#### www.thelancet.com Vol 26 September, 2022

Hospital Yunlin Branch, Yunlin, Taiwan.

<sup>1</sup> These authors contributed equally to this work.

\*Corresponding author at: National Center for Geriatrics and

Welfare Research, National Health Research Institutes, Miaoli,

Taiwan. Department of Psychiatry, National Taiwan University

E-mail address: chishinwu@nhri.edu.tw (C.-S. Wu).

# Barriers to depression care among middle-aged and older adults in Taiwan's universal healthcare system

Ting-Yu Chang,<sup>*a*,1</sup> Shih-Cheng Liao,<sup>*b*,*c*,1</sup> Chia-Ming Chang,<sup>*d*</sup> Chi-Shin Wu,<sup>*e*,*f*</sup>\* Wei-Lieh Huang,<sup>*b*,*f*</sup> Juey-Jen Hwang,<sup>*g*,*h*</sup> and Chih-Cheng Hsu<sup>*e*,*i*</sup>

<sup>a</sup>Department of Medicine, College of Medicine, National Taiwan University, Taipei, Taiwan

<sup>b</sup>Department of Psychiatry, College of Medicine, National Taiwan University, Taipei, Taiwan

<sup>c</sup>Department of Psychiatry, National Taiwan University Hospital, Taipei, Taiwan

<sup>d</sup>Department of Psychiatry, Chang Gung Memorial Hospital at Linkou, Tao-Yuan, Taiwan

<sup>e</sup>National Center for Geriatrics and Welfare Research, National Health Research Institutes, Miaoli, Taiwan

<sup>f</sup>Department of Psychiatry, National Taiwan University Hospital Yunlin Branch, Yunlin, Taiwan

<sup>g</sup>Division of Cardiology, Department of Internal Medicine, National Taiwan University Hospital Yun-Lin Branch, Yunlin, Taiwan

<sup>h</sup>Division of Cardiology, Department of Internal Medicine, National Taiwan University College of Medicine and Hospital, Taipei, Taiwan

<sup>i</sup>Institute of Population Health Sciences, National Health Research Institutes, Miaoli, Taiwan

# Summary

**Background** Barriers to depression care differ across countries, highlighting the importance of identifying gaps in health-service coverage for regional health systems. This study aims to identify the bottlenecks of depression care and associated factors.

**Methods** We used data from the Taiwan Longitudinal Study on Aging of 2015, included 7675 participants aged 50 years and older. We identified participants with clinically relevant depression using the Center for Epidemiological Studies Depression Scale or Taiwan's National Health Insurance program claims records of depressive disorders. Bottleneck analysis was based on a modified Tanahashi framework with four stages: healthcare accessibility, initial contact, adequate treatment, and effective coverage. Individual factors associated with achieving these stages were estimated using multivariable logistic regression models with multiple imputation.

**Findings** We identified 1253 patients with clinically relevant depression; 83% perceived it as convenient to access healthcare, but only 27% had initial contact with health services, 16% received adequate coverage, and 11% achieved effective treatment. In terms of factors associated with initial contact, being female, married, or retired/unemployed; having a high education level, social group engagement, or self-reported diabetes mellitus; exercising regularly; and participating in social leisure activities were associated with increasing contact. Those with alcohol use had a low likelihood of treatment.

**Interpretation** Initial contact constitutes the primary bottleneck of depression care in Taiwan. Improving mental health literacy and enhancing depression screening would be helpful to elevate treatment rates and improve depression care.

Funding This study was supported by a grant from the Ministry of Health and Welfare, Taiwan.

**Copyright** © 2022 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)

Keywords: Depression care; Tanahashi model; Effective coverage; Initial contact

# Introduction

Depression is a highly prevalent disorder that affects approximately 12.9% of the adult population.<sup>I</sup> It is predicted that depressive disorder will be the leading cause of disease burden in 2030 by the World Health Organization.<sup>2</sup> Depressive disorders affect personal well-being and impact daily functioning, education, employment, and poor quality of life.<sup>3</sup> The Lancet Regional Health - Western Pacific 2022;26: 100501 Published online 4 June 2022 https://doi.org/10.1016/j. lanwpc.2022.100501



Articles

#### **Research in context**

# Evidence before this study

We searched PubMed from database inception to January 15, 2022, with synonym search terms of "barriers", "bottlenecks", "effective coverage", "depressive disorder", and "depression" without any restrictions on language or article type. According to one systematic review in 2021 including 65 studies with 1.1 million participants from 79 countries, the treatment rates for high-, middle-, and low-income countries were 48.3%, 21.4%, and 16.8%, respectively. Another worldwide survey study across 15 countries estimated the overall contact coverage at 41.8% while contact coverage in highincome countries (52.0%) was about two times that of low- or middle-income countries (26.5%). The effective coverage for high-income countries (12.3%) was twice as high as that for low- or middle-income countries (5.6%).

#### Added value of this study

To our knowledge, this is the first study analyzed the barriers of depression care in a universal healthcare system. Based on Taiwan's nationwide survey with linkage to National Health Insurance claims database, we identified patients with clinically relevant depression. Among them, 83% perceived it as convenient to access healthcare, but only 27% had initial contact with health services for depression, 16% received adequate coverage, and 11% achieved effective treatment. The main bottlenecks of depression care in Taiwan's universal healthcare system is initial contact.

#### Implications of all the available evidence

Several factors were associated with initial contact, including being female, married, having a high education level, social group engagement, exercising regularly, and participating in social leisure activities. Improving mental health literacy, enhancing social network, and conducting depression screening would be helpful to elevate treatment rates and improve effective coverage of depression care.

However, many individuals with depressive disorder remain untreated; it is estimated that the global treatment rates for depression are at 34.8%.<sup>4</sup> Another survey showed that only a third of individuals with depression or anxiety seek professional help from health service providers.<sup>5</sup> Prolonged duration of untreated depression is associated with poor response to antidepressant therapy and disability.<sup>6</sup> Even when patients with depressive disorders contact health services, less than half receive adequate treatment.<sup>7</sup> Nonadherence to treatment increases the risk of relapse and recurrence of depression.<sup>8</sup>

Considering the different barriers to depression care among countries, it is important to identify the gaps in health service coverage for various regional health systems. Tanahashi model is an instrument to identify bottlenecks of health care delivery through several necessary stages, including health care availability and accessibility, initial contact, adequate treatment, and effective coverage.<sup>9</sup> Taiwan is a high-income country with abundant medical resources, and most residents can reach a healthcare facility within 30 minutes.<sup>10</sup> Almost all citizens are covered by the universal compulsory National Health Insurance (NHI) program. Middle-aged and older adults utilise healthcare more frequently<sup>10</sup> and have a higher prevalence of depressive disorders than young adults;<sup>II</sup> however, they might hesitate to contact mental healthcare due to stigma or lack of awareness.<sup>12</sup> One previous study revealed that the treatment rate among middle-aged and older adults in Taiwan was only 20%;<sup>13</sup> however, the estimate was based on patients' self-reports, which might be biased by recall.

In this study, we applied a modified Tanahashi framework<sup>14</sup> to identify the bottlenecks of depression care in Taiwan using a representative nationwide survey linked to the NHI claims database. Furthermore, we analysed individuals' factors associated with achieving each stage, which may give us a comprehensive understanding of the population with depression without effective treatment in Taiwan.

