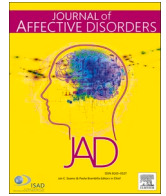




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Research paper

Impact of the COVID-19 pandemic on older adults living in long-term care centers in Thailand, and risk factors for post-traumatic stress, depression, and anxiety

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ABSTRACT

Background: There is a lack of data concerning impact of COVID-19 among older adults (OA) living at long-term care (LTC) centers. This study investigated how COVID-19 has affected this population. The prevalence of and risk factors for post-traumatic stress, depression, and anxiety were investigated.

Methods: A semi-structured interview to determine the effect of COVID-19 was conducted to 200 OA at two government LTC centers. The 17-item Post-traumatic Stress Disorder Checklist, the 9-item Patient Health Questionnaire, and the 7-item Generalized Anxiety Disorder Scale were used to evaluate post-traumatic stress, depression, and anxiety, respectively.

Results: Most OA reported moderate or severe impact of COVID-19. The most impacted area was financial due to decreased support from outside the center. Seventy percent of OA reported no or mild psychological stress from COVID-19; however, 5.5% had post-traumatic stress, 7.0% had depression, and 12.0% had anxiety. Higher psychological stress from COVID-19 and having respiratory tract infection symptoms were independently associated with post-traumatic stress, depression, and anxiety. Receiving COVID-19 news via social media was independently associated with post-traumatic stress and depression. Having psychiatric comorbidity was independently associated with depression.

Conclusions: OA living in LTC centers reported moderate or severe impact from COVID-19, especially financial, but relatively low psychological stress. Psychological stress from COVID-19, having respiratory tract infection symptoms, and receiving COVID-19 news via social media were risk factors for psychological disorders.

Limitations: The data reflected the post-outbreak period. There is limitation in the generalizability of the results for other countries with different health care systems.

1. Introduction

The novel coronavirus 2019 (2019-nCoV, SARS-CoV-2) is the causative pathogen in coronavirus disease 2019 or COVID-19. This disease emerged in December 2019 in Wuhan, China (Ahn et al., 2020), and in March 2020, the World Health Organization (WHO) declared COVID-19 a global pandemic (Cucinotta and Vanelli, 2020). COVID-19 patients can be asymptomatic, have flu-like symptoms, or develop severe pneumonia and death. Older adults, who are likely to have comorbidities, have a poor outcome (Pascarella et al., 2020).

An expert at Lancet Psychiatry expressed concern that the pandemic made it difficult for older adults to reach medical services and public transport during the pandemic (Yang et al., 2020). However, solid evidence to confirm this statement is lacking. Moreover, older adults (OA) in long-term care (LTC) centers who live 24 hours a day under the regulations may experience higher levels of stress in accessing resources by themselves. We suspected that COVID-19 might have several significant impacts on the lives of OA. Therefore, this study aims to elaborate on what areas of life, including psychological stress, and how COVID-19 has affected OA living in LTC centers. Findings from this study will

Abbreviations: OA, Older adults; LTC, Long-term care.

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benefit governments and allow providers to accurately focus on the needs of LTC OA during the pandemic.

Considering beyond a normal reaction to stress, COVID-19 was also reported to be associated with post-traumatic stress, depression, and anxiety in general population (Wang et al., 2020). Compared with younger adults, older adults demonstrated less anxiety and depression (Passos et al., 2020; Solomou and Constantinidou, 2020), and their mental health remained stable despite increased loneliness during the pandemic (van Tilburg et al., 2020). In contrast, another study reported that older adults in LTC centers were at higher risk for developing psychological disorders (Seitz et al., 2010). They may experience reduced freedom caused by institutional regulations, loss of privacy due to shared accommodations, increased loneliness, and social isolation (Choi et al., 2008). Since the COVID-19 outbreak, there is a scarcity of data concerning psychological disorders among OA living in LTC centers. We are concerned that affective disorders among OA living in LTC centers may be underrecognized. Therefore, we wanted to investigate the prevalence and factors associated with affective disorders during the pandemic. We believe that our findings will help create strategies for psychological treatment and prevention in the future.

Accordingly, the aim of this study was to investigate how COVID-19 has affected the life and psychological status of OA living at long-term care centers in Thailand. The prevalence of and risk factors for post-traumatic stress, depression, and anxiety were investigated.

2. Methods

2.1. Participants

Older adults (OA) aged ≥ 60 years were recruited from two government long-term care (LTC) centers in Thailand. OA meeting one or more of the following criteria were excluded: 1) having diagnosed dementia or a dementia screening score of 0–2 using the Mini-Cog screening tool that was administered by a social worker at each center that was trained by a study psychiatrist (MS or NV); 2) inability to understand or communicate in Thai language; 3) having active psychosis; and/or, 4) unwilling to sit for a 30-minute study-related interview. The Mini-Cog instrument has sensitivity and specificity of 91% and 86% for dementia detection, respectively, which is comparable to those of the Mini-Mental State Examination (Tsoi et al., 2015). The Thai version Mini-Cog showed good interrater reliability ($K=0.80$, $p<0.001$), and had positive concurrent validity ($r=0.47$, $p=0.007$) with the Thai version Mini-Mental State Examination (Trongsakul et al., 2015).

A total of 351 OA from two LTC centers in Thailand were screened for eligibility. After excluding 151 OA (146 with dementia, 3 who were unwilling to participate, and 2 with incomplete data), the remaining 200 OA were enrolled.

2.2. Procedures

This prospective cross-sectional study was conducted at two government LTC centers in Thailand during August 2020 to October 2020. One center is located in Bangkok, and the other is located in Chonburi Province, which is located 90 kilometers from Bangkok. Written informed consent was obtained from all study OA. Socio-demographic data were collected, and PCL-17, PHQ-9, and GAD-7 questionnaires were self-answered. Trained social workers interviewed OA about COVID-19 issues. The interviewer and study OA wore masks, and they sat at least 2 meters apart. The nurses at each LTC center reviewed clinical information. Each participating OA received 100 Thai baht (approximately 3 USD) for participating. The study protocol was approved by the Siriraj Institutional Review Board (SIRB) (COA no. Si 395/2020).

2.3. The COVID-19 situation during the data collection period

Thailand experienced the first wave of COVID-19 during March–April 2020. The government declared a nationwide emergency curfew on 25 March 2020. In April 2020, the Department of Older Persons released the manual of control and prevention of COVID-19 for all government LTC centers to ensure social distancing, which has been practiced until this time (February 2021). After the first COVID-19 outbreak was declared to be under control in May 2020, the government relieved the imposed measures, but most Thai people continue to practice social distancing.

The manual of control and prevention of COVID-19 in LTC centers includes: *for the center*: organize activities in open spaces at least 2 meters apart, separate beds and personal items 1–2 meters apart, and one-way entrance and exit; *for older adults*: physical distancing (1–2 meters apart), measure body temperature every day, separate each person's food and cutlery, regularly wash hands and wear a face mask, refrain from going in and out of the center, and nurses will refill medication for non-urgent hospital appointment; *for staff*: not allowed to travel abroad, postpone activities/projects/meetings in areas at higher risk of infection; and, *for visitors*: outside people/organizations are not permitted to arrange LTC center activities, relatives are prohibited from visiting OA in the LTC center, and those who do visit have to be carefully screened for COVID-19 risks.

