SOCIOECONOMIC STATUS DETERMINES PSYCHOLOGICAL STRESS DIFFERENCES BETWEEN OLDER ADULTS LIVING IN RURAL AND RURBAN AREAS DURING THE POST-CORONAVIRUS DISEASE 2019 PANDEMIC ERA: A GEOGRAPHIC INFORMATION SYSTEM-BASED SPATIAL ANALYSIS

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ABSTRACT

Psychological stress is a process of behavioral and physiological responses to internal and environmental changes. Older persons are group of people of difficulty in adaptation to such changes due to their physical and social limitations. Pandemics of other infectious diseases had different impacts on psychological stress levels depending on their socio-demographic and geographical variations. This present study was aimed to investigate effects of the coronavirus disease 2019 (COVID-19) pandemic on psychological stress levels in older persons living in rural area (Baan Waai) and rurban area (Khamrieng, the area with diffusion of urban and rural activities) in Maha Sarakham province, Thailand. Spatial distribution of psychological stress and socio-demographic data were collected using Global Positioning System (GPS) and were mapped together using the Geographic Information System (GIS) program. Results depicted that the older persons living in the rurban area had a higher psychological stress level. The psychological stress levels were predicted by occupational and economic statuses, especially in the rurban area due to its predominant dependency on trading products and services. In conclusion, living in rural area with job and adequate income were relieving factors of psychological stress in the older persons during the post-COVID-19 pandemic period.

Keywords: Older Person, Psychological Stress, Geographic Information System, Rurban Area, COVID-19

INTRODUCTION

As average human life span is increasing, number of elderly population is also growing. An aging society is defined as a society with more than 7% of the population aged 65 or older; a population with more than 14% is an aged society, and a population with more than 20% is defined as a super aging society (Lee et al., 2018). According to a report of an Office of the National Economic and Social Development Council (NESDC), Thailand is becoming a full-fledged aged society in 2021 as number of elderly population is rising to 13.1 million or 18.7 percent of the total population (Khamken, 2021). This is a challenging issue for older people as they confront multiple age-related changes such as degeneration of tissues and organs, sensitivity pollution and environmental stressors (Nigam et al., 2012; Simoni et al., 2015). Lack of adaptability and resilience to these changes can lead to stress-related physical and mental health problems (Zapater-Fajari et al., 2021).

Impacts of the coronavirus disease 2019 (COVID-19) pandemic globally are prominent. It enormously influences economic, social, political, and healthcare systems in many countries (Jazieh & Kozlakidis, 2020). While social isolation, social distancing, state and home quarantine, and community containment measures were immediately applied, people may experience fear of the consequences of being infected with a potentially lethal virus, loneliness, boredom, and anger during emergency lockdown (Carvalho et al., 2020; Hopman et al., 2020). Personal perception of infectious disease outbreak can effectuate psychological stress (Wu et al., 2009). According to the report of World Bank, economic growth of Thailand was expected to shrink by 5%, taking more than two years to return to pre-COVID-19 Gross Domestic Product (GDP) output levels (Kongrukgreatiyos, 2020). The economic shock related to COVID-19 has adversely affected employment, income, and poverty. Associated with both income loss and self-quarantine, it has been recently reported that psychological stress increased among 42.6% of participants living in urban area of Bangkok, Thailand (Pongutta et al., 2021). The extent of this problem on psychological stress and mental health in elderly population in rural areas of Thailand has not been elucidated.

Mental health is a global public health problem. The World Health Organization (WHO), defines mental health as "a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community" (Organization, 2004). Therefore, it can be implied that stress is one of the key determinants of individual's mental health. It has been widely reported that psychological stress is a risk factor for mental health problems (e.g., depression and anxiety) and physical health problems (e.g., stroke and heart disease) (Ryder & Cohen, 2021). Etiology of psychological stress is multifactorial encompassing physical health status, economic status, social relationship, living environment, and stressful events (Ahnquist et al., 2012; Zautra et al., 2005). It has been reported that people living in rural areas with green natural scene were more resilient to psychological stress (Mennis et al., 2018). Meanwhile, people in urbanized city were more stressful compared to those living in rural areas (Dhingra et al., 2009). Situated in the Northeastern region of Thailand, Maha Sarakham province consists of 13 districts with rural-urban disparity (Hong et al., 2020). As aforementioned, older adults have to adapt to challenging stressful situation during COVID-19 pandemic, this present study was aimed to investigate psychological stress distribution in this group of population using a geographic information system. Geographic disparity of psychological stress levels and predicting factors in rural and rurban areas were also determined.

