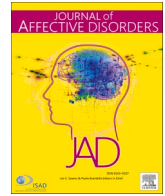




Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Association between living alone and generalized anxiety disorder in Korean adults

Su Min Park^{a,b}, Dan Bi Kim^{a,b}, Min Jeong Joo^{a,b}, Eun-Cheol Park^{b,c,*}

^a Department of Public Health, Graduate School, Yonsei University, Seoul, Republic of Korea

^b Institute of Health Services Research, Yonsei University, Seoul, Republic of Korea

^c Department of Preventive Medicine, Yonsei University College of Medicine, Seoul, Republic of Korea

ARTICLE INFO

Keywords:

Single-person household
Generalized anxiety disorder
Physical activity
Education level

ABSTRACT

Background: Globally, the rise in single-person households poses a potential risk to mental health, with generalized anxiety disorder (GAD) being a prominent concern. The proliferation of single-person households may exacerbate social isolation and foster loneliness and anxiety. Notably, research investigating the association between single-person households and GAD remains limited. Therefore, this study aimed to investigate the association between single-person households and GAD across sexes in Korea.

Methods: We utilized data from the Korea National Health and Nutrition Examination Survey conducted in 2021 and 2022, comprising a sample of 9936 participants aged 19 or older. The Generalized Anxiety Disorder Screening Tool (GAD-7) was employed to assess anxiety levels in adults. Multiple logistic regression analysis was conducted to investigate the correlation between single-person households and GAD.

Results: The reference variable used in the analysis was multi-person households (consisting of two or more individuals). The association between single-person households and GAD was statistically significant across sexes (male: odds ratio [OR]: 1.92, 95 % CI: 1.15–3.20; female: OR: 1.56, 95 % CI: 1.03–2.36). Participants in single-person households exhibited higher scores on the GAD-7 compared with those in multi-person households. Notably, marital status and education level displayed disparate effects based on sex, whereas physical activity demonstrated consistent effects irrespective of sex.

Limitations: Given the use of cross-sectional data, only correlations could be established.

Conclusion: The findings indicate an elevated risk of GAD in single-person households compared with multi-person households. Furthermore, promoting physical activity emerged as a potential strategy for mitigating GAD in single-person households.

1. Introduction

Anxiety is a pervasive aspect of modern life that deeply resonates with the evolving social fabric of contemporary Korean society (Freeston et al., 1994). Presently, Korea is witnessing a notable shift from traditional multi-person households to single-person arrangements, driven by a nexus of social, economic, and political forces. From a societal standpoint, the collective family structure is gradually yielding to individualistic ideals, fostering an increase in single-person dwellings. Economically, soaring housing expenses, escalating student loan debts, and an uncertain job market (Park and Cho, 2022) deter many from starting families, compelling them toward solitary living with a

relatively lower financial burden. Furthermore, economic factors are reshaping political perspectives, leading to government initiatives such as housing subsidies for single-person households, promoting independent living. This has fostered a culture of individual autonomy (Kim et al., 2023).

However, amidst this trend, the surge in single-person households has heralded a surge in social isolation (Park et al., 2021). Unlike their multi-person counterparts, solitary dwellers often lack regular social interactions, predisposing them to feelings of loneliness and anxiety (Smith and Victor, 2019). Indeed, the specter of social isolation looms largely in the collective consciousness of contemporary society.

The United States Census Bureau's historical household tables

* Corresponding author at: Department of Preventive Medicine & Institute of Health Services Research, Yonsei University College of Medicine, 50 Yonsei-ro, Seodaemun-gu, Seoul 03722, Republic of Korea.

E-mail address: ECPARK@yuhs.ac (E.-C. Park).

<https://doi.org/10.1016/j.jad.2024.07.112>

Received 17 April 2024; Received in revised form 25 June 2024; Accepted 16 July 2024

Available online 17 July 2024

0165-0327/© 2024 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

revealed a consistent increase in the prevalence of single-person households from 1960 to 2023. However, this trend has not been observed in the United States alone. The European Union Statistics Authority noted a similar pattern of increasing single-person households across Europe. Furthermore, there is evidence of a shift in the household composition in Asia, as well as changes in household size. According to India's National Family and Health Survey, the percentage of single-person households in India was 3.6 % during 2007–2008; this proportion increased by approximately 4.1 % from 2015 to 2016 (Dommaraju, 2015). Notably, the rising prevalence of single-person households in India, a country where familial cohesion is regarded as a fundamental value, is noteworthy. This shift can be interpreted as a consequence of evolving societal values and demographic aging (Lin, 2022) worldwide (Shams Ghahfarokhi, 2022; Yeung and Cheung, 2015).

