

RESEARCH ARTICLE

Health Behaviors, Informal Employment, and Depression Among Female Workers in Indonesia's Geographically Disadvantaged Regions

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ABSTRACT

Introduction: Employment insecurity, chronic illness, and health-risk behaviours may be associated with depressive symptoms among women working in Indonesia's disadvantaged, frontier, and outermost (3T) regions. However, nationally representative survey evidence for this population remains limited. Objective: This study aimed to identify factors associated with depressive symptoms among female workers in Indonesia's 3T regions using data from the 2023 Indonesian Health Survey.

Methods: This cross-sectional study used data from the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia; SKI 2023), which employed a multistage sampling design. The final analytic sample comprised 15,218 women aged ≥ 15 years living and working in 3T regions. Depressive symptoms were assessed using a module of the Mini International Neuropsychiatric Interview (MINI) and classified as positive or negative. Statistical analyses accounted for the complex survey design and sampling weights. Survey-adjusted chi-square tests were used for preliminary associations, and multivariable binary logistic regression was used to estimate adjusted odds ratios (aORs) with 95% confidence intervals (CIs).

Results: Depressive symptoms were identified in 1.2% ($n=180$) of female workers in 3T regions. After adjustment, depressive symptoms were associated with informal employment (aOR=3.60; 95% CI: 1.30–9.90), one comorbid condition (aOR=3.10; 95% CI: 2.10–4.56), two or more comorbid conditions (aOR=4.88; 95% CI: 2.30–10.30), insufficient physical activity (aOR=2.29; 95% CI: 1.70–3.10), and alcohol consumption (aOR=3.05; 95% CI: 1.05–8.90). Age, marital status, education level, and current smoking were not significantly associated with depressive symptoms after adjustment.

Conclusion: Among female workers in Indonesia's 3T regions, depressive symptoms were associated with informal employment,

INTRODUCTION

Depression is a major global public health issue because of its prevalence, recurrent course, substantial disability burden, and adverse effects on quality of life. Global Burden of Disease studies have shown that depressive disorders contribute substantially to years lived with disability and disability-adjusted life-years, with women affected more than men (1–3). Although age-standardised rates of depression have changed relatively little over time, the absolute number of cases has increased with population growth, population ageing, and persistent social inequalities (2–5). Depression is not only a medical disorder but also an important population-health indicator because it affects social functioning, workplace productivity, household well-being, health-system burden, and sustainable development (5–7).

Women may be particularly vulnerable to depression because biological, social, occupational, and economic factors can interact across the life course. In many low- and middle-income countries (LMICs), women may combine paid employment with unpaid domestic work and caregiving responsibilities.

This combination of roles may contribute to psychological stress and social vulnerability (6,7). Employment can provide income, autonomy, social inclusion, satisfaction, and meaning; however, unfavourable working conditions may adversely affect mental health. Psychosocial work stressors, poor employment security, limited job control, precarious or informal work, and restricted access to occupational protection have been associated with poorer employee mental health (8–10). These conditions are common in informal employment, where unstable work and limited social protection may compound women's existing economic and caregiving burdens.

Informal employment may therefore be an important socioeconomic determinant of mental health, particularly in economically vulnerable groups with limited labour protection. Previous studies have reported associations between informal employment and depressive symptoms or poorer mental health, including among urban populations in low- and middle-income settings (11). Potential pathways include income instability, limited health-insurance coverage, lack of paid leave, inadequate occupational-safety provisions, and weak bargaining power. Among women, these effects may be compounded by economic disadvantage and the unequal distribution of paid and unpaid work. Employment status is therefore an important factor when examining depressive symptoms among female workers in economically disadvantaged populations.

In addition to work-related factors, physical health and health-related behaviours may be associated with depressive symptoms among female workers. Multimorbidity, defined as the coexistence of multiple chronic conditions, is associated with depression; chronic illness may contribute to psychological stress, functional limitations, financial strain, and increased healthcare needs (12). Physical activity is another relevant behavioural factor. Previous research and meta-analyses have reported an association between low levels of physical activity and a higher risk of depression, while regular physical activity may be protective (13,14). Alcohol consumption is also associated with psychiatric disorders, including depression, through potentially overlapping biological, behavioural, and social pathways (15,16). Indonesian evidence has likewise highlighted links between lifestyle-related factors and mental health, supporting investigation of health behaviours alongside psychological well-being (17).