Research interviews of study OA were performed during August 2020 to October 2020 (Fig. 1), which is three months after the first wave of COVID-19 was declared to be under control in Thailand

2.4. Measures

2.4.1. COVID-19 questions development and interview administration

Study psychiatrists (MS, NV) trained social workers at the LTC centers in how to perform the semi-structured interview (Adams, 2015). Social workers pilot interviewed samples of OA using open-ended questions to elicit information regarding the aspects of life impacted by the COVID-19 pandemic. The interview began with the social worker attempting to develop trust, and informing OA that everything discussed would remain confidential. After 20 OA had been interviewed, we summarized and grouped the answers into five areas of impact, including financial, freedom, health, familial relationship, and relationship with others at the center.

Open-ended questions relating to the aforementioned five aspects of life were put to the remaining 180 study OA, and respondents were encouraged to elaborate by providing details that supported their responses. OA were asked to rate the severity of each factor as none, mild, moderate, or severe. OA were also asked to rate the severity of the overall psychological stress caused by the COVID-19 pandemic as none, mild, moderate, or severe. We also asked OA about other COVID-19-related issues, including which news channels they used to receive COVID-19 news; duration of receiving COVID-19 news per day; whether they felt they received a sufficient amount of COVID-19 news; frequency of using measures to protect against COVID-19 [wearing a mask when with other people, washing hands after touching things in public – which was rated as never (0% of the time), sometimes (<50% of the time), often (50–70% of the time), or always (70–100% of the time)]; whether they had at least one respiratory tract infection symptom (fever, cough, rhinorrhea, sore throat, dyspnea, and/or headache) within the previous two weeks; whether they had family members/relatives/close friends infected by COVID-19; and, self-perception of their risk of being infected by COVID-19 (rated as none, low, medium, or high).

2.4.2. Post-traumatic stress

The Thai version of the 17-item Post-traumatic Stress Disorder Checklist (PCL-17), civilian version (Chawanakrasaasin et al., 2011) was used to assess post-traumatic stress. The “stressful life experience” was identified as the “COVID-19 pandemic”. The questionnaire asks about

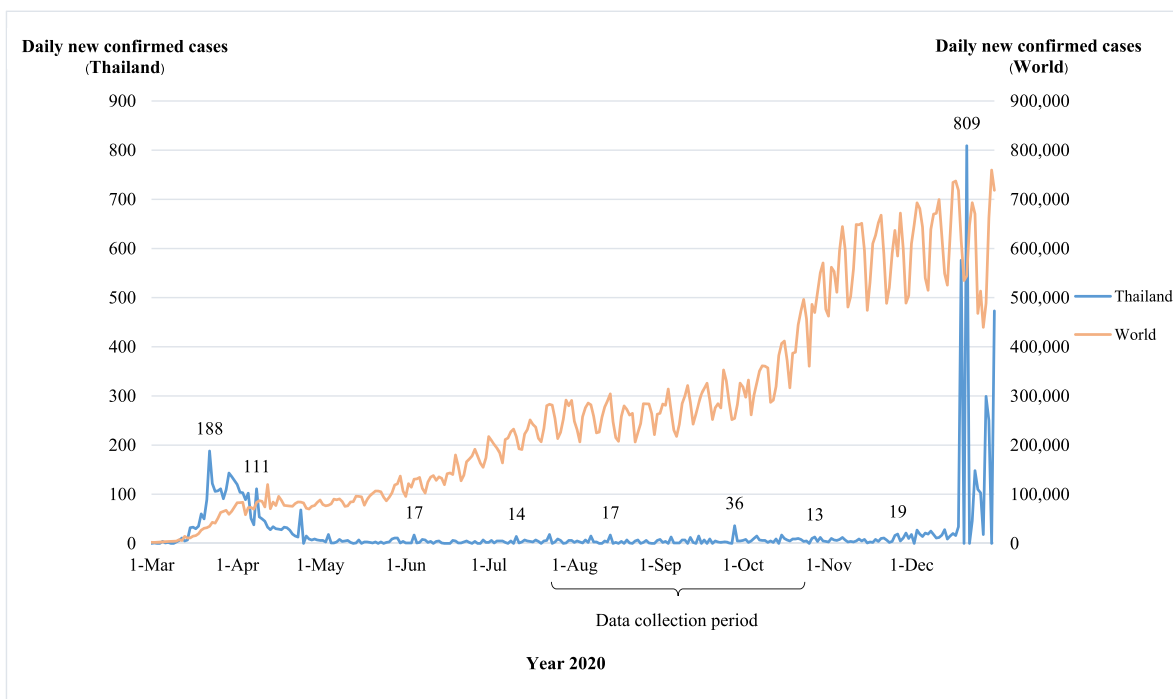


Fig. 1. COVID-19 pandemic situation during 2020.

(Data obtained from <http://www.OurWorldInData.org/coronavirus-data-explorer>)

Note. Daily new confirmed cases of COVID-19 in Thailand and globally in 2020.

post-traumatic stress disorder symptoms within the previous month. The troublesomeness of the symptom was rated from not at all (score 1) to extremely (score 5) (Weathers et al., 1993). In previous studies, the cutoff ranged from 30–60 (Terhakopian et al., 2008) depending on the characteristics of the study population and the aims of the study. The present study used a cutoff of ≥ 42 to determine the presence of PTSD. This cutoff value has 95% sensitivity and 88% specificity for detecting post-traumatic stress disorder in OA (Cook et al., 2003). The PCL-17 has excellent internal consistency (Cronbach's $\alpha=0.96$) (Chawanakrasasin et al., 2011).

2.4.3. Depression

The Thai version of the 9-item Patient Health Questionnaire (PHQ-9) was used to detect depression (Lotrakul et al., 2008). The questionnaire asks the frequency of depressive symptoms within the previous two weeks. Each item is scored from not at all (score 0) to nearly every day (score 3). The present study used a cutoff of ≥ 9 to identify depression. This cutoff has a 94% sensitivity and 82% specificity for detecting major depression in Thai OA (Lee S and Dajpratham P, 2017), and the test performance (based on area under the curve values) is comparable to that of the 15-item Geriatric Depression Scale (Phelan et al., 2010). The PHQ-9 showed good consistency with the 30-item Geriatric Depression Scale (Kappa=0.80, $p<0.001$) (Mingmai K, 2017). The PHQ-9 has good internal consistency (Cronbach's $\alpha=0.79$) (Lotrakul et al., 2008).

2.4.4. Anxiety

The Thai version of the 7-item Generalized Anxiety Disorder Scale (GAD-7) was used to detect anxiety in this study. The questionnaire asks the frequency of bothersome anxiety symptoms within the previous two weeks. Each item is scored from not at all (score 0) to nearly every day (score 3). The present study used a cutoff of ≥ 5 to identify anxiety. This cutoff value has 63% sensitivity and 90% specificity for detecting generalized anxiety disorder in OA population. The GAD-7 has good internal consistency (Cronbach's $\alpha=0.82$) (Wild et al., 2014).