# **Methods**

#### Data source

This study used data from the Taiwan Longitudinal Study on Aging (TLSA), which is a multi-wave national representative random sample of middle-aged and older adults.15 Trained interviewers collected data via face-toface home interviews using structured questionnaires. The 9<sup>th</sup> wave of the TLSA was conducted in 2019, but it is still not available for linking NHI claims database. Therefore, this study used only the 8th wave of the TLSA conducted in 2015. Our participants included those (n = 2996) enrolled in previous waves and the refresh cohort (n = 5304) newly included in this wave; a total of 8300 participants were included in this study. After excluding those who answered via proxy or who did not complete the Centre for Epidemiological Studies Depression Scale (CES-D) questionnaires, 7675 participants were included in the final analysis.

The NHI claims records linked to TLSA participants in 2015 were also included. The NHI claims database included patients' demographic characteristics, clinical diagnoses, and prescription records. The accuracy of clinical diagnosis in the NHI claims database for depression and other major psychiatric disorders has been well documented.<sup>16</sup> This study was approved by the Research Ethics Committee of the National Health Research Institutes (EC1101103-E).

# Target populations

We identified participants with clinically relevant depression based on the CES-D or NHI claims records. The original 20-item CES-D has been widely used and validated in community-residing older adults and screening for depressive disorders, including major depression, subthreshold depression, or dysthymia, with a sensitivity of 84% and 77% positive predicted value.<sup>17</sup> There are several modified short forms. In the TLSA, the 10-item CES-D was used to measure depressive symptoms; the cut-off point was 10 or more for clinical depressive symptoms.<sup>18</sup> This cut-off point yielded a specificity of 93% and a sensitivity of 96% compared to Boston form of CES-D.<sup>18</sup> Given that patients with depression might be treated and remitted, we also included those who had been diagnosed with depressive disorder (ICD-9 code: 296.2, 296.3, 300.4, or 311) in 2015 using the NHI claims database. A total of 1253 (16.3%) participants were identified as having clinically relevant depression (see Supplementary Figure 1).

# Bottleneck analysis using modified Tanahashi framework

The original Tanahashi framework evaluates health service coverage using five different stages to highlight gaps in service delivery.<sup>9</sup> This framework was further modified by the World Health Organization and United Nations Children's Fund for assessing the national health system.<sup>14</sup> The Tanahashi framework provides a bottom-up stepwise assessment, including necessary stages from supply (availability and accessibility) to stages from demand (initial contact, adequate coverage, and effective coverage).

#### Healthcare accessibility

Accessibility included different dimensions, such as essential health commodities, availability, human resources, physical access to service, and affordability.<sup>9</sup> Given that Taiwan's healthcare resources are abundant and the co-payment for health services is low, we only used self-perception of the convenience of accessing healthcare to evaluate overall healthcare accessibility. Among the target population, if the responders perceived convenience of health care facilities or had visited clinics for depression treatment, they were classified as having sufficient healthcare accessibility.

#### Initial contact

Contact coverage was defined as the proportion of treated patients among the target population. To avoid recall bias, we identified patients who received any treatment for depressive disorder based on the linked NHI claims records.

#### Adequate coverage

Adequate coverage was defined using the proportion of patients who received adequate treatment among the target populations. The adequacy of depression treatment was determined based on the practice guidelines for depressive disorders.<sup>19</sup> The quality indicators of depression care included three domains.<sup>20</sup> Visit adequacy was defined as four or more visits during the 1-year follow-up period. Dose adequacy was defined as an average dose of antidepressants equal to or higher than the minimum daily dosage.<sup>19</sup> Duration adequacy was defined as  $\geq 60$  days for continuous antidepressant treatment. The overall minimally adequate treatment was defined as fitting all criteria of visit, dose, and duration adequacy.

#### Effective coverage

Effective coverage measures the proportion of patients who received effective treatment to those who needed treatment. We defined those who had received adequate treatment and their current CES-D scores of less than 10 as patients receiving effective treatment.

# Individual factors

Individual factors included demographic variables, medical conditions, and health behaviour measures. Demographic characteristics included age (50-64, 65  $-74, 75-84, \text{ or } \geq 85$ ), sex, education year (0, 1-6, 7-12, or  $\geq$ 13), marital status (married, widowed/divorced/separated/never married), living status (alone or with family/others), residency (urban, suburban, or rural), employment status (full-/part-time job or retirement/no job), income per year (<300,000, 300,000-700,000, or  $\geq$ 700,000 New Taiwan Dollar [NTD]; the current exchange rate US dollar (USD) to NTD was approximately 31.8 in 2015). Chronic medical conditions were measured using self-reported hypertension, diabetes mellitus, and dyslipidaemia. Functional level was assessed by activities of daily living (ADL) and instrumental ADL (IADL). Participants were categorised as either totally normal or having any item impairment. Cognitive function was measured using the 9-item Short Portable Mental Status Questionnaire, whose scores range from o to 9. Cognitive impairment was defined as a score of < 7. Health behaviour measures included body mass index, self-reported tobacco or alcohol use in the preceding year, and self-reported regular exercise habits. Leisure activity was assessed by questionnaire and included watching TV, listening to music, reading, playing chess, walking, gardening, hiking or exercise, riding a bike, interacting with friends or relatives, singing or dancing, chatting, using email, or playing video games. If the participants frequently engaged

in one of these leisure activities (two times or more per week) with others, they would be classified as having social leisure activities. We withdrew the item for watching TV because it is a highly prevalent (>90%) activity with limited social interactions. Social group engagement was assessed by asking whether participants were engaged in at least one social group, including community groups, religious groups, occupation or business associations, political parties, volunteer groups, clan associations, senior organisations, or learning clubs.

# Statistical analysis

Descriptive statistics, including number and percentage, were calculated for these four stages: healthcare accessibility, initial contact, adequate treatment, and effective coverage.

The associations of individual factors with achieving each stage were estimated using univariable and multivariable adjusted logistic regression models, which included all above-mentioned individual factors. The interaction of variables was not tested due to small sample size. No variable selection was conducted.

There were missing values for individual factors; the missing rates were quite low (<1%) except that for the yearly income, which was approximately 12.5% (see supplementary Table 1). We used multiple imputation to deal with missing data under the missing at random assumption,<sup>21</sup> which supposed the probability of being missing is dependent on observed variables. Briefly, the missing values were filled by Markov chain Monte Carlo methods using all measured variables. The process was repeated 20 times to generate 20 imputed datasets. Then the 20 imputed datasets were analysed and the

model parameter estimates were combined using Rubin's rules.<sup>21</sup> The MI and MIANALYZE procedure in SAS version 9.4 (SAS Institute, Cary, NC, USA) was used. Sensitivity analysis using complete case data were also conducted. Odds ratio was used as the measure of association and 95% confidence intervals or p-value < 0.05 were used to determine statistical significance. Multiple comparison could reduce the type I error but increase type II error; therefore, it was not considered because the study aimed to explore factors associated with health care delivery. Multicollinearity was examined using variance inflation factor. Goodness-of-fit was measured using c-statistic. In multiple imputation analysis, the test static of model assumption and goodnessof-fit was reported in a range because it could not be combined.

### Role of the funding source

The funders had no role in study design, data collection, data analysis, interpretation, writing of the report.

