scientific reports

OPEN

The association between loneliness, suicidal ideation, and psychological distress considering family compositions: a cross-sectional study in a Japanese rural area

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Research on how loneliness, as a subjective experience, affects suicide risk remains insufficient. It also remains unclear whether the effects vary according to family composition. This study aimed to investigate the associations among loneliness, suicidal ideation, and psychological distress in a rural population in Japan. A cross-sectional survey was conducted between August and September 2023 in a rural town in Akita Prefecture. Of the 5,000 surveyed residents, data from 1,842 respondents were analyzed. The exposure variable was loneliness, as assessed by the University of California Los Angeles Loneliness Scale short form. The main outcome was the presence or absence of suicidal ideation, which was measured using a self-reported questionnaire. The secondary outcome was psychological distress, which was measured using the Kessler Psychological Distress Scale (K6). The collected data were analyzed using multivariate logistic regression and stratified analysis based on family composition. Loneliness was strongly associated with suicidal ideation and psychological distress. The loneliness–psychological distress association persisted regardless of family composition. Loneliness independently affected suicidal ideation and psychological distress among rural residents in Japan. To develop effective suicide prevention strategies in rural areas, it is essential to address both social isolation and the subjective experience of loneliness.

Keywords Suicidal ideation, Loneliness, Mental health, Psychological distress, Rural population

Suicide is a serious global problem[1]. Numerous epidemiological studies have identified various risk factors for suicide, including a history of suicide attempts, family history of suicide, depression, social isolation, disasters, physical illness, and economic hardship[2–8]. Despite these advances, identifying clear causal pathways for suicide mechanisms remains a significant challenge. This has not prevented, nevertheless, several suicide prevention theoretical models and guidelines being proposed. Among these, the interpersonal theory of suicide, which explains that suicidal ideation arises when individuals simultaneously experience perceived burdensomeness and thwarted belongingness, has gained prominence in recent years[9]. Suicidal ideation occurs at an early stage of the progression of suicide attempts and completed suicides, is critical for such progression[10,11], and reflects the emergence of psychological distress that can escalate if not intervened against. These characteristics render the construct an important indicator of suicide risk. Importantly, suicide results from the complex interplay of multiple factors[12], making it such that prevention is key for effectively addressing both the personal and social factors related to suicide[13].

Loneliness and social isolation are recognized as global problems and are associated with adverse mental health outcomes, such as depression[14,15]. They also heighten the risk of morbidity and mortality from chronic diseases[16]; therefore, they are regarded as critical targets for intervention in mental and public health. In recent years, loneliness and social isolation have also become pressing concerns in Japan. For example, from 2005 to

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2020, the number of single-person households increased by six million (accounting for 40% of all households nationally)[17], raising concerns about the potential decline in interactions among residents. This becomes even more paramount if we consider the concomitant phenomena in Japan of the shrinking population, falling birthrates, and aging society[18]. Since the enactment of the Basic Act on Suicide Countermeasures in 2006, the national government has implemented specific suicide prevention policies addressing social issues such as unemployment and economic hardships[19]. However, loneliness has often been overlooked as a critical factor in this context.

Japan has a higher suicide rate than other countries[20], but the national suicide prevention efforts conducted over the past decade have gradually reduced suicide rates. Despite these attempts, suicide rates have recently increased among women and younger populations, indicating a demographic shift in suicidal tendencies at the national level[21]. One factor contributing to this shift in trends is that, beyond economic factors alone, reduced social interactions have exacerbated feelings of loneliness, leading to an increase in the number of suicides[22]. Additionally, a large Japanese study suggested loneliness as a significant factor contributing to the increased risk of suicide during the COVID-19 pandemic[23].

Although often perceived as synonymous, loneliness and social isolation are distinct concepts. The first refers to a subjective sense of distress that occurs when social connections are perceived as inadequate/unfulfilling, whereas the latter is an objective indicator of estrangement in which social connections are limited or absent[24–26]. Therefore, the two concepts often conflate but do not always co-occur, in that isolated individuals may not feel lonely and those with abundant social connections can still experience loneliness[27,28]. Furthermore, although living alone has been suggested as a risk factor for suicide in previous studies[29,30], there is data from a 2022 Japanese report showing that approximately two-thirds of suicide victims lived with others at the time of death (number of suicides among people not living alone, 14,266 vs. living alone, 7,414)[31]. In another study, individuals living only with their parents were found to have a higher risk of suicide[32].