In Indonesia, these issues are particularly relevant in disadvantaged, frontier, and outermost regions, commonly referred to as 3T areas. The Indonesian Government designates disadvantaged regions using economic, human-resource, infrastructure, regional financial-capacity, accessibility, and geographic indicators (18). These structural inequalities may affect access to healthcare, depression screening, stable employment, education, transport, and health-promotion resources. Female workers may experience these geographic and occupational constraints alongside chronic illness and health-risk behaviours. The 2023 Indonesian Health Survey (*Survei Kesehatan Indonesia*; SKI 2023) provides nationally representative data on health status, psychological well-being, individual characteristics, comorbidities, and health behaviours, enabling investigation of these factors in underserved populations (19).

Existing evidence links depression with employment insecurity, multiple chronic conditions, low physical activity, and alcohol consumption. However, many studies have examined these factors separately or have been geographically restricted or limited to specific populations. Evidence on the overlap of these factors among female workers living in geographically disadvantaged communities remains limited. This gap is important because depressive symptoms in this population may reflect intersecting occupational, health-related, behavioural, and geographic vulnerabilities.

Female workers in Indonesia's disadvantaged, frontier, and outermost (3T) regions may face multiple, overlapping vulnerabilities. Informal employment can involve limited job security, occupational protection, and employment benefits, while geographic remoteness and infrastructure limitations may restrict access to healthcare, mental-health services, transport, and social support. Women may also combine paid work with household and caregiving responsibilities, increasing overall workload. These disadvantages may coexist with chronic illness and health-risk behaviours. National evidence examining these factors simultaneously among female workers in 3T regions remains limited.

Therefore, this study aimed to identify factors associated with depressive symptoms among female workers residing in Indonesia's disadvantaged, frontier, and outermost (3T) regions using nationally representative data from the 2023 Indonesian Health Survey. Unlike previous studies that have focused on individual correlates or broader populations, this study simultaneously examined demographic characteristics, employment status, multimorbidity, and health-related behaviours in this underserved population. The study sought to provide context-specific evidence to inform gender-sensitive and geographically responsive mental-health screening and prevention strategies in underserved areas of Indonesia.

METHODS

Study Design and Data Source

We conducted an analytical observational study with a cross-sectional design using secondary data from the 2023 Indonesian Health Survey (*Survei Kesehatan Indonesia; SKI 2023*), administered by the Ministry of Health of the Republic of Indonesia. SKI 2023 used the WHO STEPwise Approach to Surveillance (STEPS), integrating interviews, physical measurements, and biomarkers. The survey used a two-stage stratified cluster-sampling design to generate nationally representative estimates.

Study Population and Sample Selection

Study setting and population: This cross-sectional analysis included female workers aged ≥ 15 years who participated in SKI 2023. The initial dataset comprised 463,269 female respondents aged ≥ 15 years. We excluded respondents who were not working ($n=174,807$) and those currently attending school ($n=52,781$), leaving 235,681 respondents. We then excluded 220,391 respondents living outside 3T regions, leaving 15,290 eligible respondents. Finally, respondents with missing data for any study variable ($n=72$) were excluded. The final analytic sample comprised 15,218 female workers living in eligible 3T regions, including 180 with positive depressive symptoms and 15,038 without depressive symptoms. Figure 1 presents the sample-selection flow.

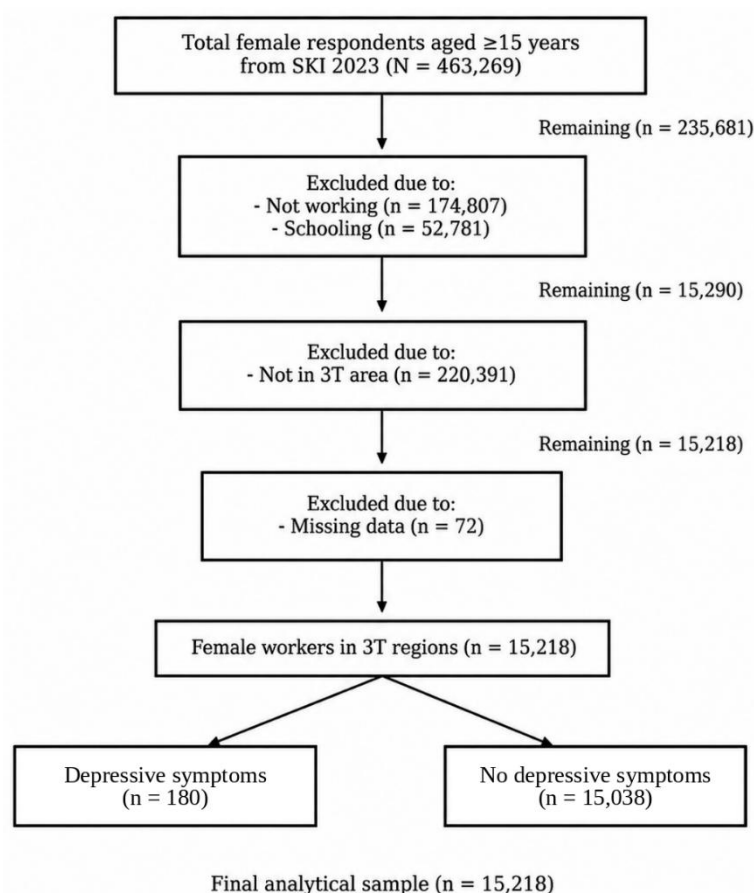


Figure 1. Flow diagram of sample selection from the 2023 Indonesian Health Survey (SKI 2023).