MATERIALS AND METHODS

Research Design and Participants

This present descriptive cross-sectional study was performed in older adults living in Baan Waai subdistrict (rural area, n=1210) and Khamrieng subdistrict (rurban area, n=627), Maha Sarakham, Thailand. It was the part of the project "Development of Mobile Application of Database of Older Persons Using Geographic Information System (GIS) to Detect and Analyze Risks of Chronic Diseases, Quality of Life, and Mental Illness by Village Health Volunteers in 7th Regional Health Office Territory" funded by the Office of the National Digital Economy and Society Commission, Ministry of Digital Economy and Society. All procedures have been conducted in accordance with the Declaration of Helsinki and approved by the Ethical Review Committee for Human Research, Maha Sarakham Provincial Public Health Office (No.6/2564). Written informed consent forms were obtained from all participants. Inclusion criteria were age ≥ 60 years old and household registered in Baan Waai or Khamrieng subdistricts with informed consent. The older adults not physically present during the study were excluded.

Data Collection Tools

The tools for data collection in this study consisted of 3 parts. First, socio-demographic data (gender, age, marital status, living arrangement, educational level, occupational status, activities of daily living (ADL) level, present illness, drinking status, and smoking status). The age 80 years old was used as a cut-off point because of critical changes in levels of sex hormone (dehydroepiandrosterone), muscle mass, physical strength recovery capability(Yiallouris et al., 2019). The Thai version of Barthel ADL index assessment tool developed by the Ministry of Public Health, Thailand was used to evaluate participants' functional ability (Jantapo & Kusoom, 2021). The standard tool consists of a 10-item questionnaire asking about ADL with the total score of 0 to 20. Its score ranges were classified as independent (12-20) and dependent (0-11) groups. In the present study, the latter two groups were further grouped into the dependent group. Secondly, a 24-item psychological stress questionnaire. Each item was rated on a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3= neither agree nor disagree, 4 = agree, and 5 = strongly agree). Possible total score (24-120) was further divided into 4 levels of psychological stress (24-48 = mild, 49-72 = moderate, 73-96 = high, and 97-120 = severe). The tool was constructed and approved for content validity by 3 experts in nursing, psychiatry, and public health. The content validity has been confirmed by index of item-objective congruence (IOC). Only the items with IOC scores ≥ 0.5 were qualified for the questionnaires. The items with Cronbach's α ≥ 0.7 were acceptable and used in the questionnaire. The socio-demographic and psychological stress data were collected by local Village Health Volunteers (VHV) using online questionnaires on a mobile phone. Locations of the participants were collected using the global positioning system (GPS) and were mapped together with the psychological stress levels using the geographic information system (GIS) program. The geographic coordinate system used in this study was the World Geodetic System 1984, Universal Transverse Mercator coordinate system (EPSG:32648 WGS 84/UTM Zone 48N). All data collection process was performed from April to July 2021.

Statistical Analyses

Continuous data are expressed as mean and standard deviation. Normality of sample data was tested by the Kolmogorov–Smirnov test. Categorical data are expressed as frequency and percentage. The statistical analyses consisted of two steps: univariate and multivariate analyses. For the univariate analysis, association between the psychological stress levels and the socio-demographic variables were evaluated with compared using Fisher's exact test. The results showed

that there was minimal multicollinearity among the socio-demographic variables. For the multivariate analysis, multivariate ordinal logistic regression was performed. The psychological stress levels were treated as the dependent variable. The socio-demographic variables proven significant at the univariate analysis were entered as independent variables in the generalized linear regression models to gain more power in investigating the effect of risk factors than the conventional logistic regression models using SPSS software version 18 (Armstrong & Sloan, 1989; Mathew et al., 2021).

