ORIGINAL ARTICLE

Physical Activity Mediated the Relationship Between Depressive Symptoms and Physical Frailty and Among Community-dwelling Older Adults in Indonesia

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ABSTRACT

Introduction: Frailty is characterized by a deterioration in function and a diminished physiological reserve capacity for homeostasis, increasing the risk of disease and hospitalization. Frailty and depression are common among Indonesia's older adult population, but few studies have examined the significance of physical exercise in this association. Objectives: This study aimed to explore the mediating effect of physical activity on the relationship between depressive symptoms and physical frailty among community-dwelling older adults in Indonesia. **Materials and methods:** A cross-sectional study was conducted in Cirebon, West Java Province, Indonesia from January to May 2023. The sample in this study was older persons aged above 65 years old, have lived in the area for at least six months. A total of 550 (64.7%) older people accepted the invitation. The FRAIL scale (FS), Geriatric depression scale-5, and International Physical Activity Questionnaire (s-IPAQ) were used to measure study variables. Depressive symptoms and physical fragility were analyzed for their potential mediation by physical exercise using a path analysis. **Results:** The average age of the participants was 68.3 years (SD = 3.56). Physical frailty varied significantly between study participants employment status, hypertension, and diabetes ($p < 0.05$). The frailty was positively associated with depressive symptoms (r=0.420, $p < 0.001$), while physical activity was negatively associated with physical frailty and depressive symptoms (r=-0.455 and r=-0.460, $p < 0.001$, respectively). Physical activity was negatively associated with frailty (direct effect [β] = -0.65), and these results indicated that physical activity partially mediated the relationship between depressive symptoms and frailty. **Conclusion:** Physical activity was partially mediated the relationship between depressed symptoms and frailty in this study. Future studies should determine whether physical activity could reduce the risk of frailty in individuals with depressive symptoms.
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Keywords: Physical activity, Depressive symptoms, Physical frailty, Older adults, Among community-dwelling

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INTRODUCTION

Around one-sixth of the world's population is expected to be 65 years or older by 2030, with the number of people over 60 years expected to increase from 1.4 billion in 2020 to 2.1 billion in 2050 (1). Indonesia has experienced an ageing demographic structure since 2021, with 10.48% of the population aged 65 years and older, making up 16.09% of the dependent population (1). As individuals age, they tend to become less physically active and more fragile, while their psychological issues become more noticeable and significant (2). Interest in ageing is growing as the global population ages, and healthy longevity is becoming more important (3).

Frailty is characterized by a decreased physiological reserve capacity for maintaining individual homeostasis and a decline in function, increasing the risk of developing diseases and hospitalization (4). It is characterized by a combination of factors such as weight loss, weakness, poor endurance, slowness, and low physical activity (5). Frailty is characterized by a vicious cycle, where energy consumption drops due to a decline in appetite, leading to low nutritional status, reducing overall physical function, fatigue, vitality, and muscle strength (2). Frailty is associated with irreversible illnesses, leading to increased hospitalization, rehabilitation difficulties, a decrease in quality of life for older adults, and ultimately an increase in mortality (2). Frailty prevalence in the older adult population varies depending on definitions and measurement instruments, but 41.9% of pre-frailty and 10.7% occur abroad (6). Pre-frail individuals are 2.63 times more likely to develop frailty within three years, and frail adults are six times more likely to die within three years than general older adults (5). Frailty is common in Indonesian nursing facilities (prevalence was 45.5%, n=214) and closely correlated with malnutrition (7). Age, functional decline, and malnutrition increase

the likelihood of frailty development (8).

The World Health Organization (2012) reports that 5.7% of persons over the age of 65 years suffer from depression. In Indonesia, the prevalence of depression among older adults was 16.3% as measured by the Center for Epidemiologic Studies Depression Scale (CES-D 10) (9). Depression risk factors include moderate economic status, residing in Java or Sumatra, lack of life satisfaction, self-perceived ill health, dependence, and falls and insomnia (9).

Frailty and depression often occur co-exist. However, the relationship between depression and frailty in older individuals of both sexes has been the subject of debate, but it has been demonstrated that depression is associated with an increased risk for frailty. Previous study highlights the challenges in diagnosing depression and frailty due to shared similar risk factors (10). Another study found that older adults with depression are more likely to be 80% more frail than non-depressed counterparts (11). People with depression experience decreased social engagement, functional decline, and frailty due to altered behavior and activity levels (12). Other studies, however, have reached the opposite conclusion (13).