#### Results

Among the participants with clinically relevant depression (n = 1253), most were women (64·4%), aged 50 -64 (34·1%) or 65-74 (31·4%), married (56·3%), and living with family or others (88·1%). In addition, they had a high proportion of hypertension (50·5%), diabetes (24·7%), dyslipidaemia (24·1%), and subjective poor health (50·8%).

Figure I shows the results of the modified Tanahashi model for depression care in Taiwan. Among participants with clinically relevant depression, 83% perceived



Figure 1. Modified Tanahashi model for depression care in Taiwan.

convenience in accessing healthcare, 27% had initial contact, 16% received adequate treatment, and 11% achieved effective coverage.

In the analysis for individual factors associated with achieving each stage, living alone, residency in suburban or rural areas, ADL or IADL impairment, and subjective poor health were associated with healthcare inaccessibility while body mass index (BMI)  $\geq 27$  or age between 65 and 74 were related to perceived convenience in accessing health care facilities (see Table I).

In terms of factors associated with initial contact, we found that being female or retired/unemployed; having a high education level, self-reported diabetes mellitus, or social group engagement; exercising regularly; and engaging in social leisure activities were associated with increasing initial treatment. However, being widowed, divorced, separated, or never married and using alcohol were associated with lack of treatment (see Table 2).

Among patients with initial contact, no individual factors were statistically significantly associated with adequate treatment (Table 3). For those who received adequate treatment, we found that patients who reported subjective poor health or with IADL impairment had a decreased likelihood of receiving effective treatment while exercising regularly and living in suburban or rural areas were associated with effective treatment (see Table 4).

The results of complete case analysis were showed in supplementary Table 2 - 5. There were some differences in significant level between complete case analysis and multiple imputation analysis; however, the direction and magnitude of association were generally consistent.

# Discussion

In this bottleneck analysis for depression care in Taiwan, we found that health accessibility was 83%. However, the initial contact was only 27%, which is the main bottleneck. Approximately 17% of patients had adequate treatment, and 11% had effective coverage. According to one systematic review including 65 studies with 1.1 million participants from 79 countries, the treatment rates for high-, middle-, and low-income countries were  $48\cdot3\%$ ,  $21\cdot4\%$ , and  $16\cdot8\%$ , respectively.<sup>4</sup> Another recent study that included 17 surveys conducted across 15 countries by the World Health Organization-World Mental Health Surveys Initiative<sup>22</sup> estimated the overall contact coverage at 41.8% while contact coverage in highincome countries (52.0%) was about two times that of low- or middle-income countries (26.5%). The effective coverage for high-income countries (12.3%) was twice as high as that for low- or middle-income countries (5.6%). Compared with our results, the contact coverage of depression in Taiwan was close to that of middle-income countries despite the fact that Taiwan is a high-income country. The effective coverage of depression in Taiwan was also lower than that in high-income countries.

#### Healthcare accessibility

Although Taiwan's healthcare facilities are abundant, we found that 17% of patients with clinically relevant depression perceived inconvenience in accessing health services. Healthcare resources were relatively insufficient in rural or suburban areas. A previous study further showed that living in urban areas was associated with a higher prevalence of frailty and worse access to medical care while higher rates of disability were also associated with inadequate access to healthcare.<sup>23</sup> This is also reflected in our results that living in suburban or rural areas and having IADL impairment were associated with healthcare inaccessibility. We also found that patients with subjective poor health were more likely to perceive inconvenience in accessing healthcare, which might be due to functional impairment. Of note, we found that age between 65 and 74 years was associated with increased accessibility. This might be because this age group is retired and has more time to access health services than those who have not yet retired. This age group also has fewer functional impairments than the older age groups. Compared to those with underweight (BMI < 18.5), participants with BMI  $\geq$  27 might have better health conditions and feel more convenience in accessing healthcare.<sup>24</sup> Cost was not the main barrier to accessing health services due to the low co-payment for utilising the NHI program; therefore, there is no association between income and healthcare accessibility.

#### Initial contact

No contact with health services is the main bottleneck that impedes patients with clinically relevant depression from receiving treatment in Taiwan. The low treatment rate is generally attributable to the stigma of mental problems, negative beliefs about treatment effectiveness and safety, and lack of awareness of depression as a treatable illness.<sup>5,12</sup> Furthermore, previous community psychiatric surveys in Taiwan revealed that the lower percentage of help-seeking behaviours might associate with "stoicism" in oriental cultures.<sup>25</sup> It means individuals with depressive disorder in Taiwan have a relatively high tolerance for or denial of emotional sufferings.<sup>25</sup> In terms of other sociodemographic correlates, women tend to seek informal or professional help while men tend to deny problems and use alcohol or drugs.<sup>5</sup> Past research has also shown that those with more social support tend to seek help.<sup>12</sup> In our investigation, women, those who are married, and those with social group engagement or social leisure activities had higher treatment rates while men and those with alcohol intake did not. In addition, we found that a high education level was associated with an increased treatment rate,