Outcome Variable

The primary outcome was depressive-symptom status (positive or negative). In SKI 2023, depressive symptoms were assessed using the depression module of the Mini International Neuropsychiatric Interview (MINI), comprising ten yes/no items. Respondents were classified as having depressive symptoms if they answered 'yes' to at least two of the three core items (items 1–3) and 'yes' to at least two of the seven additional items (items 4–10), consistent with the official SKI 2023 definition (19). This classification was applied uniformly to all respondents. The outcome represents depressive symptoms identified using the SKI 2023 MINI module rather than an independently confirmed clinical diagnosis. Survey administration, classification thresholds, and interview-based data collection may influence the observed proportion.

Explanatory Variables

Explanatory variables included demographic characteristics, employment status, comorbid conditions, and health-related behaviours. Age was grouped using the sample median into ≤ 43 years and >43 years. This categorisation was retained to facilitate interpretation and consistency across descriptive, bivariable, and multivariable analyses. Because no established age threshold was identified for classifying vulnerability to depressive symptoms among female workers in Indonesia's 3T regions, the sample median was used as a data-driven cut-off. This approach produced relatively balanced groups while

avoiding an arbitrary external threshold; however, categorisation may reduce information and obscure age-related gradients. Marital status was categorised as never married, married, or divorced/widowed. Education was classified as primary/basic, secondary, or higher education.

Employment status was categorised as formal or informal according to employment categories in SKI 2023 and the Indonesian labour-force classification. Formal employment included government employees, civil servants, members of the military or police, employees of state-owned enterprises, and private-sector employees. Informal employment included self-employed workers, farmers, fishers, labourers, drivers, domestic workers, and other occupations classified as informal.

This classification was intended to distinguish workers primarily by employment security, labour protection, and access to work-related benefits rather than by occupational tasks. Informal employment encompasses heterogeneous occupations with different physical workloads, psychosocial risks, financial pressures, and working conditions; however, these occupations may share limited access to social protection, employment insecurity, and fewer workplace benefits. Informal employment was therefore treated as a single exposure group in accordance with the study's conceptual model of employment insecurity. Occupation-specific subgroup analyses were not performed because only 180 respondents were classified as having depressive symptoms. Stratifying the analysis across multiple occupational categories could yield very few outcome events in some groups and unstable regression estimates. This limitation is acknowledged.

Comorbidity was defined as the coexistence of chronic non-communicable conditions identified in SKI 2023. The comorbidity measure was created by aggregating chronic conditions available in the dataset, including hypertension, diabetes mellitus, stroke, heart disease, chronic kidney disease, cancer, and other chronic diseases. For each condition, SKI 2023 used survey information and, where applicable, diagnosis or health measurements to determine condition status. Respondents were then categorised as having no comorbidity, one comorbid condition, or two or more conditions (multimorbidity).

Health-related behaviours included current smoking, risky food consumption, physical activity, and alcohol consumption. Current smoking was classified as yes/no based on whether respondents reported smoking at the time of the survey. Physical activity was defined using the SKI 2023 indicator, which assessed moderate- and vigorous-intensity activity during work, transport, and leisure. Respondents meeting the recommended equivalent of approximately 150 minutes of moderate-intensity activity, 75 minutes of vigorous-intensity activity per week, or an equivalent combination were classified as having sufficient physical activity; all others were classified as having insufficient physical activity.

Risky food consumption was defined using SKI 2023 food-risk behaviour indicators covering sweet, salty, and fatty/cholesterol/fried foods. In this study, consumption was classified as 'frequent' when respondents reported consuming these foods one to two times per day or one to six times per week, and as 'rare' when consumption was reported as three times or less per month or never. Alcohol consumption was assessed using the SKI 2023 alcohol-intake indicator for respondents aged >10 years. Respondents who reported consuming any alcoholic beverage during the preceding month were classified as alcohol consumers; those reporting no alcohol consumption were classified as non-consumers.