2.4.5. Medical information

Nurses at the two LTC centers reviewed the patient files and collected clinical data. Medical conditions were presented as the total number of medical comorbidities and Charlson Comorbidity Index (CCI) (Charlson et al., 1987). CCI is the sum of morbidity-weighted medical conditions with each condition scored from 1–6 (e.g., 1 point for uncomplicated diabetes mellitus, 6 points for AIDS) plus age-weighted score (3 points for age 61–70, and 4 points for age 71–80). We collected psychiatric comorbidity, current medications, psychotropic medications (antidepressants, antipsychotics, mood stabilizers, and sedatives/hypnotics/antianxiety) (Hybels et al., 2001), and depressogenic medications (steroids, barbiturate, topiramate, vigabatrin, flunarizine, efavirenz, interferon-alpha, mefloquine) (Celano et al., 2011).

2.4.6. Other risk factors

We collected other possible risk factors for post-traumatic stress, depression, and anxiety among OA, including pain score at any site of the body within the previous two weeks, history of severe illness (e.g., intensive care unit admission, received chemotherapy, underwent major surgery), number of loved ones lost, exercise, alcohol use, smoking status, and body mass index (Vink et al., 2008; Weintraub and Ruskin, 1999).

2.5. Data analysis

Subject socio-demographic data were summarized using descriptive statistics (Table 1). Categorical data are shown as number and percentage, and continuous data are given as mean plus/minus standard deviation (SD) for normally distributed data, and as median and range [quartile 1, quartile 3] for non-normally distributed data. Shapiro-Wilk test (Shapiro and Wilk, 1965) was used to explore the distribution of continuous variables. OA were categorized into the three following groups (Table 2): post-traumatic stress group, depression group, and anxiety group. All univariate variables found to be significantly associated with post-traumatic stress, depression, or anxiety ($p<0.05$) were included in the binary logistic regression model. Binary logistic

Table 1
Sociodemographic data of older adults living in long-term care centers in Thailand.

Characteristics	Participants (N = 200)
Female gender, n (%)	133 (66.5%)
Age (years), mean±SD	76.4±8.2
Marital status, n (%)	
Single	102 (51.0%)
Widowed	75 (37.5%)
Divorced	14 (7.0%)
Married	9 (4.5%)
Highest education, n (%)	
No education	23 (11.5%)
Primary school	101 (50.5%)
Secondary school	57 (28.5%)
University	19 (9.5%)
Hometown – Bangkok metropolitan region, n (%)	139 (69.5%)
Religion – Buddhism, n (%)	194 (97.0%)
Type of stay in long-term care center, n (%)	
Common room (government-paid)	165 (82.5%)
Private room (self-paid)	35 (17.5%)
Length of stay (years), median [Q1, Q3]	4.8 [1.5, 9.4]
Number of news channels used to receive COVID-19 news, mean±SD	2.1±0.8
Receiving COVID-19 news via social media, n (%)	15 (7.5%)
Duration of receiving COVID-19 news (min/day), median [Q1, Q3]	20.0 [10.0, 30.0]
Self-perception of sufficiently receiving COVID-19 news, n (%)	176 (88.0%)
Frequency of using measures to protect against COVID-19, n (%)	
Never	4 (2.0%)
Sometimes	28 (14.0%)
Often	65 (32.5%)
Always	103 (51.5%)
Having respiratory tract infection symptoms, n (%)	16 (8.0%)
Reported having family members/relatives/close friends infected by COVID-19, n (%)	4 (2.0%)
Self-perception of COVID-19 infection risk, n (%)	
None	152 (76.0%)
Low	20 (10.0%)
Medium	27 (13.5%)
High	1 (0.5%)
Body mass index ≥25 kg/m ² , n (%)	49 (24.5%)
Smoking <1 time/month, n (%)	192 (96.0%)
Alcohol use <1 time/month, n (%)	198 (99.0%)
Exercise (min/day), median [Q1, Q3]	30.0 [15.0, 50.0]
Pain score within the previous two weeks, median [Q1, Q3]	0.0 [0.0, 3.0]
History of severe illness, n (%)	60 (30.0%)
Number of loved ones lost, median [Q1, Q3]	2.0 [2.0, 3.0]
Charlson Comorbidity Index score, mean±SD	4.2±0.9
Total number of medical comorbidities, mean±SD	2.1±1.4
Having psychiatric comorbidity, n (%)	31 (15.5%)
Total number of medications used, median [Q1, Q3]	4.5 [3.0, 6.0]
Psychotropic medication use, n (%)	38 (19.0%)
Depressogenic medication use, n (%)	1.0 (0.5%)

Abbreviations: SD, standard deviation; Q, quartile; COVID-19, Coronavirus disease

regression analyses (Table 3) used dummy-coding to define each dependent variable: post-traumatic stress (1 ‘post-traumatic stress’; 0 ‘without post-traumatic stress’), depression (1 ‘depression’; 0 ‘without depression’), and anxiety (1 ‘anxiety’; 0 ‘without anxiety’). The Hosmer and Lemeshow (H-L) statistic was applied to determine the goodness of fit. A *p*-value of 0.05 or higher from H-L test indicated a good fit between the model and the data. In multiple binary logistic regression, variables with a *p*-value less than 0.05 were considered to be factors independently associated with psychological disorders. SPSS Statistics version 22.00 (SPSS, Inc, Chicago, IL, USA) was used for all data analyses.

3. Results

3.1. Participant characteristics

The socio-demographic data of included OA are presented in Table 1. Most OA living in LTC centers were female (66.5%) with a mean age of 77, single or widowed (88.5%), had low educational level (62.0%), and had an average of two medical comorbidities. History of psychiatric comorbidities and psychotropic drug use was found in 15.5% and 19.0% of OA, respectively. Most OA (82.5%) had been staying in common rooms (government-paid, free of charge) for five years. Regarding COVID-19 issues, they received news on an average 20 mins/day from two news channels and 88.0% thought this was sufficient. Most The news channels used to receive COVID-19 news included television (82.0%), newspaper (51.5%), relatives/friends (35.0%), radio (28.0%), and social media (7.5%) (e.g., Facebook, LINE, and Twitter). Most OA (84.0%) complied with COVID-19 protection measures. Few OA reported respiratory tract symptoms (8.0%) or had relatives infected with COVID-19 (2.0%). Considering all the above, most OA (76.0%) perceived they were at no risk of being infected with the disease.

3.2. COVID-19 pandemic impact on life and psychological stress

The levels of impact of the COVID-19 pandemic on several areas of life and on psychological stress level are shown in Fig. 2, and the reasons are shown in Fig. 3. The most impacted area was finance (82.5% reported a moderate-severe impact) due to decreased financial support from outside the center. Next was limited freedom of living (76.5% reported moderate-severe impact) because OA could not go outside the center as desired. Some OA said they “could not join religious ceremonies” or “felt caged”. Thirdly, health and familial relationships were also impacted (about 70% reported moderate-severe impact) because OA had difficulty in seeing doctors, and relatives could not visit them, respectively. The least impacted area of life was relationships with others living in the center (60.5% reported moderate-severe impact) because OA felt distant from others and staff. Surprisingly, even though COVID-19 has had a significant impact on the lives of OA, most (70.0%) reported no or mild psychological stress.