	Patients without healthcare accessibility (n = 208)	Patients with healthcare accessibility (n = 1045)	Crude Odds Ratio (95% CI)	<i>p</i> -value	Adjusted odds ratio (95% Cl)	<i>p</i> -value
Age groups						
50-64	60 (28 8)	367 (35 1)	Reference		Reference	
65-74	47 (32 3)	346 (33.1)	1 20 (0 80 1 82)	0 387	1 30 (1 03 1 65)	0.030
75-84	67 (32.2)	235 (22.4)	0.57 (0.39, 0.84)	0.005	1.35 (1.63, 1.63)	0.090
>85	34 (16 3)	97 (9 28)	0.47 (0.29, 0.75)	0.002	1.25 (0.91, 1.71)	0.050
Gender female	142 (68 2)	653 (62.4)	0.78 (0.56, 1.06)	0.123	0.88 (0.71, 1.08)	0.216
Education year	112 (00.2)	000 (02.1)	0.70 (0.50, 1.00)	0.125	0.00 (0.71, 1.00)	0.210
0	63 (30 2)	165 (15 7)	0.46 (0.31, 0.67)	< 001	0.89 (0.70, 1.13)	0 335
1-6	74 (35 5)	425 (40.6)	Reference	2.001	Reference	0.555
7-12	50 (24.0)	302 (28.8)	1.05 (0.71, 1.54)	0.808	0.85 (0.68, 1.07)	0 168
>13	21 (10.0)	153 (14.6)	1.05 (0.71, 1.54)	0.384	0.93 (0.69, 1.24)	0.615
Marital status	21 (10.0)	155 (11.0)	1.27 (0.70, 2.13)	0.501	0.55 (0.05, 1.2 1)	0.015
Married	101 (48 5)	604 (57 7)	Reference		Reference	
Widowed/divorced/separated/	107 (51 4)	441 (42 2)	0.69 (0.51, 0.93)	0.016	1 10 (0 91 1 33)	0 302
never married	107 (51.4)		0.09 (0.91, 0.93)	0.010	1.10 (0.91, 1.93)	0.502
Living status <sup>a</sup>						
	44 (21 1)	105 (10.0)	0 42 (0 28 0 61)	< 001	0.64 (0.50, 0.82)	< 001
Living with family or others	164 (79.9)	030 (90 0)	0.42 (0.28, 0.01) Poforonco	<.001	0.04 (0.50, 0.62) Poforonco	<.001
Posidonsy	104 (78.8)	555 (05.5)	helefence		helefence	
Urban	65 (31 2)	402 (47 0)	Poforonco		Poforonco	
Suburban	07 (46 6)	492 (47.0)		0.002		0.041
Suburban	97 (40.0)	420 (40.7)	0.58 (0.41, 0.81)	< 001	0.82 (0.68, 0.99)	0.041
	40 (22.1)	127 (12.1)	0.30 (0.24, 0.30)	<.001	0.08 (0.55, 0.67)	0.003
Employment status	114 (54.0)	(00 (50 2)	Deference		Deference	
Pull of part-time jobs	114 (54.8)	009 (38.3)	Reference	0.274	Reference	0.760
Retirement or no job	94 (45.2)	436 (41.7)	0.87 (0.65, 1.18)	0.374	0.97 (0.82, 1.16)	0.768
Income, year	124 (67.0)	452 (40 0)	0.27 (0.22, 0.62)	. 001	0.06 (0.65, 1.12)	0.070
<300K NTD	124 (67.0)	452 (49.6)	0.37 (0.22, 0.63)	<.001	0.86 (0.65, 1.13)	0.272
	43 (23.2)	284 (31.1)	0.08 (0.58, 1.20)	0.195	1.01 (0.75, 1.35)	0.949
	18 (9.7)	176 (19.3)	Reference		Reference	
Health Status						
BMI	(5 (21 2)	140 (12 2)	Deferrer		D-6	
<18.5	65 (31.2)	140 (13.3)	Reference	. 001	Reference	0.107
18.5-24	/0 (33.6)	414 (39.6)	2.78 (1.85, 4.00)	<.001	1.21 (0.96, 1.52)	0.107
24-27	41 (19.7)	264 (25.2)	3.03 (1.92, 4.55)	<.001	1.29 (1.00, 1.66)	0.054
<u>≥2/</u>	32 (15.3)	227 (21.7)	3.33 (2.04, 5.26)	<.001	1.42 (1.08, 1.87)	0.013
Hypertension	128 (61.5)	503 (48.1)	0.58 (0.43, 0.79)	<.001	1.16 (0.97, 1.39)	0.103
	59 (28.3)	250 (23.9)	0.79 (0.57, 1.11)	0.183	0.99 (0.81, 1.20)	0.885
Dyslipidemia	46 (22.1)	256 (24.4)	1.14 (0.80, 1.64)	0.501	0.97 (0.79, 1.19)	0.765
Subjective poor health	157 (75.4)	480 (45.9)	0.28 (0.20, 0.39)	<.001	0.67 (0.56, 0.81)	<.001
Hospitalization in the past year	64 (31.1)	261 (25.0)	0.75 (0.54, 1.04)	0.084	1.07 (0.89, 1.29)	0.474
Functional level	()					
ADL impairment	79 (37.9)	150 (14.3)	0.27 (0.20, 0.38)	<.001	0.75 (0.61, 0.93)	800.0
IADL impairment	152 (73.0)	441 (42.2)	0.27 (0.19, 0.37)	<.001	0.66 (0.53, 0.83)	<.001
Cognitive impairment	98 (47.1)	285 (27.2)	0.42 (0.31, 0.57)	<.001	0.92 (0.75, 1.13)	0.409
Lifestyle behaviors	25 (12.0)	141 (12 *)	1 1 4 (0 70 4 70)	0.500	0.05 (0.70, 4.05)	0.710
Smoking	25 (12.0)	141 (13.4)	1.14 (0.72, 1.79)	0.596	0.95 (0.72, 1.25)	0./19
Alcohol use	32 (15.3)	214 (20.4)	1.41 (0.94, 2.13)	0.103	0.96 (0.75, 1.22)	0.744
Exercise	80 (38.4)	518 (49.5)	1.56 (1.16, 2.13)	0.004	0.98 (0.82, 1.17)	0.838
Social group engagement	80 (38.4)	345 (33.0)	0.79 (0.58, 1.08)	0.136	1.12 (0.92, 1.36)	0.263
Social leisure activities	131 (62.9)	811 (77.6)	2.04 (1.49, 2.78)	<.001	1.16 (0.96, 1.39)	0.133

Table 1: Factors associated with healthcare accessibility among middle-aged and older adults with clinically relevant depression in Taiwan.

<sup>a</sup>with missing value. Abbreviation: NTD, New Taiwan Dollar, 1 USD  $\approx$  31-8 NTD in 2015; BMI, body mass index; ADL, activities of daily living; IADL, Instrumental activities of daily living; 95% CI, 95% confidence interval.

Test for model assumption and goodness-of-fit: variance inflation factor for all variables <5; c-statistics ranged from 0.735 to 0.803 for 20 imputed datasets.