RESULTS

The socio-demographic data of 1,837 older adults from rural (Baan Waai, n = 1,210) and rurban (Khamrieng, n =627) areas are shown in Table 1. Majority of the participants were female with mean age less than 80 years old, being married, living with family, and having at primary school level of education. Most of them were still working, having inadequate income for living. Only 42 participants were in the dependent level of ADL. Approximately 1/3 had $\geq$ 1 underlying disease of hypertension, diabetes mellitus, and musculoskeletal diseases. Only approximately 10% were drinking alcohol or smoking. The psychological stress scores collected during the post-COVID-19 pandemic era in the last 6 months are shown in Table 2. Results showed that the psychological stress scores in the older adults living in Baan Waai and Khamrieng areas were 44.99±16.18 and 52.94±16.21, respectively. Mean score comparison by independent t-test showed a significant difference between the two groups ($P<0.001$, Figure 1). Geographic distribution of the psychological levels is illustrated in Figure 2.
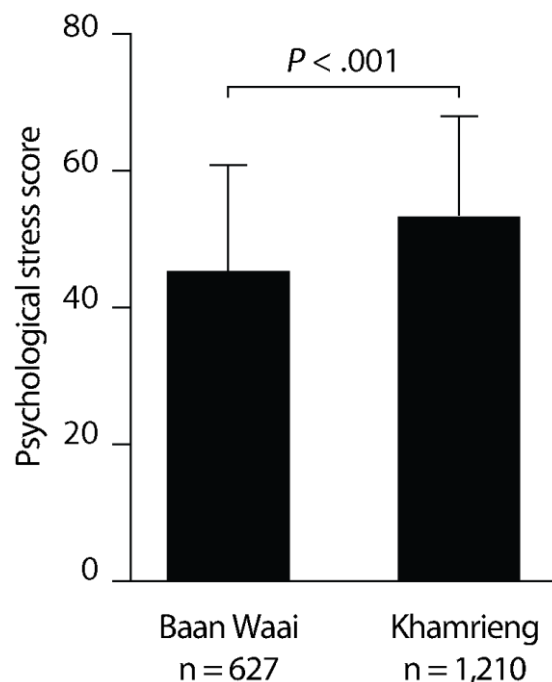

