

# Loneliness and suicide risks in the general population in Taiwan

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## Research Article

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# Abstract

**Purpose** Loneliness is a critical issue afflicting the general population. Current evidence from nationwide surveys of loneliness is scarce. This study aimed to investigate the prevalence and risk factors of loneliness in representative surveys across Taiwan.

**Methods** Four annual telephone interview surveys were performed by the Taiwan Suicide Prevention Center in 2015, 2016, 2017, and 2020. Each yearly sample was randomly selected by stratifying the general public over 15 years old in different geographical areas. Participants completed a single-item loneliness screening question and a set of instruments assessing socio-demographic and psychological distress (5-item Brief Symptom Rating Scale), as well as suicide risk (9-item Concise Mental Health Checklist). All the survey data were integrated for analysis.

**Results** In total, 8460 participants (49.4% males) were recruited. Gender, age, job, education, and marital status in the four-year distributions were similar. The average prevalence of loneliness was 12.6%. Loneliness was associated with psychological distress (e.g., insomnia and depression) and suicide risks, being positively correlated with two suicide risk factors, “alcohol/drug abuse” and “no one trustworthy to talk to”, and negatively correlated with self-rated health variables. The odds of loneliness for lifetime suicidal ideation, lifetime suicide attempt, and future suicide intent were 4.9, 5.1, and 9.2, respectively.

**Conclusion** The study highlighted key suicide-related variables of loneliness, particularly the role of future suicide intention, substance use, perceived health, and lack of trusting relationships. Promoting self-perceived health conditions and understanding suicidal ideation over lack of trusting relationships among the general public may reduce feelings of loneliness.

## Introduction

Loneliness is a subjective experience closely linked with the quality of social connections [1]. Given that support can minimize lonely feelings, the sense of loneliness varies by subjects. One may feel socially isolated but not lonely; others may objectively connect with people but still remain lonely [2]. The impact of loneliness on psychological well-being and physical health is a topic of growing interest. According to the World Health Organization (WHO) [3], up to one-third of older people feel lonely, with loneliness exerting a serious impact on their physical and mental health [4], quality of life [5], and longevity [6]. According to the Ministry of the Interior’s 2021 demographic data, Taiwan is an aged society comprising 23 million people, of which 16.85% are older adults aged over 65. However, feelings of loneliness exist in all age groups. They are related to the discrepancy between one’s desired and actual level of social relationships. In particular, chronic or severe loneliness can both threaten health and well-being [7, 8].

It is noteworthy that loneliness is distributed as a U-shape with different age ranges represented on the X-axis, with the young (15–24 year-old) and the oldest old ( $\geq 80$  year-old elderly) being the groups most vulnerable to experiencing loneliness [9]. The prevalence of loneliness among youth above 15 years of age was found to be around 15% [10, 11]. On the other hand, elderly people were found to be lonelier due to widowhood, disability, and cognitive impairment [5, 12]. In the general population, previous studies have shown that the loneliness prevalence rate was around 10.5% [9, 13]. Feelings of loneliness were relatively stronger among women, people without partners, and those living alone. Moreover, loneliness was a significant health problem for a sizeable part of population with increased risks in terms of psychological distress (e.g., depression, anxiety), suicidal ideation [14], and poor health behaviors and health care utilization [9, 13]. Loneliness was an important determinant of poor mental health among working-age adults with disability in the United Kingdom [15]. However, little is known regarding the epidemiology of key variables of loneliness in the general population.

Deaths by suicide occur across all ages. The standardized suicide death rate in Taiwan was 11.8/100,000 people in 2020 with the highest rate among those aged 65 and above (26.2/100,000), but the suicide rate among the young population aged 15–24 was 8.8/100,000 people in the same year [16]. Of those who had suicidal ideation, approximately 30% made a suicide plan and 24% made a suicide attempt [17]. A prior suicide attempt is the single most important risk factor for deaths by suicide in the general population [18]. Loneliness has been reported as a risk factor for suicidal ideation and behaviors [19]. The relationship between loneliness, depression, and suicidal behavior has also been identified in the literature. Loneliness and depression are debilitating psychological conditions characterized by a profound sense of isolation and emptiness. When a lonely, depressed person lacks contact with family or significant others to talk to, suicidal ideation or attempts may increase [20].