	Patients without treatment (n = 704)	Patient with initial treatment (n = 341)	Crude Odds Ratio (95% Cl)	<i>p</i> -value	Adjusted odds ratio (95% CI)	<i>p</i> -value
		( <b>2</b> 11)				
Age groups						
50-64	238 (33.8)	129 (37.8)	Reference		Reference	
65-74	229 (32.5)	117 (34.3)	0.94 (0.69, 1.28)	0.712	1.12 (0.94, 1.35)	0.209
75-84	165 (23.4)	70 (20.5)	0.78 (0.55, 1.11)	0.172	1.22 (0.96, 1.54)	0.098
≥85	72 (10.2)	25 (7.33)	0.64 (0.39, 1.06)	0.084	0.98 (0.72, 1.35)	0.912
Gender, female	433 (61.5)	220 (64.5)	1.14 (0.87, 1.49)	0.352	1.25 (1.06, 1.49)	0.010
Education year						
0	128 (18.1)	37 (10.8)	0.80 (0.52, 1.22)	0.316	0.88 (0.69, 1.12)	0.307
1-6	312 (44.3)	113 (33.1)	Reference		Reference	
7-12	1/3 (24.5)	129 (37.8)	2.04 (1.49, 2.78)	<.001	1.51 (1.27, 1.81)	<.001
≥13	91 (12.9)	62 (18.1)	1.89 (1.28, 2.78)	0.002	1.27 (1.02, 1.57)	0.035
Marital status	274 (52.1)	220 (67 4)	Deferrer		Deferrer	
Married	374 (53.1)	230 (67.4)	Reference	. 001	Reference	. 001
widowed/divorced/separated/never married	330 (46.8)	111 (32.5)	0.55 (0.42, 0.71)	<.001	0.74 (0.63, 0.87)	<.001
	72 (10.2)	22 (0 7)	0.02 (0.61, 1.45)	0.750	1 24 (0.06, 1.61)	0 1 0 1
Living with family or others	72 (10.2)	33 (9.7)	0.93 (0.01, 1.43)	0.759	1.24 (0.96, 1.61)	0.101
Bosidency	031 (89.8)	308 (90.3)	Reference		Reference	
Urban	322 (45 7)	170 (49 8)	Poforonco		Poforonco	
Suburban	293 (41.6)	133 (39.0)	0.86 (0.65, 1.14)	0 303	0.99 (0.85, 1.15)	0.880
Bural	295 (41.0)	29 (11 1)	0.80 (0.03, 1.14)	0.303	0.09 (0.03, 1.13)	0.000
Employment status	89 (12.0)	36 (11.1)	0.01 (0.55, 1.25)	0.556	0.99 (0.76, 1.25)	0.911
Full or part-time jobs	428 (60 7)	181 (53.0)	Reference		Reference	
Retirement or no job	276 (39.2)	160 (46 9)	1 37 (1 05 1 79)	0.022	1 20 (1 04 1 39)	0.015
Income, year <sup>a</sup>	270 (35.2)	100 (10.5)	1.57 (1.05, 1.75)	0.022	1.20 (1.01, 1.35)	0.015
	327 (53.0)	125 (42.4)	0.58 (0.40, 0.83)	0.004	0.89 (0.71 1.12)	0 308
300K-700K NTD	184 (29.8)	100 (33.9)	0.82 (0.56, 1.22)	0.329	1 00 (0 80, 1 25)	0.988
700K or more NTD	106 (17.2)	70 (23 7)	Reference	0.525	Reference	0.900
Health Status	100 (1712)	, , , , , , , , , , , , , , , , , , , ,	herenee		herenee	
BMI						
<18.5	104 (14.7)	36 (10.5)	Reference		Reference	
18.5-24	259 (36.7)	155 (45.4)	1.72 (1.12, 2.63)	0.014	1.12 (0.88, 1.43)	0.356
24-27	182 (25.8)	82 (24.0)	1.30 (0.82, 2.04)	0.269	1.03 (0.80, 1.34)	0.811
≥27	159 (22.5)	68 (19.9)	1.23 (0.77, 2.00)	0.409	1.11 (0.85, 1.46)	0.431
Hypertension	356 (50.5)	147 (43.1)	0.74 (0.57, 0.96)	0.025	1.07 (0.92, 1.25)	0.365
Diabetes Mellitus	195 (27.6)	55 (16.1)	0.50 (0.36, 0.70)	<.001	1.29 (1.07, 1.56)	0.007
Dyslipidemia	182 (25.8)	74 (21.7)	0.79 (0.58, 1.08)	0.143	1.19 (1.00, 1.42)	0.050
Subjective poor health	354 (50.2)	126 (36.9)	0.58 (0.44, 0.76)	<.001	0.86 (0.74, 1.01)	0.062
Hospitalization in the past year <sup>a</sup>	174 (24.8)	87 (25.5)	1.04 (0.78, 1.41)	0.810	1.12 (0.94, 1.32)	0.204
Functional level						
ADL impairment	107 (15.1)	43 (12.6)	0.81 (0.55, 1.18)	0.289	1.26 (0.98, 1.61)	0.070
IADL impairment	317 (45.0)	124 (36.3)	0.70 (0.53, 0.91)	0.011	0.97 (0.81, 1.17)	0.749
Cognitive impairment	214 (30.3)	71 (20.8)	0.60 (0.44, 0.82)	0.002	1.01 (0.83, 1.22)	0.942
Lifestyle behaviors						
Smoking	96 (13.6)	45 (13.1)	0.96 (0.66, 1.41)	0.846	1.14 (0.91, 1.43)	0.266
Alcohol use	152 (21.5)	62 (18.1)	0.81 (0.58, 1.12)	0.217	0.82 (0.68, 0.99)	0.043
Exercise	317 (45.0)	201 (58.9)	1.75 (1.35, 2.27)	<.001	1.19 (1.03, 1.39)	0.021
Social group engagement	207 (29.4)	138 (40.4)	1.64 (1.25, 2.13)	<.001	1.22 (1.04, 1.41)	0.012
Social leisure activities	523 (74.2)	288 (84.4)	1.89 (1.33, 2.63)	<.001	1.24 (1.02, 1.50)	0.033

Table 2: Factor associated with initial contact among depression patients with healthcare accessibility.

<sup>a</sup>with missing value.

Abbreviation: NTD, New Taiwan Dollar, 1 USD  $\approx$  31-8 NTD in 2015; BMI, body mass index; ADL, activities of daily living; IADL, Instrumental activities of daily living; 95% CI, 95% confidence interval. Test for model assumption and goodness-of-fit: variance inflation factor for all variables <5; c-statistics ranged from 0.695 to 0.770 for 20 imputed datasets.

	Patients with	Patients with	Crude Odds	<i>p</i> -value	Adjusted odds	<i>p</i> -value
	treatment	treatment	Ratio (95% CI)		ratio (95% CI)	
	(n = 135)	(n = 206)				
Age groups		74 (25.0)	Defense		Defense	
50-65	55 (40.7)	74 (35.9)	Reference	0.019	Reference	0.012
05-74	49 (30.3)	68 (33.0)	1.03 (0.02, 1.72)	0.918	1.02 (0.75, 1.38)	0.915
\ <u>0</u> E	22 (10.3)	46 (23.3)	1.01 (0.00, 3.03)	0.150	0.75 (0.50, 1.14)	0.179
≥oo Fomala	9 (0.7)	10 (7.6)	0.05 (0.61, 1.40)	0.500	0.61 (0.40, 1.40)	0.440
Education year	88 (03.2)	132 (04.1)	0.95 (0.01, 1.49)	0.035	0.95 (0.72, 1.20)	0.729
	14 (10 4)	23 (11 2)	1 09 (0 51 2 33)	0.838	0.91 (0.58 1.45)	0 701
1-6	45 (33 3)	68 (33.0)	Reference	0.050	Reference	0.701
7-12	54 (40 0)	75 (36.4)	0.92 (0.55, 1.54)	0.767	1 03 (0 77 1 37)	0.857
>13	22 (16 3)	40 (194)	1 20 (0.63, 2.27)	0.707	0.82 (0.57, 1.37)	0.308
Eamily and Marital status	22 (10.5)	10 (15.1)	1.20 (0.03, 2.27)	0.551	0.02 (0.37, 1.20)	0.500
Married	92 (68 1)	138 (67 0)	Reference		Reference	
Widowed/divorced/separated/never married	43 (31 9)	68 (33.0)	1.05 (0.66, 1.67)	0.850	0.92 (0.69, 1.23)	0 575
Living status	10 (0113)	00 (0510)	1105 (0100) 1107 )	0.050	0.02 (0.00) (1.20)	0.575
	14 (10 4)	19 (9 2)	0.88 (0.42, 1.82)	0 749	1 13 (0 72, 1 76)	0 594
Living with family members/friends	121 (89.6)	187 (90.8)	Reference	00.15	Reference	0.551
Residency	,					
Urban	66 (48.9)	104 (50.5)	Reference		Reference	
Suburban	53 (39.3)	80 (38.8)	0.96 (0.60, 1.52)	0.875	1.00 (0.77, 1.30)	0.994
Rural	16 (11.9)	22 (10.7)	0.87 (0.43, 1.79)	0.719	1.04 (0.70, 1.55)	0.841
Employment status						
Full or part-time jobs	80 (59.3)	101 (49.0)	Reference		Reference	
Retirement/no job	55 (40.7)	105 (51.0)	1.52 (0.97, 2.33)	0.064	0.83 (0.64, 1.06)	0.137
Income, year <sup>a</sup>						
<300K NTD	51 (44.0)	74 (41.3)	1.09 (0.60, 1.96)	0.791	0.93 (0.66, 1.32)	0.687
300K-700K NTD	35 (30.2)	65 (36.3)	1.39 (0.75, 2.63)	0.314	0.84 (0.60, 1.19)	0.328
700K or more NTD	30 (25.9)	40 (22.3)	Reference		Reference	
Health Status						
ВМІ						
<18.5	15 (11.1)	21 (10.2)	Reference		Reference	
18.5-24	63 (46.7)	92 (44.7)	1.04 (0.50, 2.17)	0.924	1.01 (0.64, 1.59)	0.973
24-27	27 (20.0)	55 (26.7)	1.45 (0.65, 3.23)	0.376	0.80 (0.49, 1.30)	0.371
≥27	30 (22.2)	38 (18.4)	0.90 (0.40, 2.04)	0.814	1.04 (0.65, 1.68)	0.862
Hypertension	55 (40.7)	92 (44.7)	1.10 (0.74, 1.64)	0.656	0.99 (0.76, 1.29)	0.962
Diabetes Mellitus	23 (17.0)	32 (15.5)	0.91 (0.51, 1.61)	0.764	0.98 (0.71, 1.37)	0.922
Dyslipidemia	31 (23.0)	43 (20.9)	0.91 (0.55, 1.52)	0.733	0.99 (0.73, 1.34)	0.936
Subjective poor health	53 (39.3)	73 (35.4)	0.90 (0.60, 1.37)	0.634	1.06 (0.81, 1.39)	0.666
Hospitalization in the past year	38 (28.1)	49 (23.8)	0.85 (0.52, 1.35)	0.520	1.13 (0.86, 1.50)	0.380
Functional level						
ADL impairment	21 (15.6)	22 (10.7)	0.68 (0.36, 1.30)	0.248	1.42 (0.90, 2.26)	0.133
IADL impairment	50 (37.0)	74 (35.9)	0.97 (0.64, 1.47)	0.896	1.01 (0.74, 1.37)	0.971
Cognitive impairment	27 (20.0)	44 (21.4)	1.06 (0.63, 1.82)	0.843	0.91 (0.64, 1.28)	0.573
Life style						
Smoking	18 (13.3)	27 (13.1)	0.98 (0.52, 1.85)	0.955	0.97 (0.65, 1.44)	0.887
Alcohol use	23 (17.0)	39 (18.9)	1.11 (0.64, 1.96)	0.732	0.93 (0.67, 1.28)	0.641
Exercise	69 (51.1)	132 (64.1)	1.25 (0.87, 1.79)	0.234	0.77 (0.59, 1.00)	0.051
Social group engagement	57 (42.2)	81 (39.3)	0.93 (0.62, 1.39)	0.741	1.14 (0.89, 1.47)	0.302
Social leisure activities	113 (83.8)	175 (85.0)	1.01 (0.74, 1.39)	0.956	1.07 (0.74, 1.53)	0.724

