Influences on Frailty among elderly in population-based national survey in Indonesia.

Methods: This study employed a cross-sectional design using data from the fifth wave of the Indonesian Family Life Survey (IFLS-5) conducted in 2014-2015. The participants in this study were 2,677 elderly individuals aged 60 years and above. The collected data include information about sociodemographic, independent variables including smoking, consumption of fruit, milk, eggs and vegetables, insomnia, self-report health, cognitive function, functional disability, and risk of depression. While the dependent variable is frailty. Logistic regression analysis was used to estimate the correlation between health and behavioral influences on frailty.

Results: The total sample included 2677 older adults. There was a difference in the proportion of frailty between elderly women and men, with elderly women having a lower proportion of frailty (73.4%) than elderly men (85.6%). Elderly people living in urban areas have a higher proportion of frailty (52.17%) compared to those living in rural areas (47.83%). Variables of health-related behavior including smoking (AOR=1.54, 95% CI: 1.24-1.90, p<0.001), functional disability (AOR=1.56, 95% CI: 1.13-2.14, p=0.006) and risk of depression (AOR=1.86, 95% CI: 1.53-2.26, p<0.001), increasing the risk of frailty. Meanwhile, fruit consumption (AOR = 0.6, 95% CI: 0.42-0.88, p = 0.010) and milk consumption (AOR = 0.76, 95% CI: 0.58-0.99, p = 0.049) decrease the risk of frailty.

Conclusion: Variables of health-related behavior including smoking, functional disability and risk of depression increasing the risk frailty, meanwhile fruit and milk decrease the risk of frailty in the elderly in Indonesia.

Keywords: Behavior, depression, elderly, frailty, smoking.

INTRODUCTION

Frailty is a complex and dynamic condition characterized by reduced ability to handle physical, mental and social stress and often results in loss of function and disability. The condition of frailty causes reduced physiological reserves and increased vulnerability to stressors [1]. Frailty is a geriatric syndrome that is influenced by various stressors that can accelerate deterioration, morbidity and mortality. It is frequently seen in older adults and is associated with fatigue, weight loss, muscle weakness, and decreased function [2]. Frailty increases the risk of loss of independence and even death, but exercise training can provide significant benefits for frail individuals. Frailty is characterized by fatigue, weight loss, muscle weakness, and decreased function [3].

Frailty is different from multimorbidity and disability, and can be modified through interventions such as exercise and nutritional optimization [4]. Frailty is not an inevitable part of aging and can be prevented or treated. Frailty is associated with increased risk of death, morbidity, disability, hospitalization, and nursing home admission [5].

The prevalence of frailty in the elderly varies between populations. In community-dwelling elderly people,

the prevalence of frailty is around 10.1% in China [6]. In the UK, the prevalence of frailty in adults aged 60 years and over is 14% [7]. A much higher prevalence was found in India, namely 83.4% in individuals aged 80 years and above, with poor physical performance, depression, chronic joint pain, and COPD as significant correlates [8]. Previous systematic review and meta-analysis in Indonesia found that the prevalence of frailty in community-dwelling older adults was 26.8%. This prevalence is spread in nursing homes (37.9%) in hospitals (26.3%), and in community settings (21.1%) [9].

A range of factors, with some commonalities across studies, influences frailty in older people. Previous studies highlighted sociodemographic factors such as age, gender, race, education, income and health-related factors such as cardiovascular diseases, comorbidities, functional incapacity, poor self-rated health, depressive symptoms, cognitive function, body mass index, smoking, and alcohol [10]. To the best of our knowledge, studies about patterns and relationships between health behavior and frailty in the elderly in Indonesia have not been widely discussed. This study aims to determine Health and Behavioral Influences on Frailty among the elderly in Indonesia.