3.3. Prevalence of post-traumatic stress, depression, or anxiety

Among the 200 OA enrolled in this study, 11 (5.5%) had post-traumatic stress, 14 (7.0%) had depression, and 24 (12.0%) had anxiety (Table 2).

3.4. Binary logistic regression analysis to identify risk factors independently associated with post-traumatic stress, depression, or anxiety

Multiple binary logistic regression analysis (Table 3) revealed higher psychological stress from COVID-19 (OR [95% CI] 13.77 [2.28-83.30]), having respiratory tract infection symptoms (12.70 [2.52-64.11]), receiving COVID-19 news via social media (10.24 [1.70-61.89]), and pain score (1.29 [1.04-1.60]) to be independently associated with post-traumatic stress. Factors independently associated with depression were higher psychological stress from COVID-19 (19.29 [2.85-130.47]), having respiratory tract infection symptoms (13.84 [2.15-89.10]), receiving COVID-19 news via social media (6.40 [1.01-40.62]), pain score (1.39 [1.13-1.72]), and having psychiatric comorbidity (6.28 [1.01-39.04]). Of interest, there was a trend toward statistical significance between self-perception of insufficiently receiving COVID-19 news and depression (*p*=0.094). Lastly, the factors independently associated with anxiety were higher psychological stress from COVID-19 (3.11 [1.14-8.48]), having respiratory tract infection symptoms (5.83 [1.67-20.35]), and pain score (1.20 [1.05-1.39]). Interestingly, there was a trend towards higher number of news channels used to receive COVID-19 news being significantly associated with anxiety (*p*=0.081).

Table 2
Sociodemographic and clinical characteristics compared between older adults with and without post-traumatic stress, depression, or anxiety.

Characteristics ^a	PCL-17 score					PHQ -9 score					GAD-7 score				
	Without post-traumatic stress (n=189)	With post-traumatic stress (n=11)	Difference between groups ^a (x ² , t, z)	p	Effect size ^b	Without depression (n=186)	With depression (n=14)	Difference between groups ^a (x ² , t, z)	p	Effect size ^b	Without anxiety (n=176)	With anxiety (n=24)	Difference between groups ^a (x ² , t, z)	p	Effect size ^b
Gender, n (%)			0.20	0.754	0.03			2.50	0.147	0.11			1.96	0.161	0.10
Male	64 (95.5%)	3 (4.5%)				65 (97.0%)	2 (3.0%)				62 (92.5%)	5 (7.5%)			
Female	125 (94.0%)	8 (6.0%)				121 (91.0%)	12 (9.0%)				114 (85.7%)	19 (14.3%)			
Age (years), mean±SD	76.3±8.2	76.6±9.2	-0.08	0.936	0.04	76.4±8.2	75.9±8.3	0.20	0.843	0.06	76.4±8.4	75.8±7.1	0.35	0.692	0.07
Marital status, n (%)			0.14	0.705	0.03			0.01	0.938	0.01			0.01	0.917	0.01
Single	97 (95.1%)	5 (4.9%)				95 (93.1%)	7 (6.9%)				90 (88.2%)	12 (11.8%)			
Widowed / divorced / married	92 (93.9%)	6 (6.1%)				91 (92.9%)	7 (7.1%)				86 (87.8%)	12 (12.2%)			
Highest education, n (%)			0.28	0.751	0.04			0.92	0.337	0.07			3.03	0.082	0.12
No education / primary school	118 (95.2%)	6 (4.8%)				117 (94.4%)	7 (5.6%)				113 (91.1%)	11 (8.9%)			
Secondary school / university	71 (93.4%)	5 (6.6%)				69 (90.8%)	7 (9.2%)				63 (82.9%)	13 (17.1%)			
Hometown, n (%)			1.23	0.316	0.08			0.19	0.764	0.03			0.02	0.880	0.01
Bangkok metropolitan region	133 (95.7%)	6 (4.3%)				130 (93.5%)	9 (6.5%)				122 (87.8%)	17 (12.2%)			
Other regions	56 (91.8%)	5 (8.2%)				56 (91.8%)	5 (8.2%)				54 (88.5%)	7 (11.5%)			
Religion, n (%)			0.36	1.000	0.04			0.89	0.357	0.07			2.67	0.153	0.12
Buddhism	183 (94.3%)	11 (5.7%)				181 (93.3%)	13 (6.7%)				172 (88.7%)	22 (11.3%)			
Christianity / Islam	6 (100.0%)	0 (0.0%)				5 (83.3%)	1 (16.7%)				4 (66.7%)	2 (33.3%)			
Type of stay, n (%)			0.77	0.411	0.06			0.16	0.715	0.03			4.74	0.043	0.15
Common room (government-paid)	157 (95.2%)	8 (4.8%)				154 (93.3%)	11 (6.7%)				149 (90.3%)	16 (9.7%)			
Private room (self-paid)	32 (91.4%)	3 (8.6%)				32 (91.4%)	3 (8.6%)				27 (77.1%)	8 (22.9%)			
Length of stay (years), median [Q1, Q3]	4.8 [1.5, 9.5]	8.4 [1.4, 9.0]	-0.67	0.503	0.10	4.5 [1.4, 9.1]	7.6 [2.1, 12.2]	-1.32	0.185	0.19	4.5 [1.4, 9.4]	6.2 [1.6, 9.9]	-0.76	0.449	0.11
Number of news channels used to receive COVID-19 news, mean±SD	2.0±0.8	2.4±0.8	-1.30	0.195	0.50	2.0±0.8	2.6±1.1	-2.16	0.048	0.73	2.0±0.8	2.5±1.1	-2.28	0.031	0.60
Receiving COVID-19 news via social media, n (%)			13.98	0.005	0.26			9.64	0.013	0.22			6.99	0.021	0.19
Yes	11 (73.3%)	4 (26.7%)				11 (73.3%)	4 (26.7%)				10 (66.7%)	5 (33.3%)			
No	178 (96.2%)	7 (3.8%)				175 (94.6%)	10 (5.4%)				166 (89.7%)	19 (10.3%)			
Duration of receiving COVID-19 news (min/day), median [Q1, Q3]	20.0 [8.8, 30.0]	20.0 [20.0, 40.0]	-0.56	0.573	0.08	20.0 [20.0, 30.0]	25.0 [13.4, 52.5]	-1.61	0.108	0.23	20.0 [6.0, 30.0]	30.0 [16.3, 57.5]	-2.91	0.004	0.42
Self-perception of sufficiently receiving COVID-19 news, n (%)			0.09	1.000	0.02			8.02	0.016	0.20			0.56	0.500	0.05

(continued on next page)

Table 2 (continued)