Loneliness occurs at different ages and can lead to mental and physical health problems, such as depression, anxiety, irritability, inferiority, insomnia, and even the risk of premature death. However, while most research attention has focused on chronic or mental illness among adolescents or elderly people, few studies have investigated the prevalence of loneliness in the general population. Therefore, this study aims to provide a better understanding of the magnitude of loneliness in population-based surveys with a particular focus on its association with suicide risks. We examined participants who responded to representative surveys on loneliness conducted by the Taiwan Suicide Prevention Center (TSPC). The objectives were to determine: (1) the overall prevalence and distribution of loneliness in the general population and (2) the correlation between loneliness and suicide-related risk factors.

## **Materials And Methods**

### **Recruitment and data collection**

We carried out cross-sectional surveys across the four years of 2015, 2016, 2017 and 2020. We employed the stratified proportional randomization method to recruit a representative sample of the general public using the Computer Assisted Telephone Interview (CATI) System for sampling according to the distribution of population size in different geographic areas of Taiwan [21]. The inclusion criteria were being at least 15 years of age and having provided informed consent prior to the interview. Participants under 18 years-old were recruited under agreement by their guardian. In total, 16,168 participants were contacted and the response rate was 52.4%. Individual landline telephone interviews were conducted for each participant at their home by a trained interviewer, and they completed all the surveys. In total, 8460 individuals agreed to participate (sampling error  $\pm$  2.10%, 95% CI). The surveys were approved by the institutional ethics review board of the National Taiwan University Hospital (202103109W).

## **Measures**

### **Sociodemographic characteristics**

The sociodemographic variables included gender, age, education, employment, and marital status. Age was divided into the three groups (15-24-year-old adolescents and emerging adults, 25-64-year-old adults, and  $\geq$ 65 year-old elderly people). Level of education was classified as low (below senior high school education), medium (associate/bachelor's degree), and high (graduate degree and higher qualification). Jobs were divided into four categories: employed, student, housewife/retired, and unemployed. Finally, the three different marital statuses were married, single, or divorced/windowed/separated.

### **Self-rated health (SRH) measures**

The measurements included three items (i.e., health-related self-efficacy, self-rated mental health, and self-rated physical health) to assess the participants' perceived health conditions. In particular, the association of SRH with health indicators reflects an individual's active assessment of health status and practices (dynamic) or his/her self-concept of health (static). Self-efficacy refers to the self-confidence to control one's own health status? The scores range from 0 to 100 [21]. The self-perceived health variable includes questions seeking to determine how participants feel about their "physical health" and "mental health." All responses are rated on a 5-point scale, with 1 = very poor, 2 = slightly poor, 3 = average, 4 = good, and 5 = very good [22, 23]. Consequently, SRH is increasingly used as a mental health indicator and a means to assess risk for adverse mental health outcomes [23, 24].

## Loneliness

A single-item question was used to assess the subjective perception of loneliness: In order to draw a response about personal feelings of loneliness, this question was presented to participants: "Do you often feel lonely or isolated?" Loneliness was defined as a dichotomized variable, that is, "lonely" and "non-lonely" as suggested in another study [25]. In examining the validity of this assessment, loneliness was significantly associated with psychological distress ( $r = 0.41$ ) and suicide risk ( $r = 0.44$ ) in this study. The correlation between single-item and three-item loneliness assessments [26] was tested by comparing the distribution across genders. Both scales had nearly identical distributions of loneliness across variables, including age (15–24/25–64/ $\geq 65$ ), gender (male/female), education (less than high school/associate/bachelor's/graduate degree), and occupation (employed/student/housewife/retired/not employed). The correlation between the two scales was acceptable ( $r = 0.565$ ), indicating the feasibility of using the single-item assessment in large-scale telephone survey.