Previous research on suicide prevention in rural areas has often focused on older adults, who are particularly vulnerable to loss and social isolation[33,34]. The past literature has also reported on a link between living alone and depression among older adults[35], but there is also importance in focusing on loneliness as a key factor in mental health and suicide prevention[36]. Based on previous studies, we hypothesize that loneliness has an independent influence on suicidal ideation and psychological distress, irrespective of family composition. This study aims to examine the association between loneliness, suicidal ideation, and psychological distress in Japanese rural residents. Rural towns in Japan face unique challenges that make them critical settings for studying loneliness and suicide prevention. These areas are characterized by significant population aging, which may be associated with increased loneliness and social isolation. Additionally, rural towns often have limited resources for mental health care and community support, emphasizing the need for practical and sustainable interventions suited to their specific circumstances. The results of this study have implications for the development of effective measures to address loneliness and social isolation, which may contribute to suicide prevention efforts in rural areas of Japan.

Materials and methods
Study design and data collection
Akita Prefecture is one of the most rapidly aging prefectures in Japan, with a higher proportion of older adult residents compared to other regions. It also had the highest suicide rate among Japan's 47 prefectures over the past two decades[17,37]. The suicide mortality rate varies significantly among the 25 municipalities within Akita Prefecture, with rural areas generally exhibiting higher rates than urban areas. Nearly half of the suicide victims in Akita Prefecture, are aged 60 years or older, indicating that addressing older adult suicides is a key concern in these regions[37]. Suicide prevention measures designed to address the characteristics of rural areas, including aging populations and higher suicide rates, are considered essential for reducing the overall suicide mortality in Akita.

Akita has a history of implementing suicide prevention initiatives, with municipalities organizing mental health lectures and other community-based interventions[38,39]. Addressing factors such as social isolation and loneliness in rural areas is anticipated to contribute to lowering suicide rates across the prefecture.

This cross-sectional study was based on a mental health survey conducted between August and September 2023 among residents aged 20 to 84 years in a rural town in Akita Prefecture, northern Japan. The town had approximately 14,000 residents at the time of the survey. In Japan, all prefectures and municipalities are required to develop regional suicide prevention plans tailored to the local context. This survey was conducted to develop suicide countermeasures for rural populations based on Japan's General Principles of Suicide Countermeasures Policy[40]. The prevalence of suicidal ideation in Akita Prefecture has been estimated to be approximately 3.7%[37]. To ascertain the prevalence of suicidal ideation with an accuracy of 3.7% and a 1% margin of error, the required sample size was 2028. Assuming a response rate of approximately 40%, the sample size was set to 5000. Using stratified random sampling based on sex and age distribution, 5000 residents aged 20 to 84 were selected from a population of approximately 14,000. Sampling was conducted using the basic resident register managed by the municipality. This register contains information about one's date of birth, sex, and address.

This survey will serve as a baseline survey for formulating countermeasure plans, with a follow-up survey scheduled for 2025 to assess longitudinal trends. The purpose of the survey was explained in the town's public newsletter to ensure the smooth distribution of the questionnaires. It was also announced that all personal information necessary for follow-up surveys would be managed by the local government. The extraction of participant addresses and the management of personal information were handled by public health nurses from the municipality, who also led the coordination and announcement process in the town's public newsletter. We excluded individuals certified as support level 2 or higher under the Japanese Long-Term Care Insurance (LTCI) system, as these individuals had functional disabilities that could hinder independent survey completion.

Anonymous questionnaires were mailed to 5,000 residents between August and September 2023. Returning a completed questionnaire was considered a consent to participate in the study; an explanation of the research purpose was provided alongside the survey. Participants were also informed about a follow-up survey scheduled for 2025 and their right to withdraw consent. Those wishing to withdraw consent by December 2023 could do so by submitting a withdrawal letter or answering a Google Form. Individuals who withdrew consent were excluded from the analysis, and measures were taken to ensure they would not receive the follow-up survey.