Complex Survey Specification and Weighting

All analyses accounted for the complex SKI sampling design using sampling weights, strata, and primary sampling units (PSUs). In Stata, the survey design was specified using the `svyset` command with the weight, strata, and PSU variables. Inferential analyses used survey-adjusted procedures (`svy: prefix`) to obtain appropriate standard errors and confidence intervals.

Statistical Analysis

Descriptive statistics were reported as unweighted sample counts (*n*) and unweighted percentages (%) to describe participant characteristics and the distribution of depressive symptoms among female workers in 3T regions. Both counts and percentages describe the analytic sample. Bivariable and multivariable inferential analyses incorporated sampling weights, strata, and PSUs to estimate survey-adjusted effect estimates, standard errors, 95% confidence intervals, and *p* values.

Factors associated with depressive symptoms were examined using survey-weighted multivariable logistic regression. Covariates were selected primarily on the basis of the study's conceptual framework, disease burden, and previous evidence rather than solely on statistical significance in bivariable analyses. Age, marital status, education level, employment status, comorbidity, current smoking, physical activity, and alcohol consumption were retained because of their demographic, occupational, health, or behavioural relevance. A bivariable screening threshold of $p < 0.25$ was also considered to identify additional potentially relevant factors and reduce the risk of excluding confounders.

Because depressive symptoms were uncommon, model specification considered the number of outcome events relative to the number of estimated regression parameters. Among the 180 respondents classified as having depressive symptoms, approximately 10 predictor parameters were estimated, corresponding to about 18 outcome events per parameter. Although this ratio was considered adequate for the primary multivariable model, some exposure categories, including alcohol consumption and formal employment, contained few outcome events. Estimates for these categories may therefore be imprecise and potentially affected by sparse-data instability. Interpretation emphasised the width of the 95% confidence intervals. All selected variables were entered simultaneously into the multivariable model to obtain mutually adjusted estimates. Effect sizes are reported as adjusted odds ratios (aORs) with 95% confidence intervals (CIs). Statistical significance was defined as $p < 0$

Model Diagnostics

Multicollinearity was assessed using variance inflation factors (VIFs). Additional model diagnostics appropriate for survey-weighted logistic regression were also performed.

Missing Data

Complete-case analysis was used: 72 female workers with missing data for any study variable were excluded, leaving a final analytic sample of 15,218 respondents.

Ethical Approval

The present study involved secondary analysis of de-identified data from the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia; SKI 2023). The primary SKI 2023 survey received ethical approval from the Health Research Ethics Committee of the Health Polytechnic of the Ministry of Health Jakarta II (*Komisi Etik Penelitian Kesehatan Poltekkes Kemenkes Jakarta II*), approval No. LB.02.01/I/KE/L/287/2023, dated 10 May 2023. Written informed consent was obtained from participants during the primary data collection.

The present analysis used only de-identified secondary data, involved no direct contact with participants, and collected no additional identifiable information. Under the 2021 Indonesian National Guidelines and Ethical Standards for Health Research and Development, research involving minimal or no foreseeable risk and research that has already received ethical approval from an accredited ethics committee may qualify for exemption from additional ethical review. Accordingly, no separate ethical approval was obtained for this secondary analysis.

Access to the SKI 2023 microdata was separately authorised under Non-Disclosure Agreement (NDA) No. 2604DEB1BF2A7027, issued in April 2026 by PUSDATIN, Ministry of Health of the Republic of Indonesia. The NDA governed authorised data access, confidentiality, and data security and was not considered a substitute for ethical review.

Reporting Guideline

This manuscript was prepared in accordance with the STROBE reporting guideline for cross-sectional studies.

RESULTS

Respondent Characteristics

This study included 15,218 working women from Indonesia's geographically disadvantaged, frontier, and outermost (3T) regions. Of these, 1.2% (n=180) were classified as having depressive symptoms and 98.8% (n=15,038) were not. Most participants lived in rural areas (83.8%), while 16.2% lived in urban areas. Approximately half were in the younger age category (53.5%), and 46.5% were in the older age category.

Most participants were married (81.5%); 10.7% were widowed, 5.7% had never married, and 2.1% were divorced. Primary/basic education was the most common education level (53.7%), followed by secondary (31.0%) and higher education (15.3%). Farmers constituted the largest occupational group (53.5%), followed by other occupations (23.3%), civil servants/military/police/state-owned enterprise employees (9.3%), self-employed workers (7.3%), private employees (4.7%), labourers/drivers/domestic workers (1.2%), and fishers (0.8%).