Physical activity is considered as the most effective management for improving mental health and functional ability in older individuals (14). Regular physical activity helps prevent frailty and depression. The World Health Organization (WHO) recommends that older adults engage in 150-300 minutes of moderate-intensity aerobic physical activity, 75-150 minutes of vigorous-intensity aerobic activity, or a combination of both (15). Previous study suggested that regular physical activity can mitigate negative health consequences in frail older persons, including functional performance, cognitive impairment, sarcopenia, and depression (16). Recent systematic reviews analyze the impact of exercise and physical activity on frail older individuals' health outcomes and frailty progression, focusing on the severity and rate of frailty (17). A study showed that physical exercise, such as walking, running, hiking, or dancing, reduces older adult disability compared to sedentary lifestyles (18). Another study found that high-intensity physical exercise reduced frailty and pre-frailty in healthy individuals (19). Few studies few studies have used mediation effect, which can include more than two variables in exploring the relationship between frailty, depression, and physical activity among older adults in Indonesia.

The study focuses on the older adult population in Indonesia, a multiracial archipelago. The majority of older adults (39.10%) live in three-generation homes, while 27.85% live with other family members, 20.51% with their spouse, and only 9.80% live alone (20). This is due to the Indonesian culture of respecting and taking care of the elderly until death. Around 70% of the elderly experience poly pharmacy, and potentially inappropriate medication is prevalent in primary healthcare centers (52.2%) (21). Thus, this study aimed to explore the mediating effect of physical activity on the relationship between depressive symptoms and physical frailty among community-dwelling older adults in Indonesia.

MATERIALS AND METHODS

Study design and sample

A cross-sectional study was conducted in Cirebon, West Java Province, Indonesia from January to May 2023. The sample in this study was older individuals aged 65 years or older who have lived in the area for at least six months. Participants were invited to participate, but excluded if they had severe illnesses or cognitive disorders affecting their ability to answer questions.

The study sample size was estimated using power analysis for multiple regression, requiring 442 participants to achieve a small effect size of 0.2 (22) with 90% at a 5% significance level. With a 15% attrition rate, 510 participants were needed for the study.

To begin, a software-generated random sample of 850 older adults was taken from a larger number of about 89,780 district residents who met the criteria for inclusion. The district government provided us with the sample frame. Local health workers introduced themselves and explained the study objective and procedure of the study before visiting participant homes to invite them to participate. A total of 550 (64.7%) older people accepted the invitation.

Instrument

Age, gender, marital status, level of education, place of residence, employment, monthly income, substance use, and health history were all collected using a self-designed questionnaire.

The FRAIL scale

The FRAIL scale (FS), which is based on the Frailty Index and the Cardiovascular Health Study Index, is a popular frailty screening tool for the older adult (23). FS addresses weariness, resistance, walking, diseases, and inadvertent weight loss questions. Each question has a "yes" or "no" answer that awards a score of 0 or 1. The possible results are 0 through 5. Researchers have proposed three categories for the FS score: robust (= 3), pre-frail (= 2), and frail (= 0). (23). In the current study, the Cronbach's alpha of FS is 0.84.

Geriatric depression scale-5

The GDS-5 is widely used as a screening instrument for depression developed by Hoyl (24). The GDS has 15 items. Each of the five factors is rated from 0 to 1, for a possible total score between 0 and 5. The severity

of depression symptoms increases as the score rises. Depression is present if the patient has a GDS-5 score of 2 or lower (24). In the current study, the reliability test of GDS-5 is 0.91.

International physical activity questionnaire

The shortened version of the IPAQ (s-IPAQ) was used to assess physical activity (25). Seven questions are used to determine how much time was spent engaging in light, moderate, and vigorous physical activity and meditation over the course of the preceding week. Physical activity conducted at a metabolic equivalent of task (METS) of 3.0 or above is considered moderate to intense intensity. Time spent on the survey is recorded in the form of hours and minutes, while the number of days spent on each activity is noted. Response was converted into minutes of metabolic equivalents (METs). s-IPAQ has a reliability coefficient of 0.80 in the original version (25). In the current study, the reliability test of s-IPAQ is 0.84.