Moreover, when considering the rise of single-person households, attributed to shifts in population dynamics, from an individual standpoint, occupants are afforded greater personal autonomy than that in multi-person households. However, this new freedom must be balanced with individual accountability. Individuals residing alone bear heightened responsibilities compared with their counterparts in communal living arrangements, which can potentially evoke feelings of anxiety (Basowitz et al., 1955; Hussenoeder et al., 2024) or exacerbate typical anxiety levels. While the precise etiology of anxiety disorders is not fully understood, potential contributing factors include genetic predispositions, environmental influences, psychological stressors, and physiological conditions (Penninx et al., 2021). Among these, environmental influences are predominant, encompassing a multitude of causes. In the context of evolving lifestyles and transforming social relationships, it is imperative to consider environmental determinants. By comprehensively understanding these factors, effective interventions can be developed to mitigate generalized anxiety disorder. In particular, this study focuses on examining the correlation between generalized anxiety disorder (GAD) and the increasing prevalence of single-person households, a global phenomenon.

While prior research has investigated the health status and medical requirements of single-person households among individuals aged 60 years and older, these studies were confined by age limitations and primarily examined overall health behaviors (Park et al., 2016). Furthermore, considering the potential heightened susceptibility of single-person households to generalized anxiety disorder, there is a need for a more comprehensive approach. Therefore, we conducted a comprehensive analysis across all age demographics without imposing age restrictions, with particular emphasis on mental health within the spectrum of health behaviors (Xue et al., 2021).

This study aimed to investigate the correlation between single-person households and GAD, and to compare the situation with multi-person households. Additionally, we aimed to categorize GAD based on severity and to ascertain whether a significant relationship existed between GAD levels among individuals from single-person households, as opposed to those in multi-person households.

2. Methods

2.1. Data

The data for this cross-sectional study were obtained from the 8th and 9th rounds of the Korea National Health and Nutrition Examination Survey (KNHANES, 2021–2022). The sampling framework was derived from Korea's Population and Housing Census (2016, 2019), with households serving as the primary extraction units within the survey districts. The dependent variables examined included the number of household members and GAD (Williams, 2014). To elucidate the primary variables, households were categorized into two groups: those with two, three, four, five, or more than six individuals were grouped together as multi-person households, whereas those with a single member were designated as single-person households. Regarding GAD, a

score of 10 or above on the Generalized Anxiety Disorder Scale (GAD-7) denotes moderate anxiety, whereas a score of 15 or higher indicates severe anxiety. The threshold for determining the presence or absence of GAD was set at 10 out of 21 points (Jung et al., 2022). The analysis was performed based on GAD severity.

2.2. Study population

The total number of surveyed participants was 9936 (4367 men [44 %] and 5569 women [56 %]). Infants and adolescents were excluded because the self-administered survey for GAD in the KNHANES did not include these age groups. Furthermore, the unemployed, accounting for 22.4 % of all men and 45.6 % of all women, were included in the study rather than being excluded, given their absence of employment status.

2.3. Variables

GAD is a prevalent anxiety disorder characterized by persistent worry, distress, and difficulty managing these symptoms. The presence of GAD was determined using the Generalized Anxiety Disorder Screening Tool employed in the KNHANES. This tool comprises seven items commencing with the prompt, "During the past two weeks, how often have you been bothered by the following problems?" The responses were rated on a 4-point scale. Scores for the presence of GAD ranged from 0 to 21, with scores of 0 to 9 indicating none, and scores of 10 or higher signifying the presence of GAD. The primary method for gathering household size data in this study was through an interview survey, which was integrated into a broader household survey. The researcher employed a direct input technique for data collection. Additionally, we investigated whether there was a significant trend in the severity of GAD.

The population under analysis consisted of adults aged 20 years or above, segmented into the following age groups: 20–29, 30–39, 40–49, 50–59, and 60 or older. Marital status was classified into "single" and "married," while personal income levels were delineated into three groups: upper, middle, and lower, with the upper-middle and lower-middle groups combined into the "middle" category within the personal income quartile. Geographical regions were classified as "cities," encompassing special cities and metropolitan areas based on Korea's administrative divisions, with the remaining areas classified as "rural." Body mass index was stratified as "underweight," "normal," and "obese," and occupations were segmented into white-collar, pink-collar, blue-collar, and unemployed categories. Education levels were categorized as "middle school graduate or lower," "high school graduate," and "university graduate or higher." An analysis was conducted to ascertain whether individuals engaged in physical activity, smoking, and monthly alcohol consumption (defined as consuming more than one alcoholic drink per month in the past year), as well as their perceived stress levels. Missing values for all the variables were excluded from the analysis.