## Suicide risk

The 9-item Concise Mental Health Checklist (CMHC-9) was used to assess the overall suicide risk level considering past, present (prior 7 days), and future suicidality [27]. The scale has two main factors with psychopathology (5 items on insomnia, anxiety, irritability, depression, and inferiority) and suicide risk (4 items on previous suicide attempts, stated future suicidal intentions, excessive use of ethanol or drugs to impair life, and lack of social support under emotional distress). For all the nine items, participants had to convey their response by ticking the preferred option using a dichotomous checklist (yes/no). Each item was rated one point for "yes", with a total score of 9 points. Over 4 points or higher of the score indicates a higher level of suicide risks or overall suicidality considering different time points [28]. In this study, the internal consistency was satisfactory (Cronbach's alpha = .66).

## Psychological distress

The five-item Brief Symptom Rating Scale (BSRS-5) was used to assess the level of psychological distress in the past week [29]. It is rated on a 5-point Likert scale (0 to 4) and contains the following items: (1) difficulty sleeping (insomnia); (2) feeling tense or nervous (anxiety); (3) feeling easily irritated (irritability); (4) feeling depressed (depression); and (5) feeling inferior to others (inferiority) [27]. In this study, the internal consistency was satisfactory (Cronbach's alpha = .79).

## Statistical analysis

The data were analyzed after weighting for geographic distribution, age, and gender using a ranking method to ensure that the sample was representative of the general population. Missing values, outliers, and normality were checked prior to analysis to avoid violating statistical principles. In addition to descriptive statistics of demographic variables, the following tests were used. Associations between independent variables and loneliness were assessed using chi-square tests and by calculating ORs with 95% CIs. To identify poor SRH (mental and physical), the SRH scales were split into tertiles, with the participants in the lower tertile being categorized as having poor SRH. In addition, the self-efficacy scale was also split into two categories, with the cut-off point at 78 degrees; a lower value reflected low self-efficacy and a higher value reflected good self-efficacy. Inferential statistics were applied to investigate the independent effects of

demographics (e.g., age, gender, education, occupation, and marital status), psychological distress, health-related variables, and overall suicide risks on loneliness. Lastly, the Pearson correlation coefficient was used to measure the correlation between two sets of variables. All statistical analyses were performed using SPSS v25 (SPSS, Chicago, IL, USA), and the significance level was set at  $p < 0.05$ .

## Results

Data from a sample size of 8,460 participants were collected across four years between 2015 and 2020. Table 1 illustrates the demographic profile of the sample. Females represent 50.6% of the sample. The majority (69.7%) of the participants were between 25 and 64 years of age, with one-third (33.4%) being single. There was a higher proportion of employed (57.3%), followed by retired (or not employed) (17.4%) participants. Their health-related variables and loneliness are presented in Table 2. Average/fair self-rated mental health was reported among 14.8% of participants, while a quarter (25.6%) of them reported average/fair self-rated physical health. Nearly one-third (32.7%) also reported below average self-efficacy, with the mean (standard deviation) score being 78.9 ( $\pm 13.4$ ). A total of 12.6% of participants reported feelings of loneliness.

