

Biopsychosocial Determinants of Depressive Symptoms among Middle-Aged Adults in Indonesia

Findings from the Indonesian Family Life Survey (IFLS-5)

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ABSTRACT

Depression has been recognized as a major public health issue that affects middle-aged people in developing countries. The research explored how diabetes mellitus and stroke history affected depressive symptoms in Indonesian among middle-aged adults. This is a cross-sectional study that used data from the IFLS-5, which included 7,503 participants. Weighted descriptive, bivariate, and multivariable logistic regression analyses were performed. The prevalence of depressive symptoms was 17.72%, while 5.62% reported diabetes and 1.00% reported stroke. In adjusted analysis, diabetes only ((AOR = 0.77; 95% CI: 0.57–1.03; $p = 0.082$)), stroke only (AOR = 1.32; 95% CI: 0.70–2.52; $p = 0.387$), and combined diabetes and stroke (AOR = 0.91; 95% CI: 0.18–4.50; $p = 0.912$) were not significantly associated with depressive symptoms. Female (AOR = 1.20; 95% CI: 1.05–1.39; $p = 0.009$), unhealthy self-rated health (AOR = 2.48; 95% CI: 2.17–2.84; $p = 0.001$), and lack of community participation (AOR = 0.86; 95% CI: 0.74–0.99; $p = 0.043$) were significant. However, BMI had lower odds of depressive symptoms. Marital status, education, residence, smoking status, and physical activity were not significantly associated with depressive symptoms. These findings suggest that psychosocial and perceptual factors play a more prominent role in midlife depressive symptoms than chronic disease status. Integrated public health strategies addressing self-perceived health, social engagement, and gender disparities are necessary.

Keywords

Bio Psychosocial Factors
Chronic Disease
Depression
IFLS-5
Mental Health

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Introduction

Mental health has developed into a critical worldwide public health issue that affects people throughout their entire lives, and depression stands as the foremost cause of disability and diminished life quality. The Sustainable Development Goals (SDG 3) establish mental health as an essential area of focus, for which they aim to decrease non-communicable disease-related premature deaths and enhance mental health and well-being by 2030 [1]. The worldwide agenda faces an escalating health emergency through which depressive symptoms establish themselves as an urgent public health threat. Worldwide, over 280 million people around the world experience depression, which ranks among the top three global disabilities [2]. The health systems of low- and middle-income countries face severe challenges because they lack proper resources to deal with the effects of depression, which creates a major operational burden. Depression develops through a complex process that involves multiple biological, psychological, and social elements that include genetic predisposition, ongoing health issues, individual health perception, socioeconomic status, and a network of social support [3], [4]. The analysis of depressive symptoms needs an integrated framework because multiple health and social stressors affect these populations.

The period of middle-aged adulthood, which extends from age 45 to age 64, needs more research attention because it constitutes a vital yet undervalued stage of human life. The period includes extended periods of health problems, which people experience while they manage work duties and financial responsibilities, their role as caregivers, and their changing social obligations [5]. At the same time, the midlife stage brings forth two biological processes, which include metabolic dysfunction and vascular aging, that begin to show their effects. Midlife mental health disruptions affect the workforce capacity of this productive economic group while also impacting family relationships and creating future healthcare challenges [6].

The worldwide population faces significant health risks because chronic non-communicable diseases, which include diabetes mellitus and cardiovascular diseases, rank as the top medical conditions that cause both sickness and death. Approximately 73% of all deaths worldwide are attributable to Non-communicable Diseases, with diabetes and cardiovascular diseases accounting for a substantial proportion [7]. The global diabetes epidemic has reached critical levels because 537 million adults had diabetes in 2021, which

will increase to 783 million adults by 2045, according to projections [8]. Middle-aged people demonstrate higher rates of diabetes because their body functions experience metabolic disturbances that extend over an extended period until they develop blood vessel and nerve damage.