Table 3: Factors associated with adequate coverage among patients with depression with initial contacts.

 $^{\rm a}{\rm with}$  missing value.

Abbreviation: NTD, New Taiwan Dollar, 1 USD  $\approx$  31-8 NTD in 2015; BMI, body mass index; ADL, activities of daily living; IADL, Instrumental activities of daily living; 95% CI, 95% confidence interval.

Test for model assumption and goodness-of-fit: variance inflation factor for all variables <5; c-statistics ranged from 0.618 to 0.709 for 20 imputed datasets.

	Patients with ineffective treatment	Patients with effective treatment	Crude Odds Ratio (95% CI)	<i>p</i> -value	Adjusted odds ratio (95% Cl)	<i>p</i> -value
	(n = 66)	( <i>n</i> = 140)				
Age groups						
50-65	23 (34.8)	51 (36.4)	Reference		Reference	
65-74	20 (30.3)	48 (34.3)	1.09 (0.53, 2.22)	0.828	1.20 (0.68, 2.12)	0.537
75-84	19 (28.8)	29 (20.7)	0.69 (0.32, 1.47)	0.352	1.02 (0.50, 2.07)	0.962
≥85	4 (6.1)	12 (8.6)	1.35 (0.39, 4.55)	0.649	1.25 (0.45, 3.48)	0.669
Female	48 (72.7)	84 (60.0)	0.56 (0.30, 1.06)	0.075	0.72 (0.45, 1.16)	0.178
Education year						
0	8 (12.1)	15 (10.7)	1.02 (0.38, 2.78)	0.972	1.27 (0.62, 2.60)	0.520
1-6	24 (36.4)	44 (31.4)	Reference		Reference	
7-12	24 (26.4)	51 (36.4)	1.16 (0.58, 2.33)	0.693	1.23 (0.75, 2.04)	0.412
≥13	10 (15.2)	30 (21.4)	1.64 (0.68, 3.85)	0.273	1.45 (0.78, 2.68)	0.241
Family and Marital status						
Married	40 (60.6)	98 (70.0)	Reference		Reference	
Widowed/divorced/separated/never married	26 (39.4)	42 (30.0)	0.66 (0.36, 1.22)	0.189	0.99 (0.62, 1.57)	0.968
Living status						
Living alone	9 (13.6)	10 (7.1)	0.49 (0.19, 1.27)	0.147	0.58 (0.28, 1.21)	0.145
Living with family members/friends	57 (86.4)	130 (92.9)	Reference		Reference	
Residency						
Urban	41 (62.1)	63 (45.0)	Reference		Reference	
Suburban	21 (31.8)	59 (42.1)	1.82 (0.97, 3.45)	0.067	1.84 (1.16, 2.92)	0.010
Rural	4 (6.1)	18 (12.9)	2.94 (0.93, 9.09)	0.067	2.82 (1.26, 6.34)	0.012
Employment status						
Full or part-time jobs	36 (54.5)	65 (46.4)	Reference		Reference	
Retirement/no job	30 (45.5)	75 (53.6)	1.39 (0.77, 2.50)	0.283	1.39 (0.92, 2.12)	0.122
Income, year <sup>a</sup>						
<300K NTD	26 (47.3)	48 (38.7)	0.46 (0.19, 1.15)	0.095	0.87 (0.48, 1.58)	0.652
300K-700K NTD	21 (38.2)	44 (35.5)	0.52 (0.21, 1.33)	0.171	1.00 (0.52, 1.92)	0.992
700K or more NTD	8 (14.5)	32 (25.8)	Reference		Reference	
Health Status						
BMI						
<18.5	8 (12.1)	13 (9.3)	Reference		Reference	
18.5-24	31 (47.0)	61 (43.6)	1.20 (0.45, 3.23)	0.734	0.80 (0.40, 1.61)	0.538
24-27	18 (27.3)	37 (26.4)	1.27 (0.44, 3.57)	0.672	0.89 (0.42, 1.86)	0.749
≥27	9 (13.6)	29 (20.7)	2.00 (0.63, 6.25)	0.245	1.14 (0.52, 2.50)	0.740
Hypertension	31 (47.0)	61 (43.6)	0.93 (0.55, 1.56)	0.800	1.04 (0.65, 1.67)	0.867
Diabetes Mellitus	12 (18.2)	20 (14.3)	0.79 (0.36, 1.69)	0.567	1.36 (0.76, 2.45)	0.300
Dyslipidemia	14 (21.2)	29 (20.7)	0.98 (0.48, 1.96)	0.960	0.64 (0.38, 1.10)	0.110
Subjective poor health	40 (60.6)	33 (23.6)	0.39 (0.23, 0.67)	<.001	0.38 (0.25, 0.59)	<.0001
Hospitalization in the past year	21 (31.8)	28 (20.0)	0.63 (0.33, 1.19)	0.164	0.84 (0.53, 1.35)	0.478
Functional level			/		/	
ADL impairment	10 (15.2)	12 (8.6)	0.56 (0.23, 1.37)	0.210	1.40 (0.66, 2.98)	0.380
IAUL Impairment	36 (54.5)	38 (27.1)	0.31 (0.17, 0.57)	<.001	0.60 (0.37, 0.96)	0.033
Cognitive impairment	17 (25.8)	27 (19.3)	0.75 (0.38, 1.47)	0.418	1.18 (0.68, 2.05)	0.550
	0 (12 1)	10 (12 C)	1 1 2 (0 47 2 70)	0.014	0.00 (0.51, 1.00)	0.055
Smoking	δ (12.1)	19 (13.6)	1.12 (0.47, 2.70)	0.814	0.98 (0.51, 1.88)	0.955
Alconol use	13 (19.7)	26 (18.6)	0.94 (0.45, 1.96)	0.880	0.99 (0.60, 1.65)	0.980
Exercise	31 (47.0)	101 (72.1)	2.92 (1.59, 5.37)	<.001	1.72 (1.09, 2.72)	0.020
Social group engagement	16 (24.2)	65 (46.4)	2.71 (1.41, 5.21)	0.003	1.41 (0.92, 2.18)	0.118
Social leisure activities	51 (77.3)	124 (88.6)	2.28 (1.05, 4.95)	0.039	1.06 (0.55, 2.04)	0.864