Table 1  
The demographic profile by survey year

Category		2015 (n, %)	2016 (n, %)	2017 (n, %)	2020 (n, %)	Total
		n = 2120	n = 2148	n = 2098	n = 2094	N = 8460
Gender	Male	1050(49.5%)	1062(49.4%)	1036(49.4%)	1031(49.2%)	4179(49.4%)
	Female	1070(50.5%)	1086(50.6%)	1062 (50.6%)	1063(50.8%)	4281(50.6%)
Age	$\geq 65$	301(14.2%)	319(14.9%)	327(15.6%)	375(17.9%)	1322(15.6%)
	25–64	1492(70.4%)	1504(70.0%)	1462(69.7%)	1442(68.9%)	5900(69.8%)
	15–24	327(15.4%)	325(15.1%)	309(14.7%)	277(13.2%)	1238(14.6%)
Education	Below senior high school	1064(50.2%)	1051(48.9%)	1020(48.6%)	953(45.5%)	4088(48.3%)
	Associate/bachelor's degree	912(43.0%)	966(45.0%)	937(44.7%)	940(44.9%)	3755(44.4%)
	Graduate degree	144(6.8%)	131(6.1%)	141(6.7%)	201(9.6%)	617(7.3%)
Occupation	Employed	1230(58.0%)	1225(57.0%)	1232(58.7%)	1165(55.6%)	4852(57.4%)
	Student	230(10.8%)	249(11.6%)	226(10.8%)	224(10.7%)	929(11.0%)
	Housewife	310(14.6%)	306(14.3%)	281(13.4%)	307(14.7%)	1204(14.2%)
	Retired/no employed	350(16.6%)	368(17.1%)	359(17.1%)	398(19.0%)	1475(17.4%)
Marital status	Divorced/windowed	119(5.6%)	95(4.4%)	72(3.4%)	73(3.5%)	359(4.2%)
	Single	715(33.7%)	716(33.4%)	711(33.9%)	684(32.7%)	2826(33.4%)
	Married	1286(60.7%)	1337(62.2%)	1315(62.7%)	1337(63.8%)	5275(62.4%)

Table 2  
Health-related variables and loneliness among the participants

Category		2015, n (%)	2016, n (%)	2017, n (%)	2020, n (%)	Total
		n = 2120	n = 2148	n = 2098	n = 2094	N = 8460
Self-rated mental health	(mean ± SD)	4.2(± 0.8)	4.2(± 0.8)	4.2(± 0.8)	4.2(± 0.8)	4.2(± 0.8)
	Good	1813(85.5%)	1813(84.4%)	1803(85.9%)	1781(85.1%)	7210(85.2%)
	Average	244(11.5%)	277(12.9%)	240(11.4%)	229(10.9%)	990(11.7%)
	Fair	63(3.0%)	58(2.7%)	55(2.7%)	84(4.0%)	260(3.1%)
Self-rated physical health	(mean ± SD)	3.9(± 0.9)	3.9(± 0.9)	4.0(± 0.9)	3.9(± 0.9)	3.9(± 0.9)
	Good	1598(75.3%)	1578(73.5%)	1594(76.0%)	1526(72.9%)	6296(74.4%)
	Average	336(15.9%)	390(18.2%)	345(16.5%)	384(18.3%)	1455(17.2%)
	Fair	186(8.8%)	180(8.3%)	159(7.5%)	184(8.8%)	709(8.4%)
Self-efficacy(n = 8283)	(mean ± SD)	78.9(± 13.3)	78.9(± 13.3)	78.1(± 13.3)	79.5(± 13.4)	78.9(± 13.4)
Self-efficacy	Under average	660(32.3%)	693(32.8%)	723(35.0%)	630(30.6%)	2706(32.7%)
	Above average	1382(67.7%)	1421(67.2%)	1343(65.0%)	1431(69.4%)	5577(67.3%)
Loneliness	No	1844(97.0%)	1903(88.6%)	1787(85.2%)	1857(88.7%)	7391(87.4%)
	Yes	276(13.0%)	245(11.4%)	311(14.8%)	237(11.3%)	1069(12.6%)
SD: standard deviation ; Self-efficacy means is 78 ,so, < 78 is under average, ≥78 is above average.						
Self-rated mental/physical health a higher score indicates higher level of mental/physical health.						