The relationship between diabetes and depression is well-documented and recognized as bidirectional. Diabetes patients experience higher rates of depression because their medical condition brings about complications, and they need to manage their treatment and their day-to-day activities, and they worry about their health status in the future [9]. The onset and progression of diabetes are worsened by depression because it causes people to stop taking their medication, develop unhealthy eating habits, and stop exercising, while it triggers chronic inflammation and disrupts the body's hormonal balance [10], [11]. The combination of depression and diabetes results in worse treatment results, which drives patients to seek more medical care and raises their chances of dying [12].

Stroke represents one of the most severe vascular complications associated with diabetes and poses substantial consequences for mental health. It ranks as the second most common cause of death and the third most common cause of death and disability across the globe, with about 12.2 million new cases diagnosed each year [13]. The metabolic and vascular mechanisms of diabetes lead to an increased risk of stroke [14]. Stroke causes middle-aged adults to suffer sudden loss of their physical abilities and mental faculties, while it also affects their ability to work and maintain social relationships, which increases their likelihood of developing depressive disorders. The diabetes and stroke burden in Indonesia had been increasing before the COVID-19 pandemic due to urbanization, dietary changes, and sedentary lifestyles that caused an epidemiological transition to proceed at a fast pace [15]. National data indicate that the prevalence of diabetes rose from 6.9% in 2013 to 10.9% in 2018 [16]. stroke has become the top cause of death in the country because it impacts over 2.1 million people [17]. Existing research studies in Indonesia show that people with chronic diseases experience higher rates of depressive symptoms, yet they have mostly studied diabetes and stroke and depression as separate topics without considering middle-aged adults as a distinct research group. Despite growing global recognition of the interconnectedness of physical and mental health, empirical evidence from middle-income countries examining the combined associations of diabetes and stroke with depressive symptoms remains limited. Middle-aged adults represent a particularly important group for investigation, as this life stage precedes older age and offers a critical window for prevention, early detection, and integrated intervention.

Therefore, this study aims to investigate how diabetes and stroke history interact with depressive symptoms in Indonesian middle-aged adults between 45 and 64 years, because of

their representative sample from the Indonesian Family Life Survey Wave 5 (IFLS-5) data. IFLS-5 provides one of the most comprehensive pre-pandemic datasets nationally representative in Indonesia that simultaneously captures validated measures of depressive symptoms and detailed biological, behavioral, and social variables, enabling an integrated biopsychosocial analysis. The study uses a biopsychosocial framework to examine how biological, behavioral, and social factors affect population-level research on depression, which results from chronic diseases and psychosocial conditions. The study investigates fundamental relationships between distinct factors to develop public health strategies for Indonesia, which combine mental health assessment with physical activity and social interaction and chronic disease treatment.

The article follows this particular structure. The Materials and Methods section describes the study design, data source, study population, variable measurements, and statistical analyses employed. The Results section presents the prevalence estimates and multivariable regression findings. The Discussion section interprets the findings in relation to existing literature, outlines public health implications, and discusses study limitations before concluding with recommendations for integrated mental health strategies.

Material and Methods

A. Study Design and Reporting Standards

The study used a population-based cross-sectional analytical design, which analyzed secondary data from the Indonesian Family Life Survey Wave 5 (IFLS-5). The analysis was conducted in 2014–2015. The cross-sectional analysis used only data from Wave 5 despite IFLS being a longitudinal survey. The research report follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies, which establish methodological standards and research transparency. The completed checklist is provided as Supplementary File 1. The secondary data analysis required no extra ethical approval because the IFLS-5 data existed as publicly accessible de-identified information.