MATERIALS AND METHODS

All analyses were based on secondary data; no primary data collection was conducted in this study. This study employed a cross-sectional design using data from the

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fifth wave of the Indonesian Family Life Survey (IFLS-5) conducted in 2014-2015. IFLS-5 is a population-based longitudinal household socio-economic and health survey. The IFLS survey uses a multi-stage stratified sampling design randomly selected in 13 of 27 provinces in Indonesia. The IFLS data represents 83% of the Indonesian population. The Institutional Review Board (IRB) of the Rand Corporation (USA) and the Survey Meter (Indonesia) approved the IFLS. The ethics clearance number granted by the RAND Human Subjects Protection Committee (RAND IRB) to IFLS5 is s0064-06-01-CR01. Data from IFLS-5 are available from RAND at http://www.rand.org/labor/FLS/IFLS.html. The target population in this study was those aged ≥ 60 years. In total, the sample we analyzed consisted of 2677 individuals aged 60 years and older who were provided with complete frailty measures.

Health and behavioral indicators assessed in this study include smoking status, dietary intake (fruit, vegetables, eggs, and milk), insomnia, cognitive function, functional disability, and risk of depression.

Frailty was measured using the Fried Frailty Phenotype criteria adapted for secondary survey data. Frailty was assessed using the Fried frailty indicators, which include: (1) weight loss, (2) self-reported fatigue, (3) weakness, (4) slowness, and (5) low physical activity. Each frailty indicator is given a score of zero or 1. Frailty is assessed if the sum of the indicator scores is equal to 0, indicating there is no frailty and conversely, if it is more than or equal to one then it is indicated as frail. Assessment of weight loss indicators is assessed using respondents' body mass index (BMI). If the BMI value is <18.5 kg/m2, then the indication is weight loss [11]. Self-reported fatigue is assessed by using 2 item questions of the Center for Epidemiologic Study Depression Study scale (CES-D: 10 items). The questions are "I feel like everything I do is an effort," and "I can't get started"[12]. Respondents answered sometimes or most of the time, one of the two questions is categorized as fatigue [13].

Weakness is assessed by handgrip strength (HGS). HGS in IFLS was measured using a Baseline Smedley Spring type dynamometer on each hand twice [14]. The measurement results were then categorized into 5 quintiles, where the lowest HGS quintile was categorized as weak [11]. Slowness was measured as the longest time to walk a distance of 4 m (average of two walks). The average time is then classified into quintiles and the lowest quintile is categorized as slow [15]. Low physical activity was measured using the short version from the "International Physical Activity Questionnaire (IPAQ) short version, for the last 7 days (IPAQ-S7S)"[16]. Respondent with low physical activity were given a score of 1.

Exposure Variables
Sociodemographic factor questions include age, gender, formal education, marital status, place of residence

(urban or rural), and household income. Age was categorized as 60-69 and 70 years or older. Gender was categorized as male or female. Residential status: Urban, rural. Education is categorized into low = None until high school and high= college. Marital status was categorized as single and married. Household income is categorized as less than 5 million and more than 5 million rupiah per month.

Smoking status was categorized as current smoker, former smoker, and never smoker." Due to data limitations, smoking status was dichotomized into current smokers and non-smokers was categorized as yes (1 = current smoker) or no (0 = non-smoker). Intake of green vegetables, mangoes, eggs and milk was measured using a food intake questionnaire. The food Frequency Questionnaire (FFQ), is an instrument for measuring food intake [17]. Intake of green vegetables, mangoes, eggs and milk is classified as high intake = 1 if the intake is at least once daily intake and low=0 if not daily.

Insomnia was measured with five items from "Patient Reported Outcome Measurement Information System (PROMIS)" [18]. Responses ranged from 1 = not at all to 5 = very much (Cronbach's alpha = 0.82). Insomnia was defined as having total scores of ≥21-40 [19]. Self-reported health was assessed with a single-item question, "In general, how is your health?" The answers consisted of 1=very healthy, 2=somewhat healthy, 3=somewhat unhealthy, and 4=unhealthy) [15]. Self-reported health was categorized into very healthy/somewhat healthy = 0 and somewhat unhealthy/unhealthy = 1.