In terms of suicide-related risks, Table 3 shows that the mean score of the BSRS-5 was 1.38, indicating the low distress level among the general public. However, those who were lonely experienced nearly four times greater psychological distress (BSRS-5) than those who were not lonely (3.89 vs. 1.02, respectively). Lonely people also experienced a significantly higher level of insomnia, anxiety, irritability, depression, and inferiority than did those who were not lonely, with the ORs being 3.5, 5.1, 4.4, 8.4, and 5.4, respectively. Regarding the overall suicidality, the mean CMHC-9 score was 1.13 in this study, indicating that the majority of the sample were non-high-risk. Furthermore, those who were lonely had significantly higher scores related to alcohol or drug problems and having no one to talk to (ORs 4.8 and 5.5, respectively). More than one-third (33.2%) of those with lifetime suicidal ideation reported loneliness, compared to 9.3% of those without lifetime suicidal ideation. Similarly, a significantly higher proportion of participants with lifetime suicide attempt and future suicide intent reported loneliness compared to those without suicide risk (all  $p < 0.001$ ).

Table 3  
The correlation between loneliness with suicide-related risk factors (N = 8460)

n (%)	Loneliness			$\chi^2/t$	ORs (95% CI)
	No	Yes			
BSRS-5 (Mean $\pm$ SD)	1.38( $\pm$ 2.34)	1.02 ( $\pm$ 1.81)	3.89 ( $\pm$ 3.70)	24.94***	
Insomnia				380.39*	
Yes	2183(25.8%)	1646 (22.3%)	537 (50.2%)		3.5(3.08 ~ 4.01)
No	6277(74.2%)	5744 (77.7%)	533 (49.8%)		1
Anxiety				599.75***	
Yes	1389(16.4%)	936 (12.7%)	453 (42.3%)		5.1(4.41 ~ 5.82)
No	7071(83.6%)	6455 (87.3%)	616 (57.7%)		1
Irritability				537.00***	
Yes	1950(23.0%)	1405 (19.0%)	545 (50.9%)		4.4(3.87 ~ 5.05)
No	6510(77.0%)	5985 (81.0%)	525 (49.1%)		1
Depression				1110.45***	
Yes	1352(16.0%)	808 (10.9%)	544 (50.9%)		8.4(7.34 ~ 9.72)
No	7108(84.0%)	6583 (89.1%)	525 (49.1%)		1
Inferiority				650.40***	
Yes	1350(16.0%)	894 (12.1%)	456 (42.7%)		5.4(4.70 ~ 6.22)
No	7110(84.0%)	6497 (87.9%)	613 (57.3%)		1
CMHC-9(Mean $\pm$ SD)	1.14( $\pm$ 1.54)	0.88 ( $\pm$ 1.23)	2.89 ( $\pm$ 1.98)	32.32***	
Alcohol or drug use problems				146.85***	
Yes	221(2.6%)	134 (1.8%)	87 (8.1%)		4.8(3.63 ~ 6.34)
No	8239(97.4%)	7257 (98.2%)	982 (91.9%)		1
No one trustworthy to talk				530.36***	
Yes	867(10.2%)	544 (7.4%)	323 (30.2%)		5.5(4.66 ~ 6.38)
No	7593(89.8%)	6847 (92.6%)	746 (69.8%)		1
SI_Week				259.36***	
Yes	130(1.5%)	53 (0.7%)	77 (7.2%)		10.7(7.52 ~ 15.33)
No	8330(98.5%)	7338 (99.3%)	992 (92.8%)		1

Note: \*p < .05, \*\*p < .01, \*\*\*p < .001. OR: odds ratio; CI: confidence interval; SD: standard deviation, SA: Suicide Attempt, SI: Suicide Ideation, BSRS-5: The 5-item Brief Symptom Rating Scale, CMHC-9: The 9-item Concise Mental Health Checklist.