Characteristics ^a	PCL-17 score					PHQ -9 score					GAD-7 score				
	Without post-traumatic stress (n=189)	With post-traumatic stress (n=11)	Difference between groups ^b (x ² , t, z)	p	Effect size ^b	Without depression (n=186)	With depression (n=14)	Difference between groups ^b (x ² , t, z)	p	Effect size ^b	Without anxiety (n=176)	With anxiety (n=24)	Difference between groups ^b (x ² , t, z)	p	Effect size ^b
Yes	166 (94.3%)	10 (5.7%)				167 (94.9%)	9 (5.1%)				156 (88.6%)	20 (11.4%)			
No	23 (95.8%)	1 (4.2%)				19 (79.2%)	5 (20.8%)				20 (83.3%)	4 (16.7%)			
Frequency of using measures to protect against COVID-19, n (%)			0.04	0.690	0.01			0.33	0.473	0.04			0.47	0.552	0.05
Never / sometimes	30 (93.8%)	2 (6.3%)				29 (90.6%)	3 (9.4%)				27 (84.4%)	5 (15.6%)			
Often / always	159 (94.6%)	9 (5.4%)				157 (93.5%)	11 (6.5%)				149 (88.7%)	19 (11.3%)			
Having respiratory tract infection symptoms, n (%)			22.19	0.001	0.33			15.71	0.002	0.28			16.60	0.001	0.29
Yes	178 (96.7%)	6 (3.3%)				11 (68.8%)	5 (31.3%)				9 (56.3%)	7 (43.8%)			
No	11 (68.8%)	5 (31.3%)				175 (95.1%)	9 (4.9%)				167 (90.8%)	17 (9.2%)			
Family members / relatives / close friends infected by COVID-19, n (%)			0.24	1.000	0.03			0.31	1.000	0.04			0.56	1.000	0.05
Yes	4 (100.0%)	0 (0.0%)				4 (100.0%)	0 (0.0%)				4 (100.0%)	0 (0.0%)			
No	185 (94.4%)	11 (5.6%)				182 (92.9%)	14 (7.1%)				172 (87.8%)	24 (12.2%)			
Self-perception of COVID-19 infection risk, n (%)			0.07	0.727	0.02			0.17	0.746	0.03			0.40	0.528	0.05
None	144 (94.7%)	8 (5.3%)				142 (93.4%)	10 (6.6%)				135 (88.8%)	17 (11.2%)			
Low / medium / high	45 (93.8%)	3 (6.3%)				44 (91.7%)	4 (8.3%)				41 (85.4%)	7 (14.6%)			
Impact of COVID-19 on financial status, n (%)			0.42	1.000	0.05			2.74	0.130	0.12			1.25	0.376	0.08
None / mild	31 (96.9%)	1 (3.1%)				32 (100.0%)	0 (0.0%)				30 (93.8%)	2 (6.3%)			
Moderate / severe	141 (94.0%)	9 (6.0%)				138 (92.0%)	12 (8.0%)				130 (86.7%)	20 (13.3%)			
Impact of COVID-19 on freedom of living, n (%)			2.93	0.118	0.13			1.67	0.299	0.10			0.57	0.451	0.06
None / mild	43 (100.0%)	0 (0.0%)				42 (97.7%)	1 (2.3%)				39 (90.7%)	4 (9.3%)			
Moderate / severe	130 (93.5%)	9 (6.5%)				128 (92.1%)	11 (7.9%)				120 (86.3%)	19 (13.7%)			
Impact of COVID-19 on health, n (%)			0.04	1.000	0.01			0.46	0.532	0.05			0.15	0.703	0.03
None / mild	57 (95.0%)	3 (5.0%)				55 (91.7%)	5 (8.3%)				52 (86.7%)	8 (13.3%)			
Moderate / severe	116 (94.3%)	7 (5.7%)				116 (94.3%)	7 (5.7%)				109 (88.6%)	14 (11.4%)			
Impact of COVID-19 on familial relationships, n (%)			0.62	0.727	0.06			0.00	1.000	0.00			0.01	0.931	0.01
None / mild	57 (96.6%)	2 (3.4%)				55 (93.2%)	4 (6.8%)				52 (88.1%)	7 (11.9%)			
Moderate / severe	122 (93.8%)	8 (6.2%)				121 (93.1%)	9 (6.9%)								

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Table 2 (continued)

Characteristics ^a	PCL-17 score					PHQ -9 score					GAD-7 score				
	Without post-traumatic stress (n=189)	With post-traumatic stress (n=11)	Difference between groups ^b (χ^2, t, z)	<i>p</i>	Effect size ^b	Without depression (n=186)	With depression (n=14)	Difference between groups ^b (χ^2, t, z)	<i>p</i>	Effect size ^b	Without anxiety (n=176)	With anxiety (n=24)	Difference between groups ^b (χ^2, t, z)	<i>p</i>	Effect size ^b
Impact of COVID-19 on relationship with others at the center, n (%)			0.50	0.519	0.05			1.23	0.268	0.08	114 (87.7%)	16 (12.3%)	1.18	0.277	0.08
None / mild	69 (93.2%)	5 (6.8%)				67 (90.5%)	7 (9.5%)				63 (85.1%)	11 (14.9%)			
Moderate / severe	109 (95.6%)	5 (4.4%)				108 (94.7%)	6 (5.3%)				103 (90.4%)	11 (9.6%)			
Impact of COVID-19 on psychological stress, n (%)			10.12	0.003	0.23			12.30	0.001	0.25			7.59	0.006	0.20
None / mild	137 (97.9%)	3 (2.1%)				136 (97.1%)	4 (2.9%)				129 (92.1%)	11 (7.9%)			
Moderate / severe	52 (86.7%)	8 (13.3%)				50 (83.3%)	10 (16.7%)				47 (78.3%)	13 (21.7%)			
Body mass index, n (%)			0.89	0.469	0.07			0.14	0.749	0.03			0.32	0.571	0.04
<25 kg/m ²	144 (95.4%)	7 (4.6%)				141 (93.4%)	10 (6.6%)				134 (88.7%)	17 (11.3%)			
≥25 kg/m ²	45 (91.8%)	4 (8.2%)				45 (91.8%)	4 (8.2%)				42 (85.7%)	7 (14.3%)			
Smoking status, n (%)			0.49	1.000	0.05			0.63	1.000	0.06			1.14	0.599	0.08
<1 time/month	181 (94.3%)	11 (5.7%)				178 (92.7%)	14 (7.3%)				168 (87.5%)	24 (12.5%)			
≥1 time/month	8 (100.0%)	0 (0.0%)				8 (100.0%)	0 (0.0%)				8 (100.0%)	0 (0.0%)			
Alcohol use, n (%)			0.12	1.000	0.02			0.15	1.000	0.03			0.28	1.000	0.04
<1 time/month	187 (94.4%)	11 (5.6%)				184 (92.9%)	14 (7.1%)				174 (87.9%)	24 (12.1%)			
≥1 time/month	2 (100.0%)	0 (0.0%)				2 (100.0%)	0 (0.0%)				2 (100.0%)	0 (0.0%)			
Exercise (min/day), median [Q1, Q3]	30.0 [15.0, 50.0]	30.0 [15.0, 45.0]	-0.21	0.835	0.04	30.0 [15.0, 50.0]	30.0 [15.0, 52.5]	-0.05	0.959	0.01	30.0 [15.0, 50.0]	30.0 [16.3, 56.3]	-0.49	0.625	0.09
Pain score within the previous two weeks, median [Q1, Q3]	0.0 [0.0, 3.0]	5.0 [0.0, 7.0]	-3.26	0.001	0.40	0.0 [0.0, 2.3]	5.0 [2.3, 10.0]	-4.26	<0.001	0.53	0.0 [0.0, 3.0]	2.0 [0.0, 7.0]	-2.54	0.011	0.31
History of severe illness, n (%)			3.34	0.090	0.13			0.23	0.763	0.03			0.73	0.393	0.06
Yes	54 (90.0%)	6 (10.0%)				55 (91.7%)	5 (8.3%)				51 (85.0%)	9 (15.0%)			
No	135 (96.4%)	5 (3.6%)				131 (93.6%)	9 (6.4%)				125 (89.3%)	15 (10.7%)			
Number of loved ones lost, median [Q1, Q3]	2.0 [2.0, 3.0]	3.0 [2.0, 4.0]	-1.93	0.054	0.27	2.0 [2.0, 3.0]	2.5 [2.0, 2.5]	-1.34	0.182	0.19	2.0 [2.0, 3.0]	2.0 [2.0, 3.0]	-1.29	0.198	0.18
Charlson Comorbidity Index score, mean±SD	4.2±0.8	4.4±1.1	-0.52	0.607	0.25	4.2±0.8	4.2±1.1	0.09	0.925	0.03	4.2±0.8	4.5±1.1	-1.29	0.208	0.36
Total number of medical comorbidities, mean±SD	2.1±1.4	2.2±1.5	-0.30	0.767	0.07	2.0±1.3	2.3±2.0	-0.45	0.659	0.17	2.0±1.3	2.4±1.7	-0.98	0.335	0.30