Cognitive function in the IFLS survey is measured by the Telephone Cognitive Status Survey (TICS) was conducted in a face-to-face interview. The TICS assesses awareness of dates and self-reported memory questions. The answer choices consisted of excellent, very good, good, fair, and poor. The total score ranges from 0 to 34, and a score of 13 or lower is categorized as low [15].

Functional disability was measured with five items from the Activities of Daily Living (ADL) and six items from the Instrumental Activities of Daily Living (IADL) [14]. ADL questions assess the extent of difficulty in dressing, eating, and other activities (Cronbach's alpha 0.84). IADL questions to assess the level of difficulty in performing housework (Cronbach's alpha 0.91). The answer varies from "have no difficulty; have difficulty but can still do it; have difficulty and need help; cannot do it". The total functional disability score is categorized as having no difficulty = 0 and having one or more difficulties = 1 of ADL and IADL items.

Depressive symptoms were measured by the Center for the Epidemiologic Studies Depression Scale (CES-D: 10 items). Depressive symptoms are categorized in a dichotomy, a score of 15 or more is identified as having depressive symptoms = 1 and a score of less than 15

has no depressive symptoms=0 (Cronbach alpha 0.67) [14].

Frequency and percentages were computed to summarize categorical variables. Binary logistic regression was run to determine the association of patients' features with frailty. P-value ≤0.05 was considered statistically significant. All analysis were performed using STATA software version 14.0 (Stata Corporation, College Station, TX, USA).

RESULTS

The total sample included 2677 older adults; only respondents with complete data on all variables of interest were included in the analysis. Cases with missing values were excluded listwise. Table **1** shows the results of bivariate analysis of respondent characteristics regarding frailty among the elderly in Indonesia. In general, several variables show a significant relationship with frailty in the elderly. First, there is a significant difference in the proportion of frailty between elderly women and men, with elderly women having a lower proportion of frailty (73.4%) than elderly men (85.6%), with a p value <0.001.

Table 1: Bivariate analysis of respondent characteristics regarding frailty among the elderly in Indonesia.

Variables	No Frailty n (%)	Frail n (%)	p-value
Age			
60-70 yr.	408 (21.4)	1,497 (78.6)	0.127
≥71 yr.	145 (18.8)	627 (81.2)	
Sex			
Female	364 (26.6)	1,005 (73.4)	<0.001
Male	189 (14.4)	1,119 (85.6)	
Marital status			
Single	203 (22.0)	720 (78.0)	0.215
Married	350 (20.0)	1,404 (80.0)	
Income			
< Rp 5.000.000	68 (17.5)	320 (82.5)	0.068
>= Rp 5.000.000	398 (21.7)	1,438 (78.3)	
Residential status			
Rural	234 (18.7)	1,016 (81.3)	0.020
Urban	319 (22.4)	1,108 (77.6)	
Education			
<= High school	506 (20.0)	2,021 (80.0)	0.001
> High school	47 (31.3)	103 (68.7)	
Smoking			
No/Former	411 (22.8)	1,391 (77.2)	<0.001
Yes	142 (16.2)	733 (83.8)	
Fruits			
Low	508 (20.1)	2,014 (79.9)	0.007
High	45 (29.2)	109 (70.8)	
Vegetables			
Low	338 (20.0)	1,351 (80.0)	0.275
High	215 (21.8)	772 (78.2)	
Egg consumption			
Low	490 (20.2)	1,936 (79.8)	0.063
High	63 (25.2)	187 (74.8)	