^The Fisher test involve, a 2  $\times$  2 contingency table when sample sizes are small( $\leq$  5).

n (%)	Loneliness			$\chi^2/t$	ORs (95% CI)
	No	Yes			
SI_month				154.55***	
Yes	72(0.9%)	28 (0.4%)	44 (4.1%)		11.3(7.00 ~ 18.21)
No	8388(99.1%)	7363 (99.6%)	1025 (95.9%)		1
SI_year				310.13***	
Yes	170 (2.0%)	73 (1.0%)	97 (9.1%)		10.0(7.33 ~ 13.65)
No	8290(98.0%)	7318 (99.0%)	972 (90.9%)		1
SI_lifetime				496.46***	
Yes	1040(12.3%)	685 (9.3%)	355 (33.2%)		4.9(4.19 ~ 5.65)
No	7420(87.7%)	6706 (90.7%)	714 (66.8%)		1
Future_suicide intent				226.36***	
Yes	133(1.6%)	59 (0.8%)	74 (6.9%)		9.2(6.53 ~ 13.10)
No	8327(98.4%)	7332 (99.2%)	995 (93.1%)		1
SA_year <sup>^</sup>				50.15***	
Yes	15(0.2%)	4 (0.1%)	11 (1.0%)		19.2(6.10 ~ 60.41)
No	8445(99.8%)	7387 (99.9%)	1058 (99.0%)		1
SA_lifetime				141.10***	
Yes	187(2.2%)	110 (1.5%)	77 (7.2%)		5.1(3.81 ~ 6.93)
No	8273(97.8%)	7281 (98.5%)	992 (92.8%)		1
Note: *p < .05, **p < .01, ***p < .001. OR: odds ratio; CI: confidence interval; SD: standard deviation, SA: Suicide Attempt, SI: Suicide Ideation, BSRS-5: The 5-item Brief Symptom Rating Scale, CMHC-9: The 9-item Concise Mental Health Checklist.					
<sup>^</sup> The Fisher test involve, a 2 × 2 contingency table when sample sizes are small(≤ 5).					

The results of Pearson correlation analysis are displayed in Table 4. The findings reveal that loneliness is negatively correlated to self-efficacy ( $r = -0.22$ ,  $p < 0.01$ ), self-rated mental health ( $r = -0.27$ ,  $p < 0.01$ ) and self-rated physical health ( $r = -0.20$ ,  $p < 0.01$ ) but positively correlated to BSRS-5 score ( $r = 0.41$ ,  $p < 0.01$ ), CMHC-9 score ( $r = 0.44$ ,  $p < 0.01$ ), lifetime suicidal ideation ( $r = 0.24$ ,  $p < 0.01$ ) and lifetime suicide attempt ( $r = 0.13$ ,  $p < 0.01$ ).

Table 4

The correlation matrix of health-related factors, loneliness, and overall suicide risk under adjustment (N = 8460)

Variables	1	2	3	4	5	6	7	8
1.Loneliness	1							
2.Self-efficacy	-0.22***	1						
3.SR-mental health	-0.27***	0.46***	1					
4.SR-physical health	-0.20***	0.51***	0.54***	1				
5.BSRS-5	0.41***	-0.36***	-0.40***	-0.33***	1			
6.CMHC-9	0.44***	-0.35***	-0.40***	-0.33***	0.89***	1		
7. SI_lifetime	0.24***	-0.22***	-0.23***	-0.19***	0.34***	0.37***	1	
8. SA_lifetime	0.13***	-0.12***	-0.12***	-0.10***	0.18***	0.26***	0.40***	1

Note: \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ . SR: Self-related, CMHC9 is continuous variable, range 0–9. The higher the score of CMHC9, the higher the level of suicide risk. SA: Suicide Attempt, SI: Suicide Ideation, All the cells adjusted for age and marital status.

## Discussion

The prevalence of loneliness among a representative sample of the Taiwanese general population was 12.6% in this study. Loneliness was found to be correlated with self-rated health, psychological distress, and suicide risks. Lonely subjects had significantly higher risks in terms of lifetime suicidal ideation, lifetime suicide attempt, and future suicide intention. Overall, two items of suicidality assessment—“alcohol/drug abuse” and “no one trustworthy to talk to”—were the most influential factors for loneliness.