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Table 2 (continued)

Characteristics ^a	PCL-17 score					PHQ -9 score					GAD-7 score				
	Without post-traumatic stress (n=189)	With post-traumatic stress (n=11)	Difference between groups ^a (χ^2 , t, z)	p	Effect size ^b	Without depression (n=186)	With depression (n=14)	Difference between groups ^a (χ^2 , t, z)	p	Effect size ^b	Without anxiety (n=176)	With anxiety (n=24)	Difference between groups ^a (χ^2 , t, z)	p	Effect size ^b
Having psychiatric comorbidity, n (%)			3.87	0.071	0.14			4.70	0.046	0.15			1.88	0.224	0.10
Yes	27 (87.1%)	4 (12.9%)				26 (83.9%)	5 (16.1%)				25 (80.6%)	6 (19.4%)			
No	162 (95.9%)	7 (4.1%)				160 (94.7%)	9 (5.3%)				151 (89.3%)	18 (10.7%)			
Total number of medications used, median [Q1, Q3]	4.0 [3.0, 6.0]	5.0 [2.0, 6.0]	-0.51	0.608	0.08	4.0 [3.0, 6.0]	5.0 [2.0, 6.3]	-0.25	0.804	0.04	4.0 [3.0, 6.0]	6.0 [2.0, 7.0]	-1.08	0.283	0.16
Psychotropic medication use, n (%)			0.74	0.694	0.06			0.06	0.732	0.02			0.06	0.784	0.02
Yes	37 (97.4%)	1 (2.6%)				35 (92.1%)	3 (7.9%)				33 (86.8%)	5 (13.2%)			
No	152 (93.8%)	10 (6.2%)				151 (93.2%)	11 (6.8%)				143 (88.3%)	19 (11.7%)			

A p -value < 0.05 indicates statistical significance.

^a Categorical variables were expressed as n (%) and analyzed by χ^2 (chi-square test); continuous variables with normal variances were expressed as mean \pm SD and analyzed by t (independent t-test); continuous variables with non-normal variances were expressed by median [Q1, Q3] and analyzed by z (Mann-Whitney U test).

^b Effect size measures were reported with Phi for categorical variables, and Cohen's d for continuous variables.

Abbreviations: PCL-17, Post-traumatic Stress Disorder Checklist – 17 items; PHQ-9, Patient Health Questionnaire – 9 items; GAD-7, Generalized Anxiety Disorder Scale – 7 items; SD, standard deviation; Q, quartile; COVID-19, Coronavirus disease

Table 3
Binary logistic regression analysis to identify factors independently associated with post-traumatic stress, depression, or anxiety.

Post-traumatic stress-associated factors	B (SE)	OR (95% CI)	p	Depression-associated factors	B (SE)	OR (95% CI)	p	Anxiety-associated factors	B (SE)	OR (95% CI)	p
Higher psychological stress from COVID-19 (ref: no/mild impact)	2.62 (0.92)	13.77 (2.28-83.30)	0.004	Higher psychological stress from COVID-19 (ref: no/mild impact)	2.96 (0.98)	19.29 (2.85-130.47)	0.002	Higher psychological stress from COVID-19 (ref: no/mild impact)	1.13 (0.51)	3.11 (1.14-8.48)	0.027
Having respiratory tract infection symptoms	2.54 (0.83)	12.70 (2.52-64.11)	0.002	Having respiratory tract infection symptoms	2.63 (0.95)	13.84 (2.15-89.10)	0.006	Having respiratory tract infection symptoms	1.76 (0.64)	5.83 (1.67-20.35)	0.006
Receiving COVID-19 news via social media	2.33 (0.92)	10.24 (1.70-61.89)	0.011	Receiving COVID-19 news via social media	1.86 (0.94)	6.40 (1.01-40.62)	0.049	Receiving COVID-19 news via social media	0.75 (0.79)	2.11 (0.45-9.83)	0.341
Pain score within the previous two weeks	0.25 (0.11)	1.29 (1.04-1.60)	0.023	Pain score within the previous two weeks	0.33 (0.11)	1.39 (1.13-1.72)	0.002	Pain score within the previous two weeks	0.19 (0.07)	1.20 (1.05-1.39)	0.010
				Number of news channels used to receive COVID-19 news	0.44 (0.47)	1.55 (0.62-3.86)	0.346	Number of news channels used to receive COVID-19 news	0.52 (0.30)	1.68 (0.94-3.01)	0.081
				Having psychiatric comorbidity	1.84 (0.93)	6.28 (1.01-39.04)	0.049	Duration of receiving COVID-19 news (min/day)	0.01 (0.01)	1.01 (1.00-1.03)	0.113
				Self-perception of insufficiently receiving COVID-19 news	1.51 (0.90)	4.52 (0.77-26.43)	0.094	Type of stay: private room (ref: common room)	-0.03 (0.69)	0.97 (0.25-3.73)	0.967

A p-value<0.05 indicates statistical significance.

Post-traumatic stress: Hosmer-Lemeshow $X^2=1.93$, $df=4$, $p=0.75$, Nagelkerke $R^2=0.46$.

Depression: Hosmer-Lemeshow $X^2=2.29$, $df=7$, $p=0.94$, Nagelkerke $R^2=0.56$.

Anxiety: Hosmer-Lemeshow $X^2=7.24$, $df=7$, $p=0.51$, Nagelkerke $R^2=0.31$.

Abbreviations: B, beta, SE, standard error; OR, odds ratio; CI, confidence interval; COVID-19, Coronavirus disease.