Data collection

The Institutional Review Board of the university approved this study protocol of STIKes Ahmad Dahlan Cirebon (Reference: No 351/ETIK/2022). All details of the study were discussed with prospective participants before it began. Participants were made aware that their participation was entirely optional and that they might opt out at any time. Written informed consent was obtained prior to data collection. Expert researchers conducted the poll, collecting data through in-person interviews. No information was revealed to anyone. The study was conducted in accordance with the Declaration of Helsinki.

Data analysis

Percentages and frequencies were used to represent categorical variables, whereas means and standard deviations were used to characterize continuous variables. Additionally, univariate comparisons between depressed symptoms and other possible variables were performed using Pearson's correlation, an independent t-test, and a one-way analysis of variance (ANOVA). For this linear regression analysis, we considered as independent variables the univariate analysis variables that had a p value of less than 0.05. Depressive symptoms and physical fragility were analyzed for their potential mediation by physical exercise using a path analysis. Two-tailed tests were performed on all data, and a value of $p<0.05$ was taken to indicate statistical significance. IBM SPSS version 25.0 IBM Corp., Armonk, NY) was used for all statistical analysis.

Ethics statement

The studies involving human participants were reviewed and approved the Institutional Review Board of the university (STIKes Ahmad Dahlan Cirebon : Reference: No 351/ETIK/2022). The participants provided their written informed consent to participate in this study.

RESULTS

The average age of the participants was 68.3 years (SD = 3.56), with a range of ages from 65 to 72. Five hundred and thirty-five (55.5%) respondents were male, and two hundred and thirty-four (42.5%) had only completed elementary school. There were a majority of married people (322; 58.5%), people who lived with their families (452; 82.2%), and people who had jobs (295; 53.6%). About 56.4 percent of those who took the survey had monthly incomes of less than the regional minimum wage (USD 151.32 in 2024). Only 1.8% of individuals consumed any alcohol, and only 42.7% smoked during the study. Hypertension affected 47.1% of the sample, and diabetes affected 26.4% (Table I).

Table I: t-test or one-way ANOVA of research variables (n=550).

Variable	n (%)	Physical frailty Mean±SD	t or F	*p*-value
Gender				
Male	305 (55.5)	3.22 ± 0.87	1.02	0.064
Female	245 (44.5)	3.54 ± 1.32		
Marriage				
Married	322 (58.5)	3.76 ± 1.37	0.07	0.376
Divorce/single/ widow	228 (41.5)	4.01 ± 1.82		
Education level[a]				
Illiterate	12 (2.2)	3.22 ± 1.32	1.45	0.982
Primary level	234 (42.5)	3.49 ±0.74		
Secondary level	132 (24.0)	3.35 ± 0.43		
Tertiary level	172 (31.3)	3.12 ± 1.12		
Living with family status				
Yes	452 (82.2)	3.17 ± 0.78	0.72	0.526
No	98 (17.8)	3.54 ± 1.21		
Working status				
Retired	255 (46.4)	4.23 ± 1.78	4.09	0.001
Working	295 (53.6)	3.20 ± 1.32		
Monthly income				
Under minimum regional salary	310 (56.4)	3.02 ± 1.12	1.05	0.762
Above minimum regional salary	240 (43.6)	2.98 ± 1.04		
Drinking alcohol				
Yes	10 (1.8)	3.87 ± 2.09	0.87	0.342
No	540 (98.2)	3.10 ± 1.75		
Smoking				
Yes	235 (42.7)	3.56 ± 1.26	1.82	0.165
No	315 (57.3)	3.43 ± 1.73		

CONTINUE

Table I: t-test or one-way ANOVA of research variables (n=550). (CONT.)

Variable	n (%)	Physical frailty Mean±SD	t or F	*p*-value
Hypertension				
No	259 (47.1)	2.98 ± 1.13	5.67	0.001***
Yes	291 (52.9)	3.65 ± 1.79		
Diabetes				
No	145 (26.4)	3.24 ± 0.78	4.31	0.001***
Yes	73.6)	4.10 ± 1.32		

Note: [a]= one-way ANOVA test; ***p < 0.001.

Statistical analysis using the independent t-test or one-way ANOVA revealed no significant differences in depressive symptom severity on the basis of gender, marital status, education level, monthly income, or smoking status. Physical frailty varied significantly between study participants based on factors including employment status, hypertension, and diabetes (p < 0.05).

The mean GDS-5 score was 3.46±.56, and 13.6 percent (n = 75) of the subjects met the criteria for major depression. Physical frailty was represented by a mean score of 1.39 ±0.56. In addition, 13.1% (n=72) of the individuals were considered to be frail, while 22.7% (n=125) were considered to be prefrail. Total METs were 1845.50 ±1.11, indicating of minimal activity (Table II).