Most participants had no comorbid conditions (91.1%); 7.8% had one condition and 1.1% had two or more conditions. Almost all participants were non-smokers (98.1%). Risky food consumption was classified as rare for 57.6% and frequent for 42.4% of participants. Most participants had sufficient physical activity (77.7%), and alcohol consumption was uncommon (0.6%).

Table 1. Characteristics of Female Workers in Disadvantaged, Frontier, and Outermost (3T) Regions of Indonesia (n=15,218)

Variable	Category	n	%
Depressive Symptom Status (MINI-based)	Positive (depressive symptoms)	180	1.2
	Negative (no depressive symptoms)	15,038	98.8
Residence	Rural	12,755	83.8
	Urban	2,463	16.2
Age	≤43 years	8,149	53.5

Comorbidity	Other	3,543	23.3
	None	13,869	91.1
	One condition	1,181	7.8
	≥2 conditions	168	1.1
Current smoking	No	14,923	98.1
	Yes	295	1.9
Risky food consumption	Rare	8,762	57.6
	Frequent	6,456	42.4
Physical activity	Sufficient	11,824	77.7
	Insufficient	3,394	22.3
Alcohol consumption	No	15,125	99.4
	Yes	93	0.6

Note: Values are presented as unweighted sample counts (n) and unweighted percentages (%). Percentages may not sum to exactly 100% because of rounding.

Bivariable Analysis

In bivariable analysis, residence was not significantly associated with depressive-symptom status ($p=0.296$; Table 2). Age differed significantly between groups ($p=0.004$): participants in the older age category accounted for 57.2% of those with depressive symptoms and 46.3% of those without depressive symptoms. Marital status also differed significantly ($p<0.001$), with divorced/widowed participants representing a larger proportion of the depressive-symptom group (22.8%) than the no-depressive-symptom group (12.7%).

Education level differed significantly between groups. Participants with depressive symptoms more often had primary/basic education (67.3%) and less often had higher education (4.4%) than participants without depressive symptoms (53.5% and 15.4%, respectively). Employment type also differed significantly ($p<0.001$): informal workers accounted for 97.2% of the depressive-symptom group and 85.9% of the no-depressive-symptom group.

Comorbidity differed significantly by depressive-symptom status. Among participants with depressive symptoms, 20.6% had one comorbid condition and 4.4% had two or more conditions, compared with 7.6% and 1.1%, respectively, among those without depressive symptoms. Among health-related behaviours, current smoking ($p=0.014$), physical activity ($p<0.001$), and alcohol consumption ($p=0.005$) differed significantly between groups, whereas risky food consumption did not ($p=0.804$).

Table 2. Distribution of Depressive Symptoms Among Female Workers in 3T Regions by Respondent Characteristics

Variable	Category	Depressive Symptoms (n=180) n (%)	No Depressive Symptoms (n=15,038) n (%)	p-value
Residence	Rural	156 (86.7)	12,599 (83.8)	0.296
	Urban	24 (13.3)	2,439 (16.2)	
Age	>43 years	103 (57.2)	6,966 (46.3)	0.004
	≤43 years	77 (42.8)	8,072 (53.7)	
Marital status	Divorced/widowed	41 (22.8)	1,907 (12.7)	<0.001
	Married	128 (71.1)	12,277 (81.6)	
	Never married	11 (6.1)	854 (5.7)	
Education	Primary/basic	12		

Table 3. Factors Associated with Depressive Symptoms Among Female Workers in 3T Regions: Multivariable Binary Logistic Regression

Variable	Category (reference)	aOR	95% CI	p-value
Age	>43 years (ref: ≤43)	0.98	0.70–1.36	0.889
Marital status	Divorced/widowed (ref: never married)	0.97	0.50–1.97	0.931
	Married (ref: never married)	0.60	0.30–1.16	0.134
Education	Primary/basic (ref: higher)	2.10	0.90–4.90	0.072
	Secondary (ref: higher)	1.86	0.80–4.20	0.141
Variable	Category (reference)	aOR	95% CI	p-value
Employment type	Informal (ref: formal)	3.60	1.30–9.90	0.012
Comorbidity	≥2 conditions (ref: none)	4.88	2.30–10.30	<0.001
	One condition (ref: none)	3.10	2.10–4.56	<0.001
Current smoking	Yes (ref: no)	1.80	0.85–3.80	0.118
Physical activity	Insufficient (ref: sufficient)	2.29	1.70–3.10	<0.001
Alcohol consumption	Yes (ref: no)	3.05	1.05–8.90	0.041