Variables	No Frailty n (%)	Frail n (%)	p-value
Milk consumption			
Low	462 (20.0)	1,851 (80.0)	0.026
High	91 (25.1)	272 (74.9)	
Insomnia			
No	427 (22.3)	1,492 (77.7)	0.001
Yes	126 (16.6)	632 (83.4)	
Self-report health			
Healthy	380 (22.0)	1,351 (78.0)	0.025
Unhealthy	173 (18.3)	773 (81.7)	
Cognitive function			
Low	186 (22.1))	656 (77.9)	0.223
High	366 (20.0)	1,461 (80)	
Functional disability			
Able, no difficult	502 (21.7)	1,816 (78.3)	0.001
Have one or more	51 (14.2)	308 (85.8)	
Risk of depression			
Yes	243 (16.1)	1,269 (83.9)	<0.001
No	310 (26.6)	855 (73.4)	

Rp= Indonesian Rupiah; N= number of individual; %= percentages; p-value= probability value

Furthermore, residence status is also related to frailty. Elderly people living in urban areas have a lower proportion of frailty (77.6%) compared to those living in rural areas (81.3%) (p=0.020). The educational variable also shows a significant relationship with frailty. Elderly people who have higher education tend to have a lower proportion of frailty (p=0.001).

Apart from that, several lifestyle factors also influence the state of weakness. Elderly people who do not smoke or have ever smoked have a lower proportion of frailty (77.2%) compared to those who still smoke (83.8%) (p<0.001). High fruit (p=0.007) and milk consumption (p=0.026) was also associated with a lower proportion of frailty (70.8% and 74.9%, respectively).

Insomnia and self-report health variables also showed a correlation with frailty. Elderly people who experience insomnia (p=0.001) and elderly people with poor self-reported health (p=0.025) are more likely to be frail compared to those who do not experience insomnia or have good health.

Finally, the risk of depression is also related to the state of frailty. Elderly people who are at risk of depression have a higher proportion of frailty (83.9%) compared to those who are not at risk of depression (73.4%) (p< 0.001).

Table **2** shows the results of logistic regression analysis of factors related to health behavior on welfare among the elderly in Indonesia. These results show a relationship between various health behavior factors and the incidence of frailty in the elderly in Indonesia. First, related to smoking habits, it was found that elderly people who have a smoking habit have a higher risk of frailty compared to those who are non-smokers. Elderly

Table 2: Univariate and multivariate logistic regression of behavioral and health-related determinants of frailty in older adults.

Variables	Groups	OR	95% CI	p-value	AOR	95% CI	p-value
Behavioral Factors	Smoker	1.53	1.24-1.88	<.0001*	1.54	1.24-1.90	<0.001*
	Fruit Consumption (High)	0.61	0.43-0.88	0.007*	0.61	0.42-0.88	0.010*
	Vegetable Consumption (High)	0.90	0.74-1.09	0.275	0.93	0.76-1.14	0.538
	Egg Consumption (High)	0.75	0.56-1.02	0.063	0.79	0.58-1.09	0.165
	Milk Consumption (High)	0.75	0.58-0.97	0.026*	0.76	0.58-0.99	0.049*
Health Factors	Insomnia (Yes)	1.44	1.15-1.79	0.001*	1.19	0.95-1.50	0.121
	Self-Reported Health (Unhealthy)	1.26	1.03-154	0.025*	1.13	0.92-1.39	0.234
	Cognitive Function (High)	1.13	0.93-1.38	0.223	1.10	0.90-1.35	0.327
	Functional Disability (Yes)	1.67	1.22-2.28	0.001*	1.56	1.13-2.14	0.006*
	Risk of Depression (Yes)	0.53	0.44-0.64	<0.001*	1.86	1.53-2.26	<0.001*

OR = Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval. p-value= probability value
*Significant at p<0.05

smokers had an odds ratio (AOR) of 1.54 (95% CI: 1.24-1.90, p<0.001). These results indicate that smoking habits are positively correlated with the incidence of frailty in the elderly in Indonesia.

Fruit consumption showed a protective effect against frailty. Elderly people who consume high amounts of fruit, specifically, consuming mangoes, have a lower risk of frailty compared to those who consume low amounts of mangoes. This is shown by the AOR value of 0.61 (95% CI: 0.42-0.88, p=0.010), indicating that fruit consumption is negatively correlated with the incidence of frailty.