Table II: Descriptive statistics and Pearson correlations between all variables (n=550).

Variables	Scores	1	2	3
1. Depressive symptoms	3.46 ± 1.56	1		
2. Frailty	3.39 ± 0.56	0.420***	1	
3. Physical activity (met*minutes/week)	1845.50 ±1.11	0.455***	0.460***	1

Note: ***p < 0.001.

In correlation analysis (Table II), the frailty was positively associated with depressive symptoms (r=0.420, p < 0.001), physical activity was negatively associated with physical frailty and depressive symptoms (r=-0.455 and r=-0.460, p < 0.001, respectively).

The final regression model included four predictors: working status, hypertension, diabetes, depressive symptoms, and physical activity which could explain 42.1% of the physical frailty variation (R^2 = 0.443, p < 0.001; Table III). The final regression model indicated that those who were not working, frailer, hypertension, and diabetes had a higher GDS-5. Those, who had higher physical activity had lower depressive symptoms.

Table III: Results of multiple linear regression analysis for physical frailty (n=550).

Variables	Coefficient	Standardized coefficient	95% CI		*p*-value
Working status	0.320	0.089	0.027	0.342	0.032
Hypertension	-1.143	-0.189	-0.016	-0.007	<0.001
Diabetes mellitus	-0.276	-0.425	-0.213	-0.154	<0.001
FS total score	0.521	0.557	0.221	0.734	<0.001
PA total score	0.456	0.632	0.256	0.874	<0.001

Note: F = 93.76, R^2 = 0.443; adjusted R^2 = 0.421, p < 0.001; FS, FRAIL Scale; PA, physical activity

It can be seen in the path diagram in Figure 1 that perceived physical activity partially mediated the relationship between depressive symptoms and frailty, which indicated that physical activity mediated the relationship between depressive symptoms and frailty. In step 1, depressive symptoms were significantly associated with frailty, and the total effect (τ) was 0.18. In step 2, the effect of depressive symptoms was reduced but continued to be significant when physical activity was entered in the regression model. The indirect effect of depressive symptoms and frailty, as mediated by physical activity (τ-τ′), was -0.46. In step 3, physical activity was significantly associated with frailty (direct effect [β] = -0.65), and these results indicated that physical activity partially mediated the relationship between depressive symptoms and frailty.

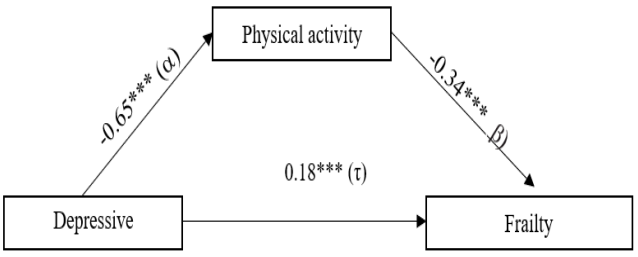

Figure 1: Path diagram.
Note: Total effect for Depressive symptoms- Frailty (t) = 0.18; Direct effect of Depressive-Frailty symptoms (t') = 0.05; Indirect effect of Depressive Symptoms-Frailty mediated by Physical Activity (t-t') = -0.46; *** p <.001.

DISCUSSION

This research found that 22.7% of the older adult were in the prefrailty category and 13.1% were frail. This prevalence was lower than the 43.3% prevalence found in a study conducted in Bali, Indonesia (7). When compared to a study conducted in Japan, the prevalence of frailty was found to be 13.1%, while the prevalence of prefrailty was found to be 57% (26). The frequency of frailty among older persons in our community may be similar to that seen in other developing countries (5.4-

44%) (27). Depending on the definition, demographic, and contexts, previous research has suggested that the frailty rate may differ from one community to the next (28). The present study's cohort is much younger than the one in the prior study, and the vast majority of its participants are still actively employed. Furthermore, the disparity may be influenced by variations in frailty assessment and definition. This study highlights the needs to more investigation aiding in the early diagnosis and treatment of frailty.