The questionnaire included items on demographic characteristics, loneliness, suicidal ideation, and psychological distress. This study followed the STROBE guidelines for reporting observational studies[41].

Measures

Sex was classified as male or female. Age was categorized into three groups: 20–39 years, 40–59 years, and ≥ 60 years. Family composition was defined as either living alone or living in a household with multiple occupants. Marital status was grouped into never married, married, separated, widowed, or missing. Subjective economic status was assessed on a five-point scale ranging from good to poor, or missing. Medical history was categorized into four groups: disease-free, having physical health conditions, having mental health conditions, multimorbidity (physical and mental health conditions), or missing.

Self-reported loneliness was the exposure variable. Loneliness was measured using the six-item University of California, Los Angeles (UCLA) Loneliness Scale (ver. 3), a loneliness scale developed by Russel[42]. We specifically used its six-item short form, which has been validated in Japanese by Toyoshima and Sato[43]. Items were responded to on a four-point scale, with total scores ranging from 0 to 24 and being calculated by summing the scores of all items. As there was no established cut-off point for this scale, we followed prior studies and distinguished the presence of loneliness based on the upper quartile of the distribution[44]. That is, a score in the third quartile or above (UCLA score ≥ 15) was defined as experiencing loneliness, and a binary variable was created to classify loneliness presence or absence.

The outcome variables were suicidal ideation and psychological distress, both of which were self-reported. Suicidal ideation was measured using the following question, "Did you think about committing suicide in the past month?" To which participants responded with "yes," "no," or "unsure," with a "yes" answer representing that the respondent experienced suicidal ideation. Since suicidal ideation precedes suicide attempts or completion[10,11], it can be regarded as a key predictor of suicide risk. This study used only this single-item to measure this construct in an attempt to simultaneously deal with the ethical concerns surrounding studies on suicide and to promote ease of response for participants. We aimed to minimize the number of questions on suicide while focusing on identifying "suicidal ideation," which is considered essential for implementing effective interventions. The item used in this survey was adapted from the Ministry of Health, Labour and Welfare's 2021 Survey on Attitudes Toward Suicide Countermeasures[45].

Psychological distress was measured using the Kessler Psychological Distress Scale (K6), a six-item questionnaire that evaluates mood and anxiety experienced in the last 30 days[46]. The total K6 scores ranged from 0 to 24. We used the Japanese version of the K6[47], adopting a cut-off value of K6 ≥ 13 to indicate a state of psychological distress[47,48]. In Japan, the K6 is frequently used as a screening tool for depression[49] and was designated as a secondary outcome of this study.

Social isolation was used as a covariate and measured based on responses to two questions, as follows: "How often do you go out, excluding visits to attend a hospital or shopping?" and "Do you have conversations with family or acquaintances?" Respondents who answered "less than once a week" to the first question and "rarely" to the second were identified as socially isolated. In Japan, going out less than once a week is commonly used as a general definition of being homebound. This item was established with reference to the definition of homebound individuals in Japan[50] and a previous study[23].

Ethical considerations

This study was approved by the Research Ethics Committee of Akita University (approval number: 3008, date: August 14, 2023) and followed the international ethical standards established in the Declaration of Helsinki. All participants were provided with information about consenting to participate in the study. Residents were informed through documents that participation was voluntary and that there would be no disadvantages for not participating. They were also informed that they could withdraw their consent to participate until December 2023 by submitting a withdrawal form, either in writing or through a Google Form, before the commencement of the analysis.