B. Data Source

Data were obtained from IFLS-5, a nationally representative household survey conducted in Indonesia between 2014 and 2015 by the RAND Corporation in collaboration with Indonesian research institutions. IFLS-5 covers approximately 83% of the Indonesian population across 13 provinces and employs a multistage stratified sampling design to ensure population-level representativeness. The survey collects multiple demographic data points together with socioeconomic information and details about physical health, mental health, healthcare usage, and health-related lifestyle practices and social engagement activities. For this study, only data from IFLS-5 were utilized. IFLS-5 includes validated measures of depressive symptoms and detailed information on chronic diseases and psychosocial factors,

allowing an integrated biopsychosocial analysis. The survey methodology can be accessed through the official website, which provides more detailed information <https://www.rand.org/well-being/social-and-behavioralpolicy/data/FLS/IFLS/hh.html>.

C. Study Population

Fig. 1 illustrates the inclusion and exclusion process used to derive the final analytical sample. From the respondents with filled depressive symptoms questionnaire data (N= 31,164), participants were excluded for incomplete information on key independent variables (Age, sex, Marital status, Education, and BMI), which accounted for a total of N= 59 exclusions, and for age eligibility screening (removing respondents aged <45 years or >64 years) as well as those with missing age information N=23,602. After applying these complete-case criteria and restricting the sample to middle-aged adults aged 45–64 years, the final analytical sample comprised N= 7,503 participants (3,965 females and 3,538 males). Multiple imputation was not performed due to the low missing data being less than 5%; instead, only a complete case analysis was done.

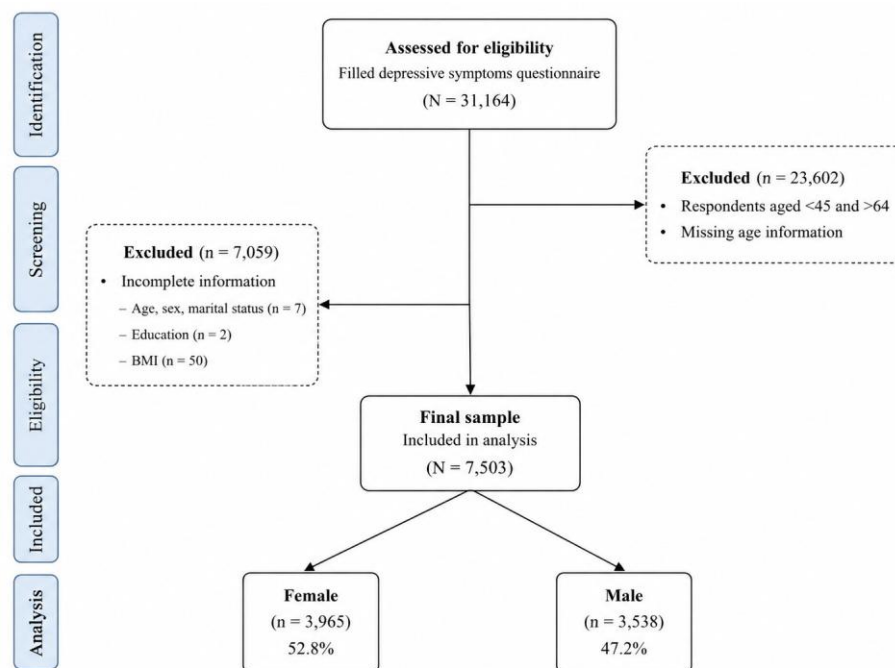


Fig. 1. Flowchart of study participant selection (inclusion and exclusion criteria)

D. Study Variables

Depressive symptoms were the dependent variable and were measured using the 10-item Center for Epidemiologic Studies Depression Scale (CES-D-10). The CES-D-10 assesses the frequency of depressive symptoms experienced during the past week. Each item is scored on a four-point Likert scale, which starts at 0 (rarely or none of the time) and ends at 3 (most of the time), thus producing total scores that range from 0 to 30, while higher scores indicate greater depressive symptom severity. According to established cut-off recommendations,

respondents were diagnosed with depressive symptoms when they scored ≥ 10 , while scores < 10 indicated that they were non-depressed. The CES-D-10 has demonstrated satisfactory reliability in Indonesian populations.