One-third of the older persons in Indonesia who participated in our study showed higher symptoms of depression as measure by GDS-5. The present prevalence of depressed symptoms in Indonesia is 6.1%, which is greater than the prevalence reported in the general population in the 2018 Indonesia Basic Health research (3.7%; WHO, 2018), but lower than the prevalence recorded in the previous study (16.3%; (9)). Higher prevalence was seen in South Korean research based on a statewide survey (27.8%; (29)). However, depressed symptoms are now a global public health concern, especially among the older adult. variations in population sizes, types, and locations, as well as in the methods used to screen for depressive symptoms, could account for both the similarities and variations seen in the available research. The present sample was drawn from the city of Cirebon in the Indonesian province of West Java. Cirebon, a special economic zone in eastern Indonesia, has a rapidly rising depressive symptoms, contrary to the findings of Indonesian national survey surveys.

The majority of study participants were found to have low levels of physical activity. It's important to note that nearly half of the people in our study (45.3%) did not get the minimal quantity of PA advised by the World Health Organization. According to prior research (30), over 30% of persons aged 60+ who do not engage in any form of physical activity live in Southeast Asia. Our study found a larger percentage of participants who did not meet PA requirements than previous research had found. Social influences, reinforcement, and aid in managing change were the most frequently cited motivators, while environmental variables and resources were the most frequently mentioned impediments (31). There is a growing interest in promoting PA goals across all age groups, and knowing the scope of PA among older persons can help inform these efforts.

This study found that the frailty was positively associated with depressive symptoms and physical activity was negatively associated with physical frailty and depressive symptoms. Sedentary behavior has been linked both ways to increased depressive symptoms. Despite widespread belief to the contrary, researchers in Bali, Indonesia, discovered no correlation between inactivity and frailty syndrome. Inactivity on the part of most study participants likely explains the divergent findings. Previous study found that people with depression, even those who were previously active, engage in less physical activity (32). Multiple studies have found that frailty and depression go hand in hand in the older adult (33). A meta-analysis in the UK found that 38.6% of 8,023 people who reported feeling weak also suffered from depression. The prevalence of frailty is 40.50 percent among 2,167 depressed people. Frail older persons are four times more likely to experience depression than non-frail older adults (34). These results suggested that a rise in frailty may contribute to an increase in geriatric depression. Depressive symptoms, smoking, obesity, and underweight are just few of the characteristics that contribute to frailty as a geriatric condition, as stated by (35). Depression is exacerbated by the feelings of helplessness and melancholy brought on by chronic pain, low exercise tolerance, and fatigue. Depressive symptoms, such as inactivity, decreased appetite, and an increased propensity to fall, have all been linked to an increased risk of frailty (36).

In our study, physical activity act as mediator of the relationship between depressive symptoms and frailty. Associations between frailty and other mediator factors have been shown in the literature. One study indicated that a person's level of physical activity mediated the relationship between frailty and physical performance, which includes movement, behavior, and body composition. The study further found that sedentary time and moderate-to-vigorous physical activity acted independently as mediators (37). greater rates of frailty were seen among individuals experiencing greater levels of psychological distress, according to research that examined the connection between frailty and cognitive performance (38). Social interaction and exercise moderated the relationship between frailty and loneliness, according to another research (39). But there was no correlation between frailty and being impeded in social activities in a cross-sectional study of Japanese older individuals conducted during the COVID-19 pandemic (40). The unusual circumstances of the pandemic may account for this result by reducing opportunities for social interaction for healthy and sick individuals equally (40).

The findings shed light on the important roles played by physical activity, depressive symptoms, and physical health among older persons residing in West Java, Indonesia, communities. Although the specific mechanisms linking depression and frailty are unknown, they may share some common roots. To begin, inflammatory markers including interleukin-6 (IL-6) and C-reactive protein (CRP) have been shown to correlate positively with frailty in cross-sectional studies, as shown by a meta-analysis (6). Previous study found that patients with anxiety and depression also had elevated levels of IL-6 and CRP (41). However, a decrease in left ventricular function is associated with a lack of physical activity because of the resulting atrophy

of cardiac muscle (42). Moreover, study emphasized that conducting strengthening exercises such as aerobic exercise and impedance exercise can help lower the prevalence of frailty (43). Thus, encouraging physical activity among the older adult may mitigate the occurrence of depressive symptoms, while frailty is itself a risk factor for depression.

CONCLUSION

This study discovered that the connection between depressed symptoms and physical frailty was mediated by physical exercise. Based on our findings, physical weakness and function play an important role in the development of depression symptoms. Future studies should determine whether physical activity could reduce the risk of frailty in individuals with depressive symptoms.

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