Statistical analysis

To examine the association of suicidal ideation and psychological distress with loneliness, we conducted a multivariate logistic regression analysis, estimating odds ratios (ORs) and 95% confidence intervals (CIs). The reference group for all models was the loneliness absent group (OR = 1.00), and the following three models were employed: Model 1 was the crude model; Model 2 adjusted for age, sex, marital status, subjective economic status, family composition, and medical history; Model 3 adjusted for all variables in Model 2 along with social isolation. Stratified analyses were conducted to investigate whether family composition (living alone or in a household with multiple occupants) influenced the associations between loneliness, suicidal ideation, and psychological distress. These analyses were stratified by family composition and adjusted for age, sex, subjective economic status, and medical history. All statistical analyses were performed using STATA version 18 (StataCorp LLC, College Station, TX, USA), and two-tailed tests were used to determine significance at the 5% level.

| Characteristics | All (%) | Loneliness | | p^1 |
		Presence (%)	Absence (%)	
Age				
20–39 years	340 (18.5)	105 (19.4)	235 (18.1)	0.69
40–59 years	546 (29.6)	154 (28.5)	392 (30.1)	
≥60 years	956 (51.9)	282 (52.1)	674 (51.8)	
Sex				
Male	812 (44.1)	258 (47.7)	554 (42.6)	0.04
Female	1030 (55.9)	283 (52.3)	747 (57.4)	
Family composition				
Living alone	115 (6.2)	26 (4.8)	89 (6.8)	0.10
Household with multiple occupants	1727 (93.8)	515 (95.2)	1212 (93.2)	
Married	1404 (76.2)	410 (75.8)	994 (76.4)	0.93
Physical illness	883 (47.9)	247 (45.7)	636 (48.9)	0.21
Psychiatric illness	95 (5.2)	55 (10.2)	40 (3.1)	<0.001
Subjective economic condition: bad	66 (3.6)	44 (8.1)	22 (1.7)	<0.001
Social isolation	112 (6.1)	25 (4.6)	87 (6.7)	0.09
K6≥13	188 (10.2)	152 (28.1)	36 (2.8)	<0.001
Suicidal ideation within the past month	41 (2.2)	34 (6.3)	7 (0.5)	<0.001

Table 1. Demographic characteristics ($n = 1842$). [1]Based on chi-square test.

| Exposure variable | Outcome variables | Model 1 | Model 2 | Model 3 |
	Number of participants with suicidal ideation	OR [1] (95% CI[2])	OR [1] (95% CI[2])	OR [1] (95% CI[2])
Loneliness				
Presence ($n = 541$)	34	12.39 (5.46–28.14)	10.56 (4.31–25.86)	10.91 (4.45–26.79)
Absence ($n = 1301$)	7	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
	Number of participants with K6 score ≥13			
Loneliness				
Presence ($n = 541$)	152	13.73 (9.38–20.09)	11.97 (8.05–17.80)	11.69 (7.84–17.42)
Absence ($n = 1301$)	36	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)

Table 2. Association between loneliness and suicidal ideation, K6 score ≥ 13 ($n = 1842$). [1]OR = Odds Ratio, [2] CI = Confidence Interval. Model 1: crude model. Model 2 (adjustment variables): age, sex, marital status, subjective economic status, family composition and medical history. Model 3 (adjustment variables): social isolation in addition to Model 2.

Results

We received 2,213 responses (response rate of 44.3%). Of these, 21 individuals with missing data on age ($n = 5$) or sex ($n = 16$) were excluded, leaving 2,192 participants. Among the study participants, 928 were male (42.3%) and 1,264 were female (57.7%). For males, 19.5% were aged 20–39 years in the initial allocation and 18.1% among study participants. Those aged 40–59 years accounted for 31.6% and 31.8%, respectively, while those aged 60 years or older accounted for 48.9% and 50.1%. For females, 17.0% were aged 20–39 years in the initial allocation and 18.5% among study participants. Those aged 40–59 years accounted for 29.6% and 27.1%, while those aged 60 years or older accounted for 53.4% and 54.4%. Among the participants, those with missing data on suicidal ideation ($n = 109$), K6 scores ($n = 149$), loneliness ($n = 82$), or family composition ($n = 10$) were excluded. Finally, the responses of 1,842 individuals were included in the analysis.

Table 1 shows participants' demographic characteristics. Among the 1,842 respondents, 188 (10.2%) reported a K6 score of 13 or higher and 41 (2.2%) reported suicidal ideation. The number of participants experiencing loneliness was 541 (29.4%). The prevalence of loneliness was higher among men, but was similar among age groups, family compositions, marital status, history of physical illness, and social isolation. Meanwhile, individuals with a history of psychiatric illness, poor subjective economic condition, psychological distress (K6 ≥ 13), and suicidal ideation in the past month showed a higher prevalence of loneliness.