The study used two main independent variables, which included self-reported physician-diagnosed diabetes mellitus and history of stroke, with two options: no and yes. These two conditions were combined into a single four-category variable, which examined how both conditions affected depressive symptoms by including the following categories: (0) neither diabetes nor stroke, (1) diabetes only, (2) stroke only, and (3) both diabetes and stroke. The researchers selected additional independent variables according to a biopsychosocial framework. The biological factors included sex, which had male and female options, and body mass index (BMI), which used weight in kilograms divided by height in meters squared (kg/m^2), and categorized weight into four groups of underweight, normal, overweight, and obese, and self-rated health status, which had healthy and unhealthy options. The social factors included three components, which were marital status (single/married), educational attainment (non-educated/educated), and place of residence (rural/urban). The researchers defined behavioral factors through three elements, which included smoking status (non-smoker/smoker), physical activity (no/yes), and community participation (no/yes). All variables were derived from standardized IFLS-5 questionnaires.

E. Data analysis

All statistical analyses were conducted using Stata MP 64-bit software from StataCorp LLC in College Station Texas USA to perform all statistical analyses. The study used descriptive statistics, which showed data as frequencies and percentages. The researchers used chi-square tests to evaluate the relationship between independent variables and depressive symptoms. The study used multivariable logistic regression analysis to investigate the relationship between diabetes and stroke history with depressive symptoms after controlling for biological, social, and behavioral factors. The study examined the effects of diabetes and stroke by testing both conditions separately and together as a four-category variable. Data weighting was carried out to account for the complex survey design and to ensure national representativeness of the estimates. The study findings present adjusted odds ratios (AORs) along with 95% confidence intervals (CIs). The researchers established statistical significance at $p < 0.05$ (two-sided).

Results and Discussions

Table 1 presents the descriptive analysis of biopsychosocial characteristics among Indonesian middle-aged adults aged 45–64 years based on IFLS-5 data. The table summarizes demographic, biological, psychological, and social variables of 7,503 respondents included in the study sample.

Table 1. Descriptive analysis Bio psychosocial Characteristics of Middle-Aged Adults (45–64 Years) in Indonesia: Evidence from IFLS-5 (n= 7,503)

Variable	Frequency(N)	Percentage (%)
Depressive Symptoms		
• No	6,134	82.28
• Yes	1,369	17.72
Diabetes Mellitus		
• No	7,080	94.38
• Yes	423	5.62
Stroke		
• No	7,422	99.00
• Yes	81	1.00
Sex		
• Male	3,538	47.47
• Female	3,965	52.53
Marital Status		
• Single	1,253	15.94
• Married	6,250	84.06
Education		
• Non Educated	624	8.53
• Educated	6,879	91.47
Residence		
• Rural	3,180	47.89
• Urban	4,323	52.11
Smoking status		
• Non smoker	4,796	63.70
• Smoker	2,707	36.30
Community Participation		
• No	5,028	65.49
• Yes	2,475	34.51
Physical Activity		
• No	1,018	12.86
• Yes	6,485	87.14
BMI		
• Underweight	649	8.75
• Normal	3,813	51.61
• Overweight	2,262	29.44
• Obesity	779	10.19
Self-rated health		
• Healthy	5,329	53.85
• Unhealthy	2,174	46.15

Data weighting was applied to ensure that the sample more accurately represented the target population; therefore, the reported percentages reflect weighted estimates. The findings showed that 17.72% of participants (n= 1,369) experienced depressive symptoms, while 82.28% (n= 6,134) were classified as non-depressed based on the CES-D-10 cut-off score. Regarding diabetes mellitus, 5.62% of participants (n= 423) reported physician-diagnosed diabetes, whereas 94.38% (n= 7,080) did not have diabetes. In addition, 1.00% of respondents (n= 81) had a history of stroke, while 99.00% (n= 7,422) reported no history of stroke.