Elderly people who regularly consume milk have a lower risk of frailty compared to those who do not or consume low amounts of milk, with an AOR of 0.76 (95% CI: 0.58-0.99, p=0.049). Other factors such as consumption of green vegetables, consumption of eggs, as well as other health conditions such as insomnia, self-report health, and cognitive function, did not show significant relationship with frailty, with value >0.05.

However, there are two other factors that correlate with the incidence of frailty, namely Functional disability and the risk of depression. Elderly people who experience one or more physical disabilities have a higher risk of frailty with an AOR of 1.56 (95% CI: 1.13-2.14, p=0.006). Meanwhile, elderly people who are at risk of depression also have a higher risk of frailty, with an AOR of 1.86 (95% CI: 1.53-2.26, p<0.001). This shows that the presence of physical disabilities and the risk of depression are important risk factors that contribute to the incidence of frailty in the elderly in Indonesia.

DISCUSSION

In this study, we examined factors related to health on frailty in the elderly in Indonesia. The results of the characteristic analysis generally show a significant relationship with frailty in the elderly. First, there is a significant difference in the proportion of frailty between elderly women and men, where elderly women have a lower proportion of frailty than elderly men. Apart from that, population status is also related to weakness. Elderly people who live in urban areas have a higher proportion of frailty compared to those who live in rural areas. The education variable also shows a significant relationship with frailty. Elderly people who have higher education tend to have a lower proportion of frailty.

Frailty is a significant concern among the elderly in Southeast Asia and Asia. Prior study in Indonesia shows that the prevalence of Frailty among the elderly in Indonesia was 26.8% [9]. The Systematic review and meta-analysis of prevalence of frailty in community-dwelling older adults in Asia as a whole is estimated at 20.5% [20].

In consistency, previous study shows that gender plays a significant role in the perception, prevalence, and impact of frailty among the elderly. Women tend to have a lower prevalence of frailty, while men are more likely to experience higher mortality rates (Influence of Gender on Perception of Frailty among Elderly [21]. This gender disparity is further influenced by factors such as marital status, with unmarried men being at a higher risk of frailty and widowed women at a lower risk [22].

Residential status was also associated with frailty. Prior study showed that there was higher prevalence of frailty among rural older adults compared to their urban counterparts [23]. This is often attributed to worse overall health in rural areas, which can increase the risk of frailty and adverse outcomes [23]. A range of studies have consistently found a link between the level of education and frailty among the elderly. Previous study found that lower education was associated with increased frailty [24].

The majority of smokers in this study were men among these elderly people. In this study, older men who smoke has a higher chance of experiencing frailty compared to those who are non-smokers. These results indicate that smoking habits are positively correlated with the incidence of frailty in the elderly in Indonesia. A prior study have found a significant association between smoking and frailty in older adults. Chu (2024) and Kojima (2019) both found that current smokers were at a higher risk of developing frailty, with Kojima noting that this risk was attenuated by socioeconomic status [25]. Shin (2020) further explored this relationship, finding that frailty prevalence differed based on smoking status and

alcohol intake [26]. These findings collectively suggest that smoking is a significant risk factor for frailty in older adults.

Then, this research shows that fruit consumption, specifically mangoes, has also been proven to have a significant influence on frailty. Elderly people who regularly consume mangoes have a lower odd of frailty compared to those who do not regularly consume fruit. A systematic review and meta-analysis by Kojima (2022) found that high fruit and vegetable consumption was significantly associated with a lower odd of incident frailty in older adults [27]. This finding is in line with a study in Korean elderly, which found that high fruit consumption was linked to a lower risk of frailty in men [28]. Study shows a significant association between vitamin C deficiency and frailty in elderly patients. This is particularly relevant in the context of mangoes, which are a rich source of vitamin C [29].