Table 2 shows the results of the associations between loneliness, suicidal ideation, and psychological distress. In Model 1, the presence of loneliness was significantly positively associated with suicidal ideation (OR = 12.39, 95% CI = 5.46–28.14, $p < 0.001$) and psychological distress (OR = 13.73, 95% CI = 9.38–20.09, $p < 0.001$). These significant positive associations remained so in Model 2 adjusted for all confounding factors (suicidal ideation: OR = 10.56, 95% CI = 4.31–25.86, $p < 0.001$; psychological distress: OR = 11.97, 95% CI = 8.05–17.80, $p < 0.001$)

Exposure variable	Outcome variables		
	Number of participants with suicidal ideation	OR[1] (95% CI[2])	p
Living alone			
Loneliness			
Presence (n = 26)	0	N/A	
Absence (n = 89)	0	1.00 (Reference)	
Household with multiple occupants			
Loneliness			
Presence (n = 515)	34	9.22 (3.98–21.41)	< 0.001
Absence (n = 1212)	7	1.00 (Reference)	
	Number of participants with K6 score ≥ 13		
Living alone			
Loneliness			
Presence (n = 26)	4	8.28 (1.13–61.31)	0.037
Absence (n = 89)	2	1.00 (Reference)	
Household with multiple occupants			
Loneliness			
Presence (n = 515)	148	11.64 (7.81–17.34)	< 0.001
Absence (n = 1212)	34	1.00 (Reference)	

Table 3. Stratified analysis by family composition. [1]OR = Odds Ratio. [2] CI = Confidence Interval. All models were adjusted for age, sex, subjective economic status and medical history.

and Model 3 additionally adjusted for social isolation (suicidal ideation: OR = 10.91, 95% CI = 4.45–26.79, $p < 0.001$; psychological distress: OR = 11.69, 95% CI = 7.84–17.42, $p < 0.001$).

Table 3 presents the results of the stratified analysis. Due to an absence of cases of suicidal ideation among individuals living alone, it was not possible to calculate an odds ratio (OR) for the association between loneliness and suicidal ideation in this group. However, when examining psychological distress, among individuals who were lonely both those living alone (OR = 8.28, 95% CI = 1.13–61.31, $p < 0.05$) and in multi-person households (OR = 11.64, 95% CI = 7.81–17.34, $p < 0.001$) had significantly higher odds of psychological distress compared to the reference group, which encompassed those with absence of loneliness.

Discussion

Our results revealed that loneliness is strongly associated with suicidal ideation and psychological distress among rural residents in Japan. Consistent with previous studies[23,29,51], loneliness was identified as a major risk factor, underscoring the need for support to those experiencing this phenomenon. Even when social isolation was included as a covariate in the analysis, the association between loneliness and psychological distress remained strong, reaffirming that loneliness is an independent risk factor affecting psychological health and its importance in suicide prevention efforts.

The stratified analysis showed that loneliness was strongly associated with psychological distress regardless of family composition. While some studies have highlighted the risk of suicide in individuals living alone[29,30], our findings indicate that loneliness is a significant risk factor both for those living alone and those living with others in the same household. What follows is that importance should be given to indicators other than objective ones (e.g., family composition) when considering measures to address loneliness. Corroborating this assertion, extant research describes the need to consider individual coping strategies[52] and the buffering model of social support[53] when addressing stressors such as loneliness. Future studies should examine the effectiveness of interventions that enhance adaptive coping strategies and social support mechanisms to reduce loneliness in the general population.