Female participants constituted a slightly higher proportion of the sample at 52.53% (n= 3,965), compared with males who accounted for 47.47% (n= 3,538). Most respondents

were married, representing 84.06% (n= 6,250), while 15.94% (n= 1,253) were single. The majority of participants had formal education, accounting for 91.47% (n= 6,879), whereas 8.53% (n= 624) reported having no formal education. In terms of residence, 52.11% of participants (n= 4,323) lived in urban areas, while 47.89% (n= 3,180) resided in rural areas.

Regarding smoking status, 63.70% of participants (n= 4,796) were non-smokers, whereas 36.30% (n= 2,707) reported smoking. Community participation was reported by 34.51% of respondents (n= 2,475), while 65.49% (n= 5,028) did not participate in community activities. Most participants, 87.14% (n= 6,485), engaged in physical activity, while 12.86% (n= 1,018) reported no physical activity.

Based on body mass index (BMI), 51.61% of participants (n= 3,813) had normal weight, 29.44% (n= 2,262) were overweight, 10.19% (n= 779) were obese, and 8.75% (n= 649) were underweight. Concerning self-rated health status, 53.85% of respondents (n= 5,329) perceived themselves as healthy, whereas 46.15% (n= 2,174) considered their health to be poor.

Table 2 presents the weighted bivariate analysis of depressive symptoms with biological, social, and behavioral factors among Indonesian middle-aged adults aged 45–64 years (N= 7,503). Pearson's chi-square test was used to examine the association between depressive symptoms and the independent variables, and the percentages presented were weighted estimates.

Table 2. Bivariate Associations of Diabetes, Stroke History, and Other Bio psychosocial Factors with Depressive Symptoms among Adults Aged 45–64 Years, IFLS-5 (n= 7,503)

Variables	Depressive Symptoms N (%)		P-Value
	Normal	Has Depressive Symptoms	
Diabetes &Stroke			
No	5,734 (82.28)	1,276 (17.72)	0.520
Diabetes Only	336 (83.46)	76 (16.54)	
Stroke Only	55 (75.65)	15 (24.35)	
Yes	9 (76.06)	2 (23.94)	
Sex			
Male	2,962 (83.81)	576 (16.19)	0.002
Female	3,172 (80.90)	793 (19.10)	
Marital Status			
Single	983 (79.01)	270 (20.99)	0.002
Married	5,151 (82.90)	1,099 (17.10)	
Education			
Non Educated	511 (83.54)	113 (16.46)	0.434
Educated	5,623 (82.16)	1,256 (17.84)	
Residence			
Rural	2,609 (82.84)	571 (17.16)	0.265
Urban	3,525 (81.77)	798 (18.23)	
Smoking status			
Non smoker	3,924 (82.39)	872 (17.61)	0.752
Smoker	2,210 (82.08)	497 (17.92)	
Community Participation			
	4,063 (81.40)	965 (18.60)	0.011

Variables	Depressive Symptoms N (%)		P-Value
	Normal	Has Depressive Symptoms	
No	2,071 (83.95)	404 (16.05)	
Yes			
Physical Activity			
No	857 (83.21)	161 (16.79)	0.449
Yes	5,277 (82.14)	1,208 (17.86)	
BMI			
Underweight	491 (77.38)	158 (22.62)	0.004
Normal	3,122 (82.11)	691 (17.89)	
Overweight	1,880 (84.07)	382 (15.93)	
Obesity	641 (82.19)	138 (17.81)	
Self-rated health			
Healthy	4,580 (88.08)	749 (11.92)	0.006
Unhealthy	1,554 (77.66)	620 (22.34)	

The analysis showed no statistically significant association between depressive symptoms and diabetes–stroke status ($p= 0.520$). Similarly, no significant relationships were observed between depressive symptoms and educational status ($p= 0.434$), place of residence ($p= 0.265$), smoking status ($p= 0.752$), and physical activity ($p= 0.449$).