Table 4: Factors associated with effective coverage among patients with depression with adequate treatment.

# $^{\rm a}{\rm with}$ missing value.

Abbreviation: NTD, New Taiwan Dollar, 1 USD  $\approx$  31-8 NTD in 2015; BMI, body mass index; ADL, activities of daily living; IADL, Instrumental activities of daily living; 95% CI, 95% confidence interval.

Test for model assumption and goodness-of-fit: variance inflation factor for all variables <5; c-statistics ranged from 0.707 to 0.893 for 20 imputed datasets.

which is compatible with other study.<sup>26</sup> Improving mental health literacy could raise mental health awareness and increase belief for treatment effectiveness and safety.<sup>27</sup> The retired or unemployed might have more time to seek treatment and had a higher contact rate than those who were employed. Past studies had controversial results relating age to help-seeking, and we did not find significant relationships in our research.<sup>12</sup>

# Adequate coverage

In this study, we found no individual factors associated with adequate depression treatment. Past research revealed factors associated with inadequate treatment, including being female or elderly or having extraversion or other personality disorder symptoms, low education level, substance use, poverty, poorer social support and family network, cost, and poor patient-physician relationship.<sup>28</sup> Some of the aforementioned attitudinal facthat influenced non-adherence were not tors measurable in our study, which might confound our results. In complete case analysis, exercise was inversely associated with adequate coverage. Participants with regular exercise might tend to use self-management strategy rather than antidepressant treatment. This finding in our study is inconsistent and needs to be replicated. Further investigations should include comprehensive assessments of attitudinal factors for adequate coverage.

#### Effective coverage

Ineffectiveness of depression treatment is related to psychiatric comorbidities, medical comorbidities, and patient-related factors.<sup>29</sup> Psychiatric comorbidities, such as substance or alcohol use, are associated with an increased risk of treatment resistance.<sup>29</sup> Patient-related factors, including decreased subjective social support, fewer interpersonal or economic resources, and poor baseline function, are reported to be poorly responsive to antidepressant treatment.<sup>29</sup> In our investigation, patients with subjective poor health and IADL impairment were more likely to receive ineffective treatment. Of note, we found that patients living in suburban or rural areas received more effective treatment than those living in urban areas. Healthcare resources in rural areas are relatively insufficient. Patients who live in suburban or rural areas and receive adequate treatment might have strong motivation, thereby enhancing the treatment response. In addition, we found that participants who exercised regularly were also more likely to achieve effective treatment. It is not surprising that exercise had a synergistic effect on depression treatment.<sup>30</sup> On the other hand, while past research has related low economic status and alcohol consumption with treatment-resistant depression, the results of our investigation did not show a similar trend.

#### Limitations

The present study had several limitations. First, healthcare accessibility is assessed based on the subjective report rather than objective measures. In addition, the assessment is not specified for mental health services. Community mental health services are less common than general medical healthcare. Especially, the psychiatrist density in Taiwan is around 7 per 100,000 population, which is less than most high-income countries. In rural area, the psychiatrist-per-population ratio is lower compared to that in urban area. It might be overestimated if we attempt to generalise mental healthcare accessibility. However, primary care physicians in Taiwan received psychiatry training during residency and could provide primary treatment of depression. The actual mental health accessibility warrants further investigation. Second, healthcare provider information was not available in this study. The treatment adequacy and effectiveness are partially determined by healthcare providers. Whether primary care clinicians as well as psychiatrists adhere to treatment guidelines remains unclear. Third, we used NHI claims records and CES-D  $\geq$  10 to identify individual with clinically relevant depression. However, there are still false positives and negatives under the CES-D cutoff point, which might distort our estimates for each stage in this bottleneck analysis. If the cutoff point is low, the number of target population would be over-estimated and lead to underestimate the initial contact rate. Fourth, we included only middle-aged and older adults. Our results cannot be generalised to other age groups. Fifth, although TLSA is a multi-wave longitudinal cohort, the latest TLSA survey conducted in 2019 is still not available for linking NHI claims database. Therefore, we only conducted a cross-sectional analysis using TLSA 2015 dataset. The temporal relationship between individual factors and each necessary stage of depression care is unclear. Reverse causality between subjective poor health and effective treatment is possible. In addition, our findings might not generalize to the current coverage of depression, especially the prevalence of depressive disorder might increase during the COVID-19 pandemic. Sixth, several potential mutable factors, such as stigma, psychosocial and inter-personal problems, and health literacy were not assessed in this study. These factors not only play an important role on health service utilization but also are potential confounders. Further investigations should include these measures comprehensively. Seventh, we conducted multiple imputation analyses under missing at random assumption. Unfortunately, this assumption is untestable. If it is violated, the results will be biased. Eighth, we did not adjust for multiple comparisons because this study is exploratory in nature; the findings may be significant due to inflated type I error. Finally, psychotherapy was not assessed in the present study. Thus, contact and adequate coverage might have been underestimated. However, psychotherapy in Taiwan remains unpopular. Thus, we believe that the underestimation was small.

# Conclusions

In conclusion, the main bottleneck in depression care in Taiwan is initial contact. Although healthcare accessibility is acceptable, most middle-aged and older adults with clinically relevant depression did not receive treatment. This may be due to stigma or lack of awareness. High education, social group engagement, and participation in social leisure activities were associated with increasing treatment rates, implying that the main barrier impeding patients in Taiwan from seeking help may be alleviated by improving mental health literacy and social support. Enhancing depression screening would also be helpful for increasing initial utilization. Finally, the overall effective coverage of depression care was only 11%. Identifying strategies for improving medication adherence and increasing the treatment response rate warrant further investigation.

# Contributors

TYC, SCL,CSW have roles in conceptualization, data curation, metholdology, and writing original draft.

SCL, CSW had roles in data analysis. CMC, WLH had roles in outbreak investigation, conceptualization, data interpretation, and validation.

JJH, CCH had roles in study supervision and validation.