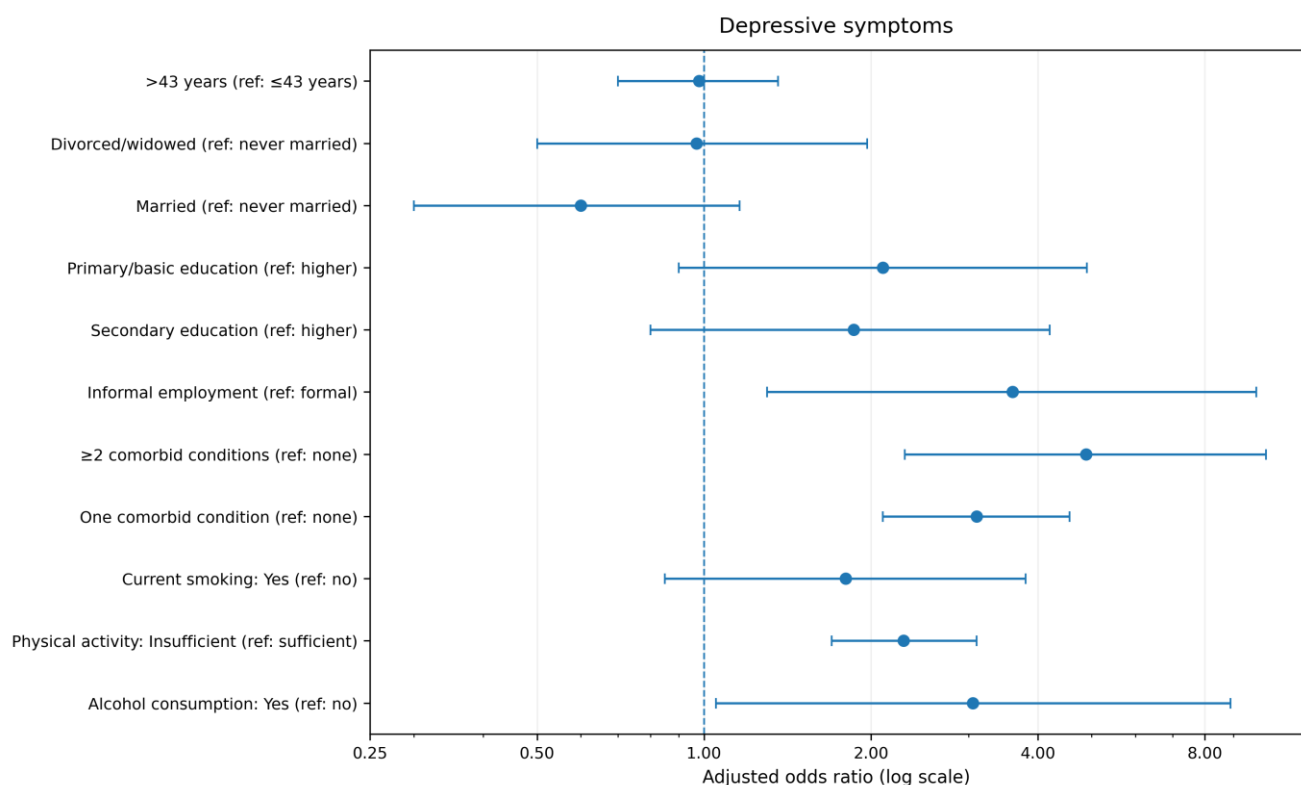
Abbreviations: aOR, adjusted odds ratio; CI, confidence interval. Estimates were obtained using survey-weighted multivariable binary logistic regression incorporating sampling weights, strata, and primary sampling units.

Compared with formal employment, informal employment was associated with higher odds of depressive symptoms (aOR=3.60; 95% CI: 1.30–9.90; $p=0.012$). The relatively wide confidence interval indicates substantial uncertainty in the magnitude of this association, and the estimate should therefore be interpreted cautiously.

Compared with respondents with no comorbid conditions, those with one condition had higher adjusted odds of depressive symptoms (aOR=3.10; 95% CI: 2.10–4.56; $p<0.001$), and those with two or more conditions had still higher adjusted odds (aOR=4.88; 95% CI: 2.30–10.30; $p<0.001$).

Insufficient physical activity was associated with higher adjusted odds of depressive symptoms compared with sufficient physical activity (aOR=2.29; 95% CI: 1.70–3.10; $p<0.001$). Alcohol consumption was also associated with higher adjusted odds of depressive symptoms (aOR=3.05; 95% CI: 1.05–8.90; $p=0.041$). However, only 93 participants reported alcohol consumption, and only four of these participants had depressive symptoms.

The wide confidence interval and small number of outcome events among alcohol consumers indicate considerable statistical uncertainty and potential sparse-data instability. The alcohol finding should therefore be interpreted as suggestive rather than conclusive. In contrast, age, marital status, education level, and current smoking were not significantly associated with depressive symptoms after multivariable adjustment (all $p>0.05$). The model estimates are summarised in Table 3 and Figure 2.