Several variables demonstrated statistically significant associations with depressive symptoms. Sex was significantly associated with depressive symptoms ($p= 0.002$), with females reporting a higher proportion of depressive symptoms than males. Marital status also showed a significant relationship ($p= 0.002$), as single participants reported a higher prevalence of depressive symptoms compared with married participants.

Community participation was significantly associated with depressive symptoms ($p= 0.011$), with participants who did not participate in community activities reporting higher depressive symptoms than those who participated. Body mass index (BMI) categories were also significantly associated with depressive symptoms ($p= 0.004$), particularly among underweight participants who showed the highest prevalence of depressive symptoms. Self-rated health status demonstrated a significant association with depressive symptoms ($p= 0.006$), as respondents with unhealthy self-rated health reported higher depressive symptoms compared with those who perceived themselves as healthy.

Table 3 presents the results of the weighted multivariable logistic regression analysis examining factors associated with depressive symptoms among Indonesian adults aged 45–64 years. All biological, demographic, behavioral, and psychosocial variables were entered simultaneously into the model. Adjusted odds ratios (AORs), 95% confidence intervals (CIs), and p-values are reported, with weighted estimates used in the analysis.

Table 3. Multivariable logistic regression analysis of factors associated with depressive symptoms among adults aged 45–64 years in Indonesia (IFLS-5), $n= 7,503$

Variable	AOR	95% CI	p-value
Diabetes & Stroke[ref=(Normal)]			

Diabetes only	0.77	0.57-1.03	0.082
Stroke only	1.32	0.70-2.52	0.387
Both	0.91	0.18-4.50	0.912
Sex[ref=(Male)]			
Female	1.20	1.05-1.39	0.009
Marital status[ref=(Unmarried)]			
Married	0.86	0.72-1.02	0.095
Education[ref=(Non Educated)]			
Educated	1.21	0.94-1.56	0.142
Residence[ref=(rural)]			
Urban	1.14	0.99-1.30	0.067
Smoking[ref=(Non-smoker)]			
Smoker	0.98	0.86-1.13	0.821
Community Participation[ref=(No)]			
Yes	0.86	0.74-0.99	0.043
Physical Activity[ref=(No)]			
Yes	1.25	0.92-1.37	0.243
BMI[ref=(Underweight)]			
Normal	0.77	0.62-0.97	0.024
Overweight	0.62	0.49-0.79	0.001
Obesity	0.66	0.49-0.89	0.006
Self-rated health[ref=(healthy)]			
Unhealthy	2.48	2.17-2.84	0.001

After adjustment, diabetes and stroke status were not significantly associated with depressive symptoms. Compared with individuals without diabetes or stroke, participants with diabetes only (AOR = 0.77; 95% CI: 0.57–1.03; $p = 0.082$), stroke only (AOR = 1.32; 95% CI: 0.70–2.52; $p = 0.387$), and both diabetes and stroke (AOR = 0.91; 95% CI: 0.18–4.50; $p = 0.912$) did not show statistically significant associations with depressive symptoms.

Sex was significantly associated with depressive symptoms, with females having higher odds of depressive symptoms compared with males (AOR = 1.20; 95% CI: 1.05–1.39; $p = 0.009$). Marital status was not significantly associated with depressive symptoms, although married participants showed lower odds compared with unmarried participants (AOR = 0.86; 95% CI: 0.72–1.02; $p = 0.095$). Educational attainment and place of residence were also not significantly associated with depressive symptoms. Similarly, smoking status showed no statistically significant association with depressive symptoms (AOR = 0.98; 95% CI: 0.86–1.13; $p = 0.821$). Physical activity was not significantly associated with depressive symptoms (AOR = 1.25; 95% CI: 0.92–1.37; $p = 0.243$).