The prevalence of loneliness varied by country and measurement scales. In Germany, the prevalence of loneliness among the public was 10.5% [13]. In Indonesia, self-reported prevalence was 10.6% (all of the time) and 8.0% (sometimes) [9]. Moreover, perceived loneliness in adults was 18% (20.9% among women vs. 15.0% among men) in a UK-based national survey using a screening questionnaire [30]. Although the measurements of loneliness differed between studies, the prevalence rates ranged between 8% and 18% among the general population, which was consistent with our study finding. Another focus of analysis lies in the age groups surveyed in loneliness studies. Previous studies in Taiwan related to loneliness were mostly focused on the elderly [4, 31, 32]. Loneliness prevalence was found to be higher among the elderly than among those under 65 years of age (14.0% vs. 10.7%, respectively) [4]. Elderly loneliness was associated with poor health condition, no work, no spouse, and poor emotional support [31, 32]. Higher stress levels and depressive symptoms were also found to be highly associated with loneliness among Taiwanese elderly people [32]. Future studies should provide more evidence regarding the causality between age and loneliness.

Our findings supported the association between loneliness and a variety of suicide risks, consistent with the findings of a study by Stikley and Koyanagi (2016), which highlighted that a higher level of loneliness was significantly associated with lifetime suicidal ideation (OR = 5.8) and lifetime suicide attempt (OR = 3.5) in the general population [14]. Our study highlighted the fact that loneliness is associated with past, present, and future suicidality, with future suicide intent having the highest odds for loneliness. This finding was supported by the notion that loneliness could predict later suicidal ideation or behavior [18, 33, 34]. In addition, a dose-response association existed between loneliness and suicidality across time [14, 33]. Therefore, the evidence revealed the importance of assessing suicidality among lonely people. Whether in the community or in clinical settings, lonely individuals require sensitivity from healthcare providers

so that they can detect their lifetime, current, or future suicidal ideation/suicide attempt at an early stage in order to prevent the increase of suicide risks.

In terms of other suicide risk factors, the study identified two critical factors related to loneliness—"no one trustworthy to talk to" and "alcohol or drug abuse problems." Lonely participants reported a higher percentage of a lack of trusting relationships than did their non-lonely counterparts. This finding was supported by a UK study that explored the cause of loneliness among 48 economically deprived young adults (18–24 years) and found that many were lonely due to being unable to express themselves or their feelings and discuss their issues. [35]. Further, social support may mediate the relationship between loneliness and suicidal behavior in the general population [14]. Such evidence highlights the role of trusting and supportive relationships for lonely people. Besides, we found that the odds of drug abuse among lonely participants was 4.8-times higher than among non-lonely participants. Previous studies have also shown a correlation between loneliness and substance abuse, especially for lonely people with psychological distress such as depression and anxiety [9, 13]. Another study in Taiwan revealed a similar result, in which loneliness was related to various dimensions of psychological well-being including depressive symptoms, self-efficacy, suicidal thoughts, and alcohol consumption [36]. Therefore, loneliness may also play a role in alcohol consumption [20, 36, 37, 38], which in turn could cause suicidal ideation [39]. This vicious cycle leads to the common condition of loneliness as reflected by the Taiwanese proverb "the more you drink, the lonelier you get." Therefore, excessive drinking or substance abuse is likely to be a behavioral manifestation of loneliness.

In terms of psychological distress, the study found that insomnia, anxiety, irritability, depression, and inferiority were 4–7 times more common among lonely participants than among non-lonely participants. Previous studies have also pointed out that loneliness is associated with insomnia, which is believed to be caused by the emotional impact of loneliness that is commonly associated with anxiety and depression, affecting daily rest and sleep [23]. In the English Longitudinal Study of Ageing (ELSA), loneliness was found to be associated with more sleep problems and short sleep duration, evidenced by the fact that highly lonely individuals were particularly vulnerable to sleep problems [40]. Thus, the role of insomnia in the trajectory of loneliness cannot be neglected. Promotion of sleep hygiene and treatment of sleep problems early in the assessment of mental health problems such as loneliness may be necessary.