DISCUSSION

In this analysis of nationally representative survey data from 15,218 female workers residing in Indonesia's disadvantaged, frontier, and outermost (3T) regions, 1.2% were classified as having depressive symptoms. Informal employment, multimorbidity, insufficient physical activity, and alcohol consumption remained statistically associated with depressive symptoms after multivariable adjustment. Age, marital status, and education level, which were associated with depressive symptoms in bivariable analysis, were no longer statistically significant after adjustment, suggesting that their crude associations may be partly explained by other factors included in the model.

The observed unweighted proportion of participants with depressive symptoms was 1.2%. This estimate should not automatically be interpreted as indicating a low burden of mental-health problems in the wider population. Depressive symptoms were identified using the SKI 2023 MINI-based classification algorithm rather than an independently confirmed clinical diagnosis. Under-reporting may also occur in national surveys because of stigma, culturally specific expressions of distress, limited mental-health literacy, or concerns about discussing emotional symptoms with an interviewer. These issues may be especially relevant in geographically isolated areas with limited access to mental-health information and services. The estimate therefore reflects the proportion of respondents classified as having depressive symptoms under the SKI 2023 MINI criteria and should be interpreted within that measurement context.

The observed associations should be interpreted within the intersecting structural, occupational, health-related, and gendered circumstances of female workers in 3T regions. Informal employment, chronic disease burden, health-related behaviours, and geographic disadvantage may coexist rather than operate independently. Female informal workers may face variable income, limited labour protection, restricted employment benefits, and unpaid domestic or caregiving responsibilities. In remote settings, these challenges may be compounded by transport barriers, limited access to health and mental-health services, and fewer social and economic resources. Chronic health conditions may further contribute to functional limitations, treatment demands, healthcare costs, and psychological strain. The associations observed in this study may therefore reflect cumulative disadvantage rather than isolated effects of individual factors.

These findings are consistent with evidence that employment arrangements, physical health, and health-related behaviours are associated with depressive symptoms among female workers in 3T regions. Because the cross-sectional design does not establish causal pathways, temporal relationships, or interactions, the findings support an integrated interpretation rather than separate causal interpretations of each factor. Previous systematic reviews and meta-analyses have linked persistent precarious employment with poorer health outcomes, including mental health (20), while prospective evidence has associated perceived job insecurity with depressive symptoms (21). Precarious employment may contribute to health inequities through material pathways, such as financial strain and lack of benefits, and psychosocial pathways, including chronic work-related stress and limited workplace control (22). These pressures may be amplified by gendered social roles and limited employment opportunities in resource-constrained remote settings.

Informal employment should also be interpreted within broader structural and financial contexts. It encompasses diverse occupations, but many informal workers experience irregular income, limited employment protection, and restricted access to social-security benefits. For female workers, these occupational pressures may coincide with unpaid caregiving and household responsibilities and, in some cases, responsibility for household income. Geographic remoteness, transport barriers, and limited mental-health services may further delay assessment, referral, and treatment while increasing the time and cost required to seek care. These mechanisms were not measured directly in this study and should therefore be regarded as plausible contextual explanations rather than confirmed pathways. The relatively wide confidence interval for informal employment also warrants cautious interpretation.

Multimorbidity showed the strongest association with depressive symptoms, consistent with evidence that depression commonly co-occurs with chronic physical illness and is associated with poorer overall health status (23). Chronic disease burden may involve persistent pain or fatigue, functional limitations, long-term treatment, and financial strain, all of which may contribute to psychological distress. However, because chronic conditions and depressive symptoms were assessed in the same cross-sectional survey, the temporal direction of this relationship cannot be established. Depressive symptoms may also influence disease management, healthcare use, symptom perception, and self-reported health status. The observed association should therefore be interpreted as evidence of co-occurring physical and mental-health burden rather than proof that multimorbidity causes depressive symptoms.

Insufficient physical activity was also associated with depressive symptoms. Previous research suggests that physical activity may benefit mental health through neurobiological and psychosocial pathways, including stress regulation, self-efficacy, and social engagement (24, 25). However, because this study was cross-sectional, it cannot establish whether low physical activity preceded depressive symptoms (25). Reverse causation is also plausible because depressive symptoms may reduce motivation or participation in physical activity. The finding should therefore be interpreted as an association rather than evidence that physical inactivity causes depressive symptoms. Accessible, context-sensitive physical-activity programmes may nevertheless be considered within broader health-promotion strategies, while recognising that this study does not establish that physical activity alone prevents or reduces depression.