Community participation was significantly associated with depressive symptoms, with participants involved in community activities showing lower odds of depressive symptoms compared with non-participants (AOR = 0.86; 95% CI: 0.74–0.99; $p = 0.043$). Body mass index (BMI) categories demonstrated significant associations with depressive symptoms. Compared with underweight participants, those with normal BMI (AOR = 0.77; 95% CI: 0.62–0.97; $p = 0.024$), overweight (AOR = 0.62; 95% CI: 0.49–0.79; $p = 0.001$), and obesity (AOR = 0.66; 95% CI: 0.49–0.89; $p = 0.006$) had lower odds of depressive symptoms. Whereas Self-rated health

status was strongly associated with depressive symptoms. Respondents reporting unhealthy self-rated health had significantly higher odds of depressive symptoms compared with those reporting healthy self-rated health (AOR = 2.48; 95% CI: 2.17–2.84; $p = 0.001$).

Discussion

The research investigated how diabetes and stroke history, together with biopsychosocial factors, were associated with depressive symptoms among middle-aged Indonesian adults. Using weighted analyses to improve population representativeness, the findings showed that diabetes and stroke status were not independently associated with depressive symptoms in the adjusted model. In contrast, sex, community participation, body mass index, and self-rated health were significantly associated with depressive symptoms. Marital status, educational attainment, residence, smoking status, and physical activity were not significantly associated with depressive symptoms in the adjusted weighted model. These findings suggest that psychosocial and perceptual factors may play a more important role in depressive symptoms among middle-aged adults than chronic disease status alone. However, post-pandemic changes in health systems, mental health burden, and lifestyle behaviors may alter these associations, and therefore, caution is needed when generalizing these findings to current populations.

Although previous studies have consistently reported strong associations between diabetes and depression, the present study did not find a statistically significant independent association after adjustment for biopsychosocial variables. Multiple meta-analyses have demonstrated that people with diabetes experience a much higher chance of developing depressive symptoms compared to individuals without diabetes [18], [19]. However, several studies found that diabetes and depression show a decreasing relationship once researchers adjust for socioeconomic status, lifestyle choices, and health perceptions [20]. This suggests that psychosocial and behavioral factors may mediate the relationship between chronic disease and depressive symptoms, which may explain the non-significant findings observed in the present study. Since the IFLS-5 data were collected before the COVID-19 pandemic, these findings should be interpreted as reflecting pre-pandemic baseline associations.

Similarly, stroke history was not independently associated with depressive symptoms in the adjusted model. This finding differs from previous studies reporting high rates of post-stroke depression among stroke survivors. A study by [21] estimated that approximately one-third of stroke survivors experience depressive symptoms. More recently, [22] confirmed that stroke survivors have a significantly elevated risk of depression compared to non-stroke populations. The discrepancy in our findings may reflect differences between clinical stroke cohorts and community-based samples, where stroke prevalence is lower and functional impairment may vary substantially.

Females demonstrated higher chances of developing depressive symptoms according to worldwide research findings. Epidemiological studies consistently show that women are nearly twice as likely as men to experience depression [23]. Biological mechanisms, including hormonal fluctuations, as well as social and gender-related factors, have been proposed to explain this disparity [24]. The persistence of this association in our adjusted model reinforces the importance of gender-sensitive mental health strategies.

The body mass index showed a negative relationship with depressive symptoms because underweight people had a higher chance of depression than those who had a normal weight, or were overweight or obese [25]. Previous research has reported non-linear relationships between BMI and depression, including U-shaped patterns [26]. Some studies have shown that obesity increases depression risk for certain groups, while underweight status indicates fragile people who need food because of their medical condition [27]. These findings highlight the importance of examining BMI categories within specific sociocultural contexts.

Active community participation leads to reduced chances of developing depressive symptoms because research shows that social contact protects against depression. The studies demonstrate that people who participate more in their communities experience lower chances of developing depressive symptoms as they age [28]. People who take part in their community can expect better emotional assistance and better social connections, which help them handle stressful situations while their depressive symptoms decrease [29]. This finding underscores the relevance of integrating community-based social interventions into public health strategies.