FIGURE 1
COMPARISON OF PSYCHOLOGICAL STRESS SCORES (MEAN±SD) BETWEEN RURAL (BAAN WAAI) AND RURBAN (KHAMRIENG) AREAS
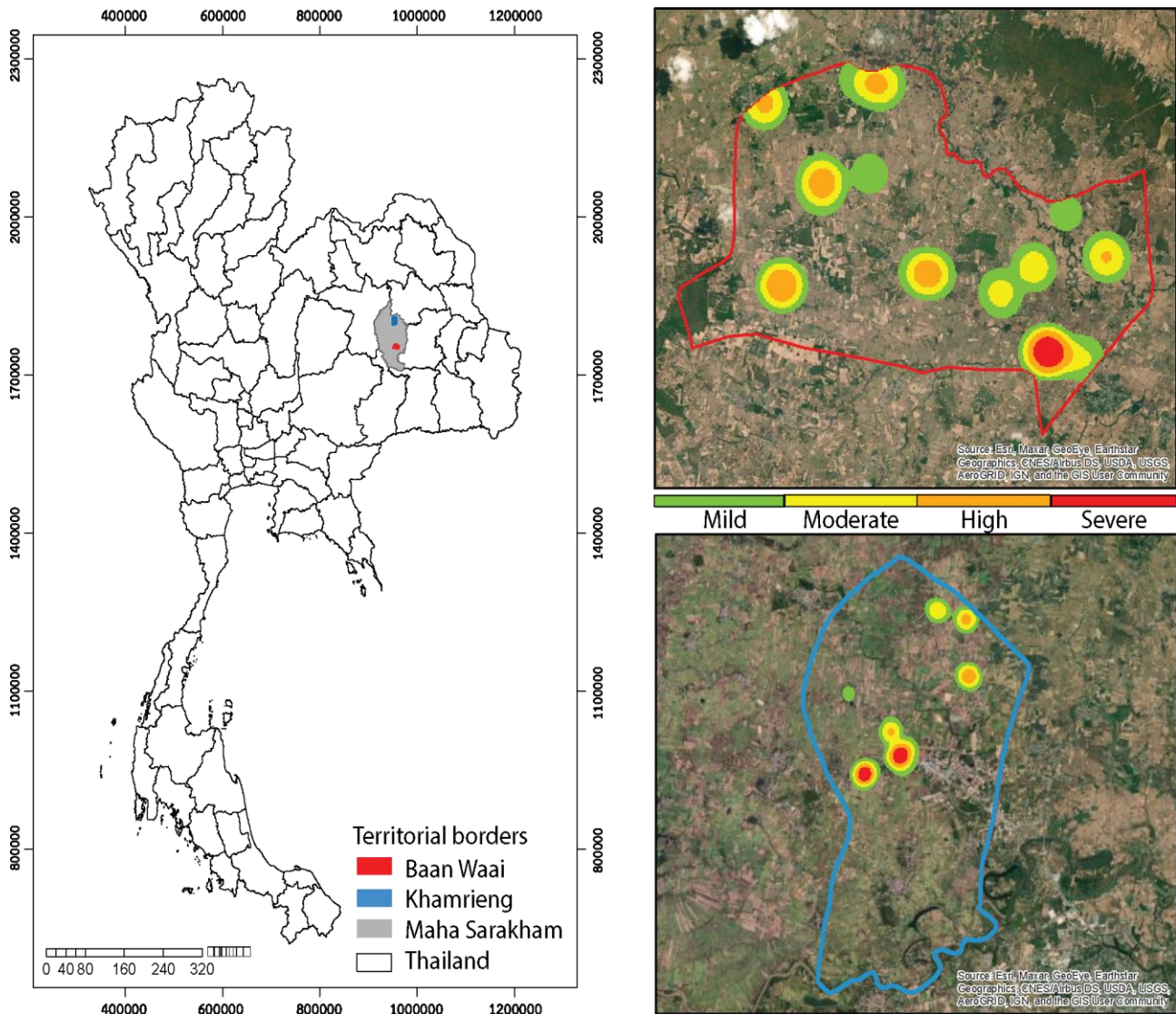
FIGURE 2
GEOGRAPHICAL DISTRIBUTION OF PSYCHOLOGICAL STRESS LEVELS IN COMMUNITY-DWELLING OLDER ADULTS IN RURAL (BAAN WAAI, RED BORDER) AND RURBAN (KHAMRIENG, BLUE BORDER) AREAS

Furthermore, relationship between the psychological stress levels and socio-demographic characteristics of participants were analyzed by the Fisher's exact test (Table 3). Results revealed that the psychological stress levels were associated with the locations of living, occupational status, and economic status ($P<0.001$). In addition, multivariate ordinal logistic regression analysis of independent predictors for psychological stress levels using the generalized linear regression models. Based on the data shown in Table 4, location of living significantly predicted the likelihood of the older adults to have a higher level of psychological stress at $P<0.05$. The older adults living in Khamrieng area were 2.327 times more likely to have a higher level of psychological stress than those living in Baan Waai area. Similarly, occupational and economic statuses were also the predictors of the psychological stress levels. The older adults without jobs and inadequate income for living were 1.300 and 1.849 times more likely to have a higher level of psychological stress than those with jobs and adequate income.