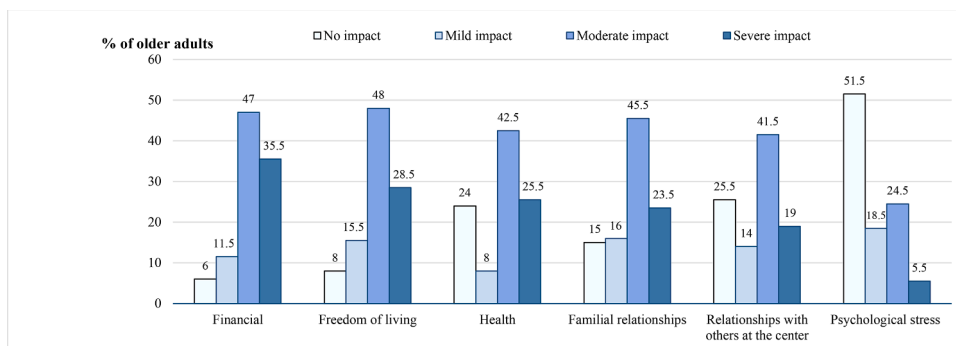


Fig. 2. Life and psychological impact level .

Note. Level of impact of COVID-19 on different aspects of life and on psychological stress level among older adults living in long-term care centers in Thailand.

The model for post-traumatic stress, depression, and anxiety had Nagelkerke $R^2=0.46$, 0.56 , and 0.31 , respectively.

4. Discussion

To our knowledge, this is the first study to employ the use of a semi-structured interview to evaluate the impact of COVID-19 among OA living in LTC centers.

4.1. Impact of COVID-19 on life and psychological stress

Finance was the aspect of life most impacted during the COVID-19 pandemic with 82.5% of OA reporting moderate or severe impact. The main reason was reported to be decreased financial support from outside the center. They were also financially impacted by a decrease in their own personal savings or a decrease in family savings. The income of most OA at government LTC centers in Thailand was reported to be derived from donations from outside LTC centers (Tokun et al., 2020). Before the pandemic, a significant proportion of financial revenue was

derived from outside supporters (e.g., organized activities or donations to LTC centers). During the pandemic, however, monetary support from outside decreased because LTC centers did not allow outsiders into the center in order to minimize the risk of infection among OA LTC center residents.

Freedom of living was moderately to severely adversely impacted for 76.5% of OA in our study, mostly because OA were prevented from freely going in and out of the LTC center as they were used to doing prior to the pandemic. However, unlike the findings of a study that was conducted during the COVID-19 pandemic in general population that found that autonomy satisfaction mediated positive and negative emotions (Šakan et al., 2020), the present study did not find association between limited freedom and depression or anxiety. Another study reported that OA had less to worry about finances and work, so lockdown seemed to have less adverse effect on OA compared to their younger adult counterparts (Pieh et al., 2020).

The present study found the degree of health impact to be moderate to severe for 68.0% of OA, mainly due to difficulty seeing their physicians. One-third of OA also said that their medication was insufficient.

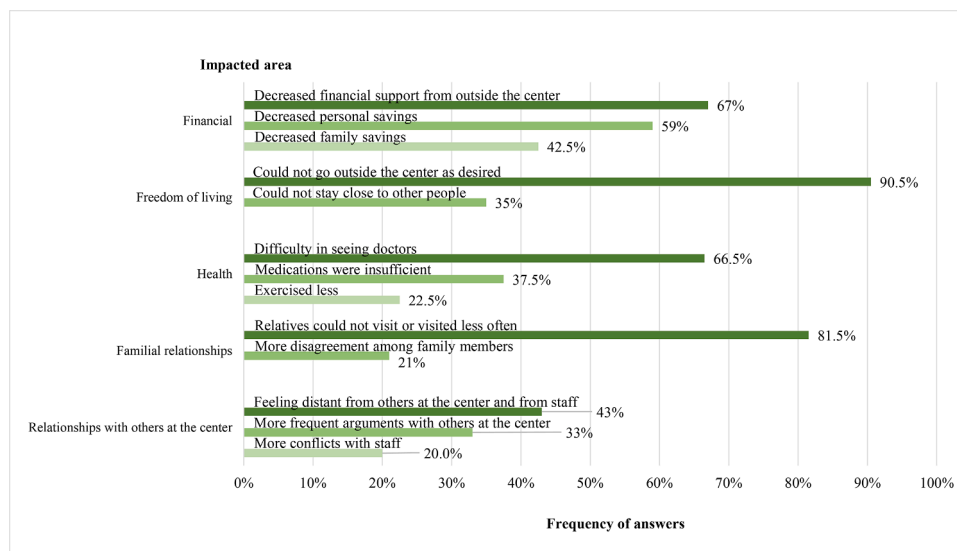


Fig. 3. How COVID-19 impacted life.

Note. Responses relate to how the COVID-19 pandemic affected the lives of older adults living in long-term care centers in Thailand

This highlights a problem that can occur in countries that have not yet adopted telemedicine as a component of their healthcare system. Furthermore, some OA reported not being familiar with online communication. The findings of this study support the previously reported finding that healthcare access is a problem among OA during pandemic time (Yang et al., 2020).

Our results also showed that familial relationships suffered moderately to severely in 69.0% of OA, mostly because their relatives could not visit them or because they visited them less often. Of interest, one-fifth of OA reported more disagreement among family members. Concerning the relationship between OA and other OA living at the LTC center, 60.5% of OA reported moderate to severe adverse impact, with most reporting a feeling of being distant from their LTC center counterparts. One-third and one-fifth of OA said that they had more frequent arguments with others living at the LTC center, and LTC center staff, respectively. Social distancing leads to less regular contact with others (Flint et al., 2020), and also reduces the quality of communication (e.g., emotional sharing and clear information) (Prime, 2020). Familial relationship and relationship with others living at the LTC center were the two areas least impacted by COVID-19, and neither of those parameters was found to be significantly associated with post-traumatic stress, depression, or anxiety. Our study's interview data showed that even though OA in LTC centers remained physically distant, they still saw each other's faces and lived together, which may have protected them from developing intense feelings of loneliness and isolation.

Despite the reported moderate to high impact that COVID-19 exerted on several aspects of the lives of OA in this study, most OA (70.0%) said that COVID-19 had no impact or mild impact on their psychological stress level. Similarly, previous studies found that OA had lower psychological stress and morbidity during disease outbreaks than younger adults (Bruine de Bruin, 2021; Pieh et al., 2020; Shaikh et al., 2004; Sim et al., 2010). Moreover, at the same exposure to stressors, OA were more likely to regulate emotion and experienced less stress than younger adults (Birditt et al., 2005).

4.2. Prevalence of post-traumatic stress, depression, and anxiety

At a PCL-17 score of ≥ 42 , 5.5% of OA in our study had post-traumatic stress. This prevalence rate is higher than past-year prevalence of 2.6% in community older adults during non-pandemic time as measured by structured interview based on DSM-IV criteria (Reynolds et al., 2016). These differences in prevalence may be due to differences

in participant characteristics and/or measurements, or may be a consequence of the COVID-19 pandemic.