Self-rated health emerged as the strongest predictor of depressive symptoms. Poor self-rated health has consistently been associated with elevated depressive symptoms across diverse populations [30]. Self-rated health defines both actual disease burden and personal health perceptions, which directly impact mental health. The research establishes that people who regard their health as bad tend to develop depression at a later time despite having no known health issues [31]. Our findings from pre-pandemic IFLS-5 data indicate that subjective health perception functions as a primary mechanism that connects physical health and mental health.

Physical activity was not significantly associated with depressive symptoms in the adjusted analysis. This finding differs from many previous studies that have reported protective effects of physical activity against depression [25], [26]. However, some studies have similarly found that the association becomes non-significant after controlling for socioeconomic, behavioral, and psychosocial factors [27], [28]. One possible explanation is that physical activity among middle-aged adults in Indonesia may largely involve occupational or daily living activities rather than leisure-time exercise, which may provide fewer mental health benefits. In addition, differences in the type, intensity, and context of physical activity may

influence its relationship with depressive symptoms. These findings suggest that physical activity alone may not independently predict depressive symptoms when broader psychosocial and health-related factors are considered simultaneously.

These findings indicate that depressive symptoms among middle-aged adults are more strongly associated with psychosocial and perceptual factors than with chronic disease status alone. Mental health interventions targeting this population should therefore emphasize social engagement, subjective health perception, and broader psychosocial well-being. Collectively, these findings provide important pre-pandemic baseline evidence regarding the biopsychosocial determinants of depressive symptoms among middle-aged adults in Indonesia

Strengths and Limitations

This study has several important strengths, including the use of nationally representative IFLS-5 data and the application of sampling weights to improve population representativeness among middle-aged adults in Indonesia. The study also employed data that represents the entire national population and uses a complete biopsychosocial framework that combines biological, behavioral, demographic, and psychosocial elements into one integrated system. The features create a vital population reference point, which enables researchers to examine depressive symptom patterns before the COVID-19 pandemic while establishing a benchmark for future time-based studies. However, several limitations should be considered when interpreting the findings. The researchers used a cross-sectional study design, which restricted their ability to determine cause-and-effect relationships. Furthermore, several variables, including physical activity, self-rated health, diabetes, and stroke history, were based on self-reported information rather than objective clinical assessments, which may have introduced recall bias or misclassification. Although sampling weights improved population representativeness, residual confounding from unmeasured socioeconomic, clinical, or psychosocial variables may remain. Additionally, because the IFLS-5 data were collected before the COVID-19 pandemic, post-pandemic changes in mental health burden, healthcare access, social interaction, and lifestyle behaviors may influence the current relevance of these findings; therefore, caution is needed when generalizing these findings to current populations.

Conclusion

Diabetes and stroke were not independently associated with depressive symptoms among middle-aged Indonesian adults after adjustment for biopsychosocial factors. In contrast, female sex, unhealthy self-rated health, lower BMI, and lack of community participation were significantly associated with depressive symptoms. These findings highlight the important role of psychosocial and perceptual determinants in midlife mental health beyond chronic disease status alone. The results suggest that public health interventions should integrate mental

health screening with community-based social support and strategies that address subjective health perceptions among middle-aged adults. Future longitudinal studies are needed to clarify causal pathways and examine changes in these associations in post-pandemic populations.

Ethical Clearance

Ethical approval for IFLS-5 was granted by RAND's Human Subjects Protection Committee (Protocol No. s0064-06-01-CR01) and Gadjah Mada University. The present study used publicly available, de-identified secondary data and therefore required no additional ethical approval.

Conflict of Interest

The authors declare no conflict of interest.

AI Use Statement

The authors used ChatGPT (OpenAI) to assist with language editing and clarity improvement. All scientific content, statistical analysis, interpretation, and conclusions are entirely the responsibility of the authors.

Availability of data and materials

This study used IFLS-5 data, which are publicly available, conducted by RAND. Researchers can access the data upon registration at the RAND Corporation website:

www.rand.org/well-being/social-and-behavioral-policy/data/FLS/IFLS.html

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