Table 1 **SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS (N=1,837)**				
Characteristics	**Category**	**Baan Waai Area** **n (%)**	**Khamrieng Area** **n (%)**	*P*-value
Gender	Male	528 (43.6)	242 (38.6)	0.041*
	Female	682 (56.4)	385 (61.4)	
Age	60-79	1061 (87.7)	561 (89.5)	0.146
	≥ 80	149 (12.3)	66 (10.5)	
Marital status	Married	757 (62.6)	358 (57.1)	0.024*
	Single (widowed/divorced/separate)	453 (37.4)	269 (42.9)	
Living arrangement	Living with family	1149 (95.0)	593 (94.6)	0.740
	Living alone	61 (5.0)	34 (5.4)	
Educational level	Higher than primary school	45 (3.7)	56 (8.9)	<0.001*
	Primary school	1165 (96.3)	571 (91.1)	
Occupational status	Working	915 (75.6)	463 (73.8)	0.426
	Not working	295 (24.4)	164 (26.2)	
Economic status	Enough income for living	553 (45.7)	230 (36.7)	<0.001*
	Not enough income for living	657 (54.3)	397 (63.3)	
ADL level	Independent	1175 (97.1)	620 (97.1)	0.020*
	Dependent	35 (2.9)	7 (2.9)	
Present illness	No underlying disease	827 (68.3)	380 (60.6)	0.001*
	≥ 1 underlying disease	383 (31.7)	247 (39.4)	
Drinking status	Non-alcohol drinker	1036 (85.6)	563 (89.8)	0.013*
	Alcohol drinker	174 (14.4)	64 (10.2)	
Smoking status	Non-smoker	1065 (88.0)	575 (91.7)	0.017*
	Smoker	145 (12.0)	52 (8.3)	

ADL, activity of daily living; *P*-value < .05 by χ^2 test.

Table 2 **PSYCHOLOGICAL STRESS SCORES DURING THE POST-COVID-19 PANDEMIC ERA IN THE LAST 6 MONTHS (N=1,837)**					
		Psychological stress score			
No.	**Item description**	**Baan Waai** (n = 1,210)		**Khamrieng** (n = 627)	
		Mean	SD	Mean	SD
1	I have been afraid of death.	1.84	1.10	2.52	1.30
2	I have been afraid of severe illness.	2.25	1.29	2.72	1.16

3	I have been afraid of being burden of my children and family.	2.32	1.24	2.63	1.25
4	My family members have had conflicts over financial issues and household affairs.	1.67	0.81	2.07	1.10
5	I have felt like I am in "competition" or being compared with others.	1.61	0.79	2.03	0.98
6	I have worried about air, light, noise or water pollution, or even exposure to poisonous substances.	2.08	1.08	2.45	1.13
7	I have been in frustration, fear, and despair of COVID-19 pandemic situation.	2.33	1.15	2.81	1.20
8	I have felt sleepless or frequently have sleep startle.	1.89	0.85	2.27	0.97
9	I have had pain on my back, neck, shoulder, or occipital area.	2.03	0.95	2.22	0.96
10	I have had one-side headache or dizziness.	1.70	0.85	1.99	0.91
11	I have experienced reduced appetite.	1.81	0.87	2.15	0.94
12	I have had frequent urination during night-time sleep.	1.87	0.85	2.17	0.95
13	I have had feeling of discomfort, shortness of breath, or frustration.	1.63	0.81	1.89	0.91
14	I have had feeling of grief or loneliness.	1.57	0.84	1.86	0.98
15	I have felt that I have no enough money for living.	2.16	1.16	2.13	1.08
16	I have had tension or pain in muscle.	2.01	0.95	2.05	0.88
17	I have had frequent feeling of anger or irritation.	1.70	0.86	2.19	1.35
18	I have had headache from stress.	1.69	0.83	2.03	1.21
19	I have felt of confusion, loss of focus, or forgetfulness.	1.98	0.94	2.30	1.31
20	I have had a temporary memory loss.	2.04	0.94	2.24	1.05
21	I have had a migraine.	1.58	0.81	1.83	0.91
22	I have felt tired or faint.	1.75	0.86	2.14	0.98
23	I have had feeling of lack of self-control.	1.96	0.93	2.34	1.05
24	I have felt bored, not doing anything, and wishing to stay alone.	1.51	0.77	1.92	1.02
Total		44.99	16.18	52.94	16.21

Table 3
RELATIONSHIP BETWEEN PSYCHOLOGICAL STRESS LEVELS AND SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PARTICIPANTS