Elderly people who regularly consume milk have a lower odd of frailty compared to those who do not or consume low amounts of milk. Research on the relationship between milk consumption and frailty among the elderly has yielded mixed results. Cuesta-Triana et al. (2019) reported a potential reduction in frailty risk with high consumption of low-fat milk and yogurt [30].

This study showed that Functional disability was correlated with the incidence of frailty. Elderly people who experience one or more physical disabilities have a higher risk of frailty. Research has consistently shown a strong association between frailty and functional disability among the elderly. Tang et al. (2023) found that cognitive frailty, a combination of physical frailty and cognitive impairment, significantly increased the risk of developing disabilities in activities of daily living (ADL) and instrumental ADL (IADL) [31]. Nguyen et al. (2021) reported a correlation between frailty and functional disability, with higher levels of frailty significantly increasing the odds of dependency in IADL [32]. Functional disability and frailty are closely linked constructs. Although measured separately in our study, the potential for conceptual and statistical overlap should be considered. Thus, the observed association may reflect collinearity rather than independent predictive power.

Meanwhile, elderly people who are at risk of depression also have a higher risk of frailty. This shows that the presence of the risk of depression is contributed to the incidence of frailty in the elderly in Indonesia. Frailty and depression are closely linked in the elderly population, with both conditions often coexisting [33]. This relationship is influenced by a range of psychosocial factors, including depression severity, age, and social engagement [34].

LIMITATIONS

There are several limitations to this research. First, this was a cross-sectional study, in the nature of study design, causality cannot be inferred. Additionally, residual confounding due to unmeasured variables such as detailed socioeconomic factors or baseline health status may influence the observed associations. Second, in this study, only older adults living in the community and does not include older adults in nursing homes. Third, this study involved multiple comparisons across several variables. Although we did not apply formal corrections, our analysis is exploratory. Hence, findings should be interpreted with caution due to the increased risk of Type I error. Fourth, frailty in this study is categorized into a dichotomy where frailty is generally divided into frail, pre-frail and strong. The IPAQ physical activity questionnaire uses cut-off values for general criteria, not specifically for the elderly. Fruit, green vegetables and protein are only limited to a few types, so they do not reflect fruit and vegetable consumption and protein intake as a whole. Fifth, several variables, including dietary intake and insomnia, were measured using single-item self-reports, which may limit their validity and reliability. Lastly, the frailty measure was adapted from the Fried Frailty Phenotype and operationalized in a binary format, which may not fully capture gradations of frailty severity.

CONCLUSION

In conclusion, higher fruit and milk consumption had a significant protective effect on the prevention of frailty. On the other hand, smoking, functional disability, and depressive symptoms were significant predictors of frailty in the elderly. These findings highlight the importance of modifiable behavioral and health-related factors in addressing frailty among older adults. Suggestions for further research are to further explore the relationship of other factors with frailty, as well as to develop more effective interventions in preventing and managing frailty in the elderly in Indonesia.

ETHICS APPROVAL

The IFLS was approved by the Institutional Review Board (IRB) of the Rand Corporation (USA) and the Survey Meter (Indonesia). The ethics clearance number granted by the RAND Human Subjects Protection Committee (RAND IRB) to IFLS5 is s0064-06-01-CR01.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA

Data from IFLS-5 are available from RAND at http://www.rand.org/labor/FLS/IFLS.html

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Declared none.

AUTHOR'S CONTRIBUTION

Akhmad Azmiardi: Data collection, statistical analysis, literature search, interpreted the results, and drafted the manuscript.

LIST OF ABBREVIATIONS

ADL   : Activities of Daily Living
AOR   : Adjusted Odd Ratio
BMI   : Body Mass Index
CES-D   : Center for the Epidemiologic Studies Depression
FFQ   : Food Frequency Questionnaire
HGS   : Hand Grip Strength
IADL   : Instrumental Activities of Daily Living
IFLS   : Indonesian Family Health Survey
IPAQ   : International Physical Activity Questionnaire
PROMIS : Patient Reported Outcome Measurement Information System
TICS   : The Telephone Cognitive Status Survey

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