All authors had roles in review and editing.

## Declaration of interests

All authors declare no conflict of interest.

#### Data sharing statement

The datasets supporting this study is available from Taiwan's Health and Welfare Data Science Centre. Due to legal restrictions, data cannot be made publicly available. Requests for data can be sent as a formal proposal to Taiwan's Health and Welfare Data Science Centre (https://dep.mohw.gov.tw/dos/mp-II3.html).

#### Acknowledgements

This work was partly supported by the Taiwan Ministry of Health and Welfare (MOHW109-MHAOH-M-II3-II2002, PI: CSW) and the National Health Research Institutes, Taiwan (CG-II0-GP-0I, PI: CSW).

## Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j. lanwpc.2022.100501.

#### References

- Lim GY, Tam WW, Lu Y, Ho CS, Zhang MW, Ho RC. Prevalence of depression in the community from 30 countries between 1994 and 2014. Sci Rep. 2018;8(1):1–10.
- 2 Ferrari ÅJ, Charlson FJ, Norman RE, et al. Burden of depressive disorders by country, sex, age, and year: findings from the global burden of disease study 2010. PLoS Med. 2013;10:(11) e1001547.
- 3 Eaton WW, Martins SS, Nestadt G, Bienvenu OJ, Clarke D, Alexandre P. The burden of mental disorders. *Epidemiol Rev.* 2008;30:1–14.
- 4 Mekonen T, Chan GCK, Connor JP, Hides L, Leung J. Estimating the global treatment rates for depression: a systematic review and meta-analysis. J Affect Disord. 2021;295:1234–1242.
- 5 Roness A, Mykletun A, Dahl AA. Help-seeking behaviour in patients with anxiety disorder and depression. Acta Psychiatr Scand. 2005;111(1):51-58.
- 6 Ghio L, Gotelli S, Cervetti A, et al. Duration of untreated depression influences clinical outcomes and disability. J Affect Disord. 2015;175:224–228.
- Puyat JH, Kazanjian A, Goldner EM, Wong H. How often do individuals with major depression receive minimally adequate treatment? A population-based, data linkage study. *The Canadian Journal of Psychiatry*. 2016;61(7):394-404.
  Hepner KA, Rowe M, Rost K, et al. The effect of adherence to practice of the study. The study of the study of the study.
- 8 Hepner KA, Rowe M, Rost K, et al. The effect of adherence to practice guidelines on depression outcomes. Ann Intern Med. 2007;147 (5):320–329.
- 9 Tanahashi T. Health service coverage and its evaluation. Bull World Health Org. 1978;56(2):295.
- Yang YT, Iqbal U, Ko HL, et al. The relationship between accessibility of healthcare facilities and medical care utilization among the middle-aged and elderly population in Taiwan. *Int J Qual Health Care.* 2015;27(3):222–231.
- II Chien I-C, Kuo C-C, Bih S-H, et al. The prevalence and incidence of treated major depressive disorder among National Health Insurance enrollees in Taiwan, 1996 to 2003. Can J Psychiatry. 2007;52 (1):28–36.
- Lavingia R, Jones K, Asghar-Ali AA. A systematic review of barriers faced by older adults in seeking and accessing mental health care. *Journal of Psychiatric Practice*<sup>®</sup>. 2020;26(5):367–382.
   Wu C-S, Yu S-H, Lee C-Y, Tseng H-Y, Chiu Y-F, Hsiung CA. Preva-
- 13 Wu C-S, Yu S-H, Lee C-Y, Tseng H-Y, Chiu Y-F, Hsiung CA. Prevalence of and risk factors for minor and major depression among community-dwelling older adults in Taiwan. *Int Psychogeriatr.* 2017;29(7):1113–1121.
- 14 O'Connell T, Sharkey A. Reaching Universal Health Coverage Through District Health System Strengthening: Using a Modified Tanahashi Model Sub-Nationally to Attain Equitable and Effective Coverage. New York: UNICEF; 2013.
- 15 Cornman JC, Glei DA, Goldman N, et al. Cohort profile: the social environment and biomarkers of aging study (SEBAS) in Taiwan. Int J Epidemiol. 2016;45(1):54-63.
- Int J Epidemiol. 2016;45(1):54–63.
  Wu C-S, Kuo C-J, Su C-H, Wang SH, Dai H-J. Using text mining to extract depressive symptoms and to validate the diagnosis of major depressive disorder from electronic health records. J Affect Disord. 2020;260:617–623.
- 17 Haringsma R, Engels GI, Beekman A, Spinhoven P. The criterion validity of the Center for Epidemiological Studies Depression Scale (CES-D) in a sample of self-referred elders with depressive symptomatology. Int J Geriatr Psychiatry. 2004;19(6):558–563.
- 18 Chang K-F, Weng L-J. Screening for depressive symptoms among older adults in Taiwan: Cutoff of a short form of the Center for Epidemiologic Studies Depression Scale. 2013.
- 19 Gelenberg A, Freeman M, Markowitz J, et al. American Psychiatric Association practice guideline for the treatment of patients with major depressive disorder. Am J Psychiatry. 2010;167(suppl).
- 20 Petrosyan Y, Sahakyan Y, Barnsley JM, Kuluski K, Liu B, Wodchis WP. Quality indicators for care of depression in primary care settings: a systematic review. Syst Rev. 2017;6(1):1–14.
- 21 Sterne JA, White IR, Carlin JB, et al. Multiple imputation for missing data in epidemiological and clinical research: potential and pitfalls. *Bmj.* 2009;338.
- 22 Vigo D, Haro JM, Hwang I, et al. Toward measuring effective treatment coverage: critical bottlenecks in quality- and useradjusted coverage for major depressive disorder. *Psychol Med.* 2020:I–II.
- 23 Hsu HC, Liang J, Luh DL, Chen CF, Wang YW. Social determinants and disparities in active aging among older Taiwanese. Int J Environ Res Public Health. 2019;16(16).

- 24 Chang H-T, Hsu N-W, Chen H-C, Tsao H-M, Lo S-S, Chou P. Associations between body mass index and subjective health outcomes among older adults: findings from the Yilan Study, Taiwan. Int J Environ res Public Health. 2018;15(12):2645.
- 25 Liao SC, Chen WJ, Lee MB, et al. Low prevalence of major depressive disorder in Taiwanese adults: possible explanations and implications. *Psychol Med.* 2012;42(6):1227–1237. Marcus SC, Olfson M. National trends in the treatment for depression
- 26
- from 1998 to 2007. Arch Gen Psychiatry. 2010;67(12):1265–1273. Su J-A, Chang C-C, Yang Y-H, Chen K-J, Li Y-P, Lin C-Y. Risk of incident dementia in late-life depression treated with 27

antidepressants: A nationwide population cohort study. Journal of Psychopharmacology. 2020;34(10):1134–1142. Sansone RA, Sansone LA. Antidepressant adherence: are

- 28 patients taking their medications? Innov Clin Neurosci. 2012;9 (5-6):41-46.
- Gaynes B. Assessing the risk factors for difficult-to-treat depression 29 and treatment-resistant depression. J Clin Psychiatry. 2016;77 (Suppl 1):4-8.
- Barbour KA, Edenfield TM, Blumenthal JA. Exercise as a treatment 30 for depression and other psychiatric disorders: a review. J Cardiopulm Rehabil Prev. 2007;27(6):359-367.