It is also of importance that loneliness is influenced by cultural and social contexts, and this relationship requires careful consideration. For example, an Organisation for Economic Co-operation and Development survey indicated that loneliness in Japan often stems from a lack of emotional support, such as the absence of close friends[54]. In contrast, in countries like Turkey and the United States of America, existential loneliness (i.e., a feeling of fundamental separateness from others and the wider world) has been suggested as a significant factor contributing to loneliness. These cultural differences suggest that interventions to alleviate loneliness must be tailored to societal norms and expectations in a country[55]. Another study highlighted loneliness's multifaceted and complex nature, emphasizing the need for interventions informed by a nuanced understanding of its components[56]. A problem here is that while structural factors such as family composition and living arrangements contribute to social isolation, they are difficult to address through external interventions, which creates a significant barrier to the implementation of effective measures. Despite these potential challenges, loneliness is a subjective and modifiable experience, making it an important focus for potential interventions.

In 2024, the Act on Promotion of a Policy for Loneliness and Isolation came into effect in Japan, emphasizing the need for comprehensive strategies to tackle these issues nationwide[57]. Local governments are tasked with

developing specific measures to alleviate loneliness and reduce social isolation. Recently, internationally recognized interventions, such as Social Prescribing (SP), have garnered attention for their focus on addressing social determinants of health[58,59], These approaches may hold particular promise in Japan, where rural areas face significant challenges related to population decline and social isolation. While introducing innovative approaches like SP is important, strengthening existing human resources is equally crucial. Implementing practical and sustainable programs is essential in rural areas, where financial and human resources are often limited. For instance, providing additional training for public health nurses, gatekeepers, and other professionals could enhance their capacity to recognize and address feelings of loneliness more effectively. Such training could enable them to intervene early and offer targeted support to those in need. Moreover, fostering collaborations with non-profit organizations (NPOs) that address loneliness and social isolation could play a vital role in strengthening local support systems. In rural and mountainous areas, where community cohesion and traditional support networks may still play a significant role, building on these existing strengths through such collaborations could enhance the effectiveness of future interventions.

To build on these strategies, further research is needed to refine our understanding of the complex relationships between loneliness, suicidal ideation, and psychological distress. Longitudinal studies can help identify causal pathways and inform the development of interventions that are both evidence-based and designed to address the specific needs of rural populations. Additionally, evaluating the effectiveness of context-specific interventions in various communities will be crucial for enhancing suicide prevention efforts and reducing psychological distress in these areas.

Limitations

This study had several limitations. First, because this was a cross-sectional study, causal associations could not be directly assessed. Second, the study was limited to one rural area, and thus we suggest caution when generalizing the results to other regions. Third, the sample size was small, as the prevalence of suicidal ideation in the past month was only 41 (2.3%) and the number of participants living alone was only 115 (6.2%) in a total sample of 1,842 valid participants. This may have resulted in wide confidence intervals and potentially imprecise estimates of the associations. This underrepresentation of single-person households (i.e., only 6.2% of the sample) also applies if we consider information at the municipal level, as the municipality's demographic statistics show that these households accounted for 17.8% of the municipality in 2020[60]. This discrepancy may limit the generalizability of our findings regarding loneliness and its association with suicidal ideation and psychological distress in this population. Future studies should consider larger sample sizes to allow for more reliable stratified analyses and more precise estimates of these associations. Fourth, the question used to assess suicidal ideation was adapted from a national survey on suicide prevention. While this direct phrasing was intended to facilitate intervention planning, it may have led to underreporting or non-response due to the topic's sensitive nature. Future research should consider exploring alternative phrasing or designing more suitable items to capture this sensitive information better while minimizing bias and non-response. Finally, the measure used to assess loneliness (i.e., using a six-item self-administered questionnaire) may have fallen short of holistically capturing the nuances of this complex concept. Moreover, as the data were self-reported and included sensitive topics such as suicidal ideation, socially desirable responding may have influenced the results.

Conclusions

This study revealed that loneliness is strongly associated with suicidal ideation and psychological distress among rural residents in Japan. The strong association of loneliness with psychological stress persisted even after considering social isolation and living arrangements, suggesting that loneliness is an independent risk factor for psychological health deterioration. To develop effective suicide prevention strategies in rural areas of Japan, it is essential to address both social isolation (i.e., as an objective indicator) and the subjective experiences of loneliness.

Data availability

The data that support the findings of this study are available on request from the first author, [AI] or corresponding author, [FT].

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Declarations

Competing interests
The authors declare no competing interests.

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