Furthermore, our study highlighted the relatively stronger association between depression and loneliness in comparison with other psychological factors such as anxiety or inferiority, which is supported by other studies [9, 36]. In addition, loneliness could actually predict changes in depressive symptom in longitudinal studies, independent of social network size [41]. Social network can also influence depression through the mediating effect of loneliness [42]. It is clear to summarize that loneliness could be viewed as one of the factors of social network and depression. Research pointed out that personality factors (such as high neuroticism, low extraversion, and low feelings of mastery) might further mediate the association between loneliness and depression, with these traits influencing the sense of loneliness and depression [43].

Our study had the advantage of using a large representative sample to understand loneliness prevalence in the general public. However, there are some limitations. First, since this was a cross-sectional study, we could not determine the causality. Second, although the prevalence and correlation of loneliness can be understood by using a single-question screening scale, the type or severity of loneliness remains unclear. Third, the study focused on the association between feeling of loneliness, suicidality, and psychological distress. We failed to consider the influence of internal and external environmental or social factors such as family support. These issues must be examined in detail for future surveys of the general population. Moreover, a longitudinal design is recommended for future research to facilitate the understanding of the causal relationship between loneliness and suicidality.

In summary our study implied that about one in ten people in Taiwan experienced feelings of loneliness. Due to its significant association with suicide and mental distress, it is necessary to consider several psychological factors when engaging with lonely people. However, interventions to reduce loneliness are difficult and complex, due to several interacting components (e.g. goals, personnel, activities, resources, and delivery mode), which may interact with features of the local context in which they are applied (including age profile and health status). These characteristics need to be well described, using the body of evidence to identify those that are effective in a particular context and for a specific population. The study implied that addressing loneliness is essential to our mental and physical health, especially within the community. The first step to improve feelings of loneliness and its subsequent psychological effects will be to effectively link community resources and screen individuals' loneliness status to identify high-risk groups for further intervention [29, 44]. Furthermore, encouraging community participation in social activities can also promote neighborhood ties and increase social connectedness, thus reducing loneliness [5]. The goal of loneliness reduction can be targeted by improving both physical and mental health while also enhancing psychological well-being in the general population [7, 8, 45].

## Conclusion

Our study indicated a significant association between loneliness and suicide risk in the general population, particularly the risks of future suicide intention, substance use, and perceived distress or lack of support. About one in ten individuals in the general population may have frequent feelings of loneliness. Managing personal health behaviors such as poor sleep or depression prevention through psychological support and trusting relationships may reduce the feelings of loneliness and prevent suicide. Promoting self-perceived health conditions and understanding suicidal ideations among the general public may also reduce feelings of loneliness. Future research using longitudinal data is needed to understand the potentially complex associations between loneliness, psychological distress, social support, and suicidality in the general population. This will be an initial step to identify lonely people in the community, as part of its suicide prevention efforts.

## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** The ethical approval for this study was acquired from the principle investigators' affiliated hospital (202103109W).

**Consent to participate** All participants were informed in detail about the aims and procedures of the study. This study included anonymous representative telephone interviews; therefore, the survey was initiated after verbal consent. Additionally, verbal consent from a legal guardian was required for participants under the age of 18.

**Consent for publication** All authors agreed to publish this study.

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### **Contributions**

Conception or design of the work: MBL, CYW, CTC and CYC; acquisition of the funding: MBL; analysis or interpretation of data: WCH, CYW, CTC and CYC; drafting the paper or critically revising the contents: MBL, WCH and CYW; final approval of the draft for submission: MBL, WCH, CYW, CTC and CYC. All authors have read and agreed to the published version of the manuscript.

### **Ethics declarations**

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