Characteristic	Psychological stress level					P-value
	Mild n (%)	Moderate n (%)	High n (%)	Severe n (%)	Total n (%)	
Living in Baan Waai area	790 (65.3)	330 (27.3)	89 (7.4)	1 (0.1)	1210(100)	
Living in Khamrieng area	261 (41.6)	291 (46.4)	69 (11.0)	6 (1.0)	627 (100)	<0.001*
Male	456 (59.2)	247 (32.1)	64 (8.3)	3 (0.4)	770 (100)	
Female	595 (55.8)	374 (35.1)	94 (8.8)	4 (0.4)	1067 (100)	0.524
Age 60-79	939 (57.9)	536 (33.0)	141 (8.7)	6 (0.4)	1622 (100)	
Age ≥ 80	112 (52.1)	85 (39.5)	17 (7.9)	1 (0.5)	215 (100)	0.237
Married	657 (58.9)	357 (32.0)	99 (8.9)	2 (0.2)	1115 (100)	
Single (widowed/divorced/separate)	394 (54.6)	264 (36.6)	59 (8.2)	5 (0.7)	722 (100)	0.059
Living with family	1,000 (57.4)	588 (33.8)	147 (8.4)	7 (0.4)	1742 (100)	
Living alone	51 (53.7)	33 (34.7)	11 (11.6)	0 (0.0)	95 (100)	0.637
Higher than primary school	57 (56.4)	36 (35.6)	8 (7.9)	0 (0.0)	101 (100)	
Primary school	994 (57.3)	585 (33.7)	150 (8.6)	7 (0.4)	1736 (100)	0.950
Working	826 (59.9)	425 (30.8)	122 (8.9)	5 (0.4)	1378 (100)	
Not working	225 (49.0)	196 (42.7)	36 (7.8)	2 (0.4)	459 (100)	<0.001*
Sufficient income for living	531 (67.8)	193 (24.6)	55 (7.0)	4 (0.5)	783 (100)	
Insufficient income for living	520 (49.3)	428 (40.6)	103 (9.8)	3 (0.3)	1054 (100)	<0.001*
Independent level of ADL	1,032 (57.5)	602 (33.5)	154 (8.6)	7 (0.4)	1,795 (100)	
Dependent level of ADL	19 (45.2)	19 (45.2)	4 (9.5)	0 (0.0)	42 (100)	0.348
No underlying disease	694 (57.5)	416 (34.5)	94 (7.8)	3 (0.2)	1,207 (100)	
≥ 1 underlying disease	357 (56.7)	205 (32.5)	64 (10.2)	4 (0.6)	630 (100)	0.174
Non-alcohol drinker	918 (57.4)	542 (33.9)	134 (8.4)	5 (0.3)	1,599 (100)	

Alcohol drinker	133 (55.9)	79 (33.2)	24 (10.1)	2 (0.8)	238 (100)	0.393
Non-smoker	946 (57.7)	554 (33.8)	133 (8.1)	7 (0.4)	1,604 (100)	
Smoker	105 (53.3)	67 (34.0)	25 (12.7)	0 (0.0)	197 (100)	0.160

ADL, activity of daily living; *P-value < .05 by Fisher's exact test.

Table 4
MULTIVARIATE ORDINAL LOGISTIC REGRESSION ANALYSIS OF INDEPENDENT PREDICTORS FOR PSYCHOLOGICAL STRESS LEVELS

Dependent variable	Independent predictors	n (%)	B	OR	95% CI [lower-upper]	P-value
Psychological stress	Living area					
	Baan Waai	1210 (65.9)		Ref		
	Khamrieng	627 (34.1)	0.845	2.327	[1.922-2.818]	<0.001*
	Occupation status					
	Working	1378 (75.0)		Ref		
	Not working	459 (25.0)	0.262	1..300	[1.055-1.603]	0.014*
	Economic status			Ref		
	Sufficient income for living	783 (42.6)				
	Insufficient income for living	1054 (57.4)	0.615	1.849	[1.524-2.244]	<0.001*

OR, odds ratio; 95% CI, 95% confidence interval; P < .05 by multivariate ordinal logistic regression.