At a PHQ-9 score of ≥ 9 , 7% of OA in our study had depression. This prevalence rate is not higher than the prevalence of depression during non-pandemic time. Previous studies in government LTC centers in Thailand during non-pandemic time found a prevalence of severe/major depression of 6.3–23.5% (Karuncharernpanit et al., 2016; Somporn et al., 2012; Tosangworn et al., 2018; Wongpakaran and Wongpakaran, 2012). Differences in the cutoff scores used, and none of those studies excluded OA with cognitive impairment may explain the reported differences in prevalence. Our study's depression prevalence rate is lower than that from a general population survey in Sweden during the COVID-19 pandemic that used a PHQ-9 score cutoff of ≥ 10 that found a 30% prevalence of depression (McCracken et al., 2020). We think that this difference between our study and the Sweden study is likely due to the more active COVID-19 situation in Sweden, but the effect of age cannot be ruled out.

At a GAD-7 score of ≥ 5 , 12% of OA in our study had anxiety. This prevalence rate is just above the prevalence range (1–11%) reported in OA living at LTC facilities during non-pandemic time, but that study used different measurement instruments (Creighton et al., 2016). Using the same cutoff value that we used in this study, 71.3% of people in Portugal and Brazil (Passos et al., 2020), and 51% of people in Sweden had anxiety (McCracken et al., 2020). Variation in the prevalence of COVID-19 cases likely explains the observed difference in anxiety among countries.

4.3. Risk factors for post-traumatic stress, depression, and anxiety

We did not find significant association between the severity of the impact of COVID-19 for any evaluated aspect of life and post-traumatic stress, depression, or anxiety among OA living in LTC centers in Thailand. However and taken together, overall stress caused by COVID-19 was found to be independently associated with all three psychological disorders. Consistent with our findings, nationwide lockdown and COVID-19 consequences increased distress, depression, and anxiety among populations (Chew et al., 2020; Dubey et al., 2020).

Having respiratory tract infection symptoms was associated with post-traumatic stress, depression, and anxiety among OA living at LTC centers in our study. Studies among Chinese and Turkish general population during the COVID-19 outbreak found a similar association (Cansel et al., 2021; Wang et al., 2020). People with anxiety trait may

self-interpret their physical symptoms during the COVID-19 pandemic, and this could increase anxiety (Asmundson and Taylor, 2020).

Among OA living in LTC centers, we found receiving COVID-19 news via social media to be significantly associated with post-traumatic stress and depression, and there was a trend toward association between higher number of news channels receiving COVID-19 news and anxiety. The WHO reported that an overabundance of incorrect information posted on news platforms (“Infodemics”) could harm mental health (WHO et al., 2020). Studies during the COVID-19 pandemic showed that social media was misused for spreading fake news (Kadam and Atre, 2020), and the use of social media was associated with post-traumatic stress and depression (Fekih-Romdhane et al., 2020; Zhao and Zhou, 2020). Perceived vulnerability to COVID-19 mediates receiving news and depression (Olagoke et al., 2020), and depressed people might have selective attention for COVID-19’s threatening information, which maintained their depressive symptoms, and vice versa (Beevers et al., 2015). Of interest, this study found a trend toward association between self-perception of insufficiently receiving news and depression. This is consistent with the findings of a study in Chinese adolescents that found self-perception of sufficient COVID-19 knowledge, (e.g., familiar with information about prevention and control of COVID-19) to be a protective factor against depression (Zhou et al., 2020). Therefore, receiving news has inherent advantages and disadvantages. Self-perception of sufficiently receiving information may reduce depression, but being overwhelmed by “Infodemics” from social media may cause psychological problems. Therefore, we recommend that OA be advised to receive their news from reliable new sources.

Consistent with a study from Turkey (Cansel et al., 2021), we found having psychiatric comorbidity to be independently associated with depression. However, whether the COVID-19 pandemic triggered exacerbation of the preexisting psychiatric condition, or whether the psychiatric morbidity was active regardless of COVID-19 would need to be determined. Contrary to previous studies in general population (Passos et al., 2020; Wang et al., 2021), we did not find association between female OA and anxiety during the COVID-19 pandemic. More study among OA may be needed to explain this conflicting result. As known from previous systematic review and meta-analysis, higher pain score was associated with post-traumatic stress, depression, and anxiety (Afari et al., 2014; Fishbain et al., 2017).

4.4. Strengths and limitations

The present study has several strengths. First, the face-to-face interview approach enrolled more participants and elicited more complete data than an online questionnaire study design would have been able to achieve due to the lack of familiarity with electronics that is reported by many OA. Second, this study evaluated the socio-demographic effects of the COVID-19 pandemic as opposed to the morbidity and mortality effects of the pandemic. Third and last, we excluded OA with dementia due to related psychological disturbances (Radue et al., 2019) that could lead to a false positive finding of psychological disorders not related to the COVID-19 pandemic.

Our study also has some limitations. First, we did not use a specific geriatric scale to measure depression or anxiety among OA. These specific instruments can take a long time to complete, and we thought that this added to the other assessments and the interview would be too much for OA to bear. Second, data collection was performed in the post-outbreak period, so it is possible that OA responded to questionnaire and interview questions differently than they would have during the outbreak. Third, our study was conducted in two LTC centers in Thailand’s urban area. There was a limitation in the generalizability of the results for those in the rural area and in other countries with different health care systems. Fourth, according to LTC center policy, only LTC center social workers could administer the interview. OA may not feel comfortable divulging information to people that work where OA live. However, it was reported that social workers are not in normal contact

with OA, and social worker interviewers were trained to interview with nonjudgmental acceptance of all answers. Fifth, the prevalence of post-traumatic stress, depression, and anxiety is very low and performing a logistic regression analysis with this sample could be not representative. Sixth, the cross-sectional nature of the study does not establish the direction of causality as well as the timing and sequence of symptom onset during the analyzed period. Seventh and last, 62% of the sample had a low educational level and may not understand the item questionnaire. However, if OA had any doubts while answering, they could ask the interviewers who helped us collect the questionnaires.

5. Conclusion

Most OA living in LTC centers in Thailand experienced moderate to severe impact of the COVID-19 pandemic, and the areas most affected was financial. Interestingly, despite the reported high impact of the pandemic on different aspects of daily life, OA reported a relatively low level of psychological stress from COVID-19. Psychological stress from COVID-19, having respiratory tract infection symptoms, and receiving COVID-19 news via social media were risk factors for psychological disorders.

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CRedit authorship contribution statement

Maytinee Srifuengfung: Conceptualization, Data curation, Funding acquisition, Investigation, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing. **Kitikan Thana-udom:** Resources, Visualization, Investigation. **Woraphat Ratta-apha:** Conceptualization, Supervision. **Sudsabuy Chulakadabba:** Conceptualization, Supervision. **Naratip Sanguanpanich:** Data curation, Formal analysis, Investigation, Software. **Natee Viravan:** Conceptualization, Data curation, Funding acquisition, Investigation, Validation, Visualization, Writing – review & editing.

Declaration of Competing Interests

All authors declare no personal or professional conflicts of interest relating to any aspect of this study.

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