Alcohol consumption was associated with higher adjusted odds of depressive symptoms, although this finding requires cautious interpretation. The relationship between alcohol use and depressive disorders may be bidirectional and may involve neurobiological, behavioural, and socioeconomic factors (26). Because the study did not establish whether alcohol use preceded depressive symptoms, temporal direction cannot be inferred. Only four alcohol consumers had depressive symptoms, resulting in a small number of outcome events and limited precision. The alcohol estimate should therefore be regarded as suggestive rather than conclusive evidence. Brief assessment of alcohol use could be considered alongside

mental-health screening, provided the uncertainty of this association is recognised. Indonesian studies have also reported lifestyle-related correlates of mental health among students (17), suggesting that day-to-day health behaviours may merit consideration within comprehensive mental-health promotion.

From a public-health perspective, the findings may support consideration of context-sensitive depression screening and early identification through primary healthcare and community services in 3T regions. Female informal workers and women with multiple chronic conditions may warrant particular attention. Integrating brief mental-health assessment into routine care for chronic conditions could provide an opportunity to identify individuals who may benefit from further assessment or referral. Community-based health-promotion strategies, including accessible physical-activity programmes, may also be appropriate if they account for constraints related to employment, household and caregiving responsibilities, geography, participation, self-efficacy, and adherence (25).

The association between informal employment and depressive symptoms also highlights the potential relevance of employment conditions and social protection. Previous evidence suggests that employment and social insecurity may affect mental health through material and psychosocial pathways related to precarious work (20–22). Because this study did not measure regular income, workplace stress, working hours, wealth, workplace characteristics, occupational rights, or access to social protection, it cannot identify which labour-market or social-protection measures would reduce depressive symptoms. Recommendations in these areas should therefore remain general. Longitudinal and occupation-specific studies that measure working conditions and social protection directly are needed to clarify these relationships.

This study has several strengths, including a large sample drawn from a nationally representative survey, use of survey-weighted analyses, and simultaneous consideration of demographic, occupational, health, and behavioural factors. Several limitations should also be noted. First, the cross-sectional design precludes conclusions about causality or temporal sequence, and reverse causation is particularly plausible for physical activity and alcohol consumption. Second, depressive symptoms were assessed using an interviewer-administered MINI-based survey classification; the relatively low observed proportion should therefore be interpreted in light of possible under-detection related to stigma, culturally patterned symptom expression, mental-health literacy, or reluctance to disclose emotional difficulties. The MINI-based outcome should not be equated with an independently confirmed clinical diagnosis. Third, self-reported physical activity and alcohol use may be affected by recall and social-desirability bias. Fourth, unmeasured factors such as income, employment quality, caregiving burden, social support, social protection, and access to mental-health services may contribute to residual confounding. Fifth, informal workers were analysed as a heterogeneous single group because occupation-specific analyses could be unstable. Finally, although the overall event-to-parameter ratio was considered adequate, the small numbers of alcohol consumers and formally employed participants with depressive symptoms limited statistical precision, as reflected in the wide confidence intervals. These estimates, particularly for alcohol consumption, should therefore be interpreted cautiously. Future longitudinal studies with more outcome events and detailed measures of employment conditions are warranted.

CONCLUSION

This cross-sectional study of female workers in Indonesia's disadvantaged, frontier, and outermost (3T) regions found that depressive symptoms were associated with informal employment, multimorbidity, insufficient physical activity, and alcohol consumption. These findings indicate that occupational, physical-health, and behavioural factors may coexist with depressive symptoms but do not establish temporal or causal relationships. Given the wide confidence intervals and small numbers of depressive-symptom cases in some exposure categories, particularly alcohol consumption and formal employment, these estimates should be interpreted cautiously. The findings may support consideration of context-sensitive depression screening and early detection through community and primary healthcare, particularly for female informal workers and women with multiple chronic conditions. Integration of mental-health assessment with chronic-disease services and feasible health-promotion strategies may also be considered in 3T regions. Longitudinal and occupation-specific research is needed to clarify temporal relationships and provide more detailed evidence across occupational groups.

DECLARATIONS

Author contributions: Fatmawaty Mallapiang: Conceptualization, Data curation, Formal analysis, Methodology, Visualization, Writing – original draft, Writing – review & editing. Syamsul Alam: Methodology, Validation, Writing – review & editing. Nildawati: Methodology, Validation, Writing – review & editing. Andi Nidaul Hasanah: Data curation, Formal analysis, Visualization. All authors read and approved the final manuscript and accept responsibility for the integrity and accuracy of the work.

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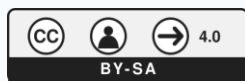
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