DISCUSSION

This present study shows the different distribution of psychological stress levels of the older adults living in rural and rurban areas during the post-COVID-19 pandemic era. This disparity is associated with socioeconomic statuses of the older adults. Our conclusion is based on the following findings: 1) the psychological stress score in the older adults living in Baan Waai (rural) area was in a mild level, whereas Khamrieng (rurban) area was in a moderate level, and 2) the older adults without jobs and inadequate income for living were more likely to have a higher level of psychological stress than those with jobs and adequate income.

Mental health is a foundation for well-being and effective functioning for every life of an individual and eventually brings about healthy community (Lahtinen et al., 1999). Being able to cope with stress of life is a key element of healthy mentality (Organization, 2004). From the environment–organism transaction perspective, psychological stress is product of the progressing personal transactions with stressors (environmental or internal perturbations) (Monroe & Cummins, 2015). Severe or chronic psychological stress can lead to behavioral or physiological distress, a negative process of failure to return to homeostasis, which might turn into mental illness (Council, 2008). Therefore, early recognition and management of risk factors for perceived psychological stress are pivotal steps to mental health promotion strategic planning.

Levels of psychological stress increase with an advancing age due to deteriorating health and decline in social relationship (Borson et al., 2001). This present study points out that occurrence of COVID-19 are in close relationship with psychological stress, especially in the rurban area. According to previous studies, Prevalence of Psychological Stress and Posttraumatic Stress Disorders (PTSD) among South Korean and Hong Kong people during outbreaks of Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) significantly increased in the pandemic regions (Lee et al., 2007; Shin et al., 2019). Recently, it has been estimated that an impact of COVID-19 pandemic on psychological stress among Korean people was

1.5 times higher than those who experience MERS (Lee et al., 2020). A study in Nepalese people showed that the influences of COVID-19 pandemic on psychological distress in age group > 45 years old were higher than in the younger age group (Shrestha et al., 2020). They also reported that females and people with post-secondary education had higher risk of developing distress as compared to males and the others with secondary education or lower. In contrast, there are predictive significance of gender and educational levels on psychological stress levels in the present study. As opposed to these findings, this present study signifies the differences in occupational and economic statuses are the predictors of psychological stress levels as shown in the multivariate ordinal logistic regression results. However, the adequate income in the rural area seems to be a solely predicative factor for its relatively low level of psychological stress in comparison to the rurban area as shown in the chi-square analysis results. This might be explained by due to predominant dependency on trading products and services in the rurban area.

Nevertheless, our study also lacks of evident information pertaining to natural and landscape environments. According to literature, Khamrieng is an urbanizing area with high growing rate of infrastructure construction as it is the place where Mahasarakham University is situated in (Chaisantaow et al., 2021). Parts of the land in the neighborhood were transformed from farms to real states because of an increasing number of population and demand in residency, particularly in Khamrieng neighborhoods (Abreu-Vilomar, 2013). It has been reported that people living in a green area have lower psychological stress level (Mennis et al., 2018). Based data from the Global Forest Watch in Maha Sarakham as of 2010, the top 5 regions represent 57% of all tree cover (www.globalforestwatch.org). The data also showed that Wapi Pathum (including Baan Waai) had the most tree cover at 2.25 kilohectare (kha) whereas Kantharawichai (including Khamrieng) was 1.36 ha. From 2001 to 2020, Maha Sarakham lost 141 ha of tree cover, equivalent to a 7.5% decrease in tree cover since 2000 and 67.7 kiloton of CO_2 equivalent emissions. Thus, it can be implied that less green in the urbanizing Khamrieng area might result in higher psychological stress level in older people.

In conclusion, this present study illustrates that the older adults living in rurban area have higher levels of psychological stress compared to those living in the rural areas during the post-COVID-19 pandemic era. This higher psychological stress level is predicted by no occupation and inadequate income of the older adults. These finding should be taken into account by the decision makers in strategic planning as a model to improve mental health of population in the areas.

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CONFLICT OF INTEREST

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