2.4. Statistical analysis

The association between the frequency of single-person households and GAD was assessed using a chi-square test. Additionally, factors influencing GAD were analyzed using multiple logistic regression, considering both single- and multi-person households as variables of interest. Furthermore, single-person households were segregated into subgroups along with multi-person households to identify significant trends in the remaining independent variables via factor analysis. Finally, multinomial regression was employed to investigate whether GAD exhibited a worsening trend in single-person households compared to multi-person households.

3. Results

In the 8th and 9th KNHANES, 114 individuals from single-person

households, comprising 36 men and 78 women, reported experiencing GAD. Conversely, 358 individuals (102 men and 256 women) from multi-person households reported GAD. The total number of participants with GAD across single- and multi-person households was 472,

equivalent to 4.7 % of the total surveyed population ($N = 9936$). Considering the one-year prevalence of anxiety disorder in Korea in 2021 (3.1 %), alongside the ongoing increase in the number of individuals affected by mental illness, the demographics of individuals

Table 1
General characteristics of participants.

Characteristics	Generalized Anxiety Disorder (GAD)													
	Male						Female							
	Total		Yes		No		P-value	Total		Yes		No		P-value
	N	%	N	%	N	%		N	%	N	%	N	%	
Total ($N = 9936$)	4367	100.0	138	3.2	4229	96.8		5569	100.0	334	6.0	5235	94.0	
Number of household members						0.0002								0.0019
Single-Person Households	635	14.5	36	5.7	599	94.3		948	17.0	78	8.2	870	91.8	
Multi-Person Households	3732	85.5	102	2.7	3630	97.3		4621	83.0	256	5.5	4365	94.5	
Age (year)						0.0421								<0.0001
19–29	575	13.2	25	4.3	550	95.7		653	11.7	60	9.2	593	90.8	
30–39	541	12.4	23	4.3	518	95.7		664	11.9	64	9.6	600	90.4	
40–49	732	16.8	25	3.4	707	96.6		969	17.4	49	5.1	920	94.9	
50–59	738	16.9	25	3.4	713	96.6		1054	18.9	40	3.8	1014	96.2	
60+	1781	40.8	40	2.2	1741	97.8		2229	40.0	121	5.4	2108	94.6	
Marital status						0.0201								<0.0001
Married	3350	76.7	94	2.8	3256	97.2		4639	83.3	248	5.3	4391	94.7	
Single	1017	23.3	44	4.3	973	95.7		930	16.7	86	9.2	844	90.8	
Personal income level						0.0149								0.0018
Low	1086	24.9	48	4.4	1038	95.6		1363	24.5	104	7.6	1259	92.4	
Middle	2167	49.6	64	3.0	2103	97.0		2804	50.4	168	6.0	2636	94.0	
High	1114	25.5	26	2.3	1088	97.7		1402	25.2	62	4.4	1340	95.6	
Region						0.9188								0.611
Urban	1838	42.1	57	3.1	1781	96.9		2385	42.8	148	6.2	2237	93.8	
Rural	2529	57.9	81	3.2	2448	96.8		3184	57.2	186	5.8	2998	94.2	
Body mass index (BMI)						0.7125								0.0145
Underweight	113	2.6	5	4.4	108	95.6		314	5.6	28	8.9	286	91.1	
Normal	1260	28.9	38	3.0	1222	97.0		2368	42.5	122	5.2	2246	94.8	
Obese	2994	68.6	95	3.2	2899	96.8		2887	51.8	184	6.4	2703	93.6	
Occupational categories						0.0047								0.1287
White	1199	27.5	40	3.3	1159	96.7		1282	23.0	81	6.3	1201	93.7	
Pink	441	10.1	16	3.6	425	96.4		822	14.8	50	6.1	772	93.9	
Blue	1431	32.8	27	1.9	1404	98.1		926	16.6	40	4.3	886	95.7	
Inoccupation	1296	29.7	55	4.2	1241	95.8		2539	45.6	163	6.4	2376	93.6	
Education level						0.98								0.789
Middle school graduate or less	970	22.2	30	3.1	940	96.9		1751	31.4	110	6.3	1641	93.7	
High school graduation	1549	35.5	50	3.2	1499	96.8		1783	32.0	107	6.0	1676	94.0	
University graduate or higher	1848	42.3	58	3.1	1790	96.9		2035	36.5	117	5.7	1918	94.3	
Physical activity						0.9297								0.3843
No	2342	53.6	73	3.1	2269	96.9		3253	58.4	187	5.7	3066	94.3	
Yes	2025	46.4	65	3.2	1960	96.8		2316	41.6	147	6.3	2169	93.7	
Current smoking of cigarettes						0.0483								<0.0001
Yes	1270	29.1	51	4.0	1219	96.0		281	5.0	41	14.6	240	85.4	
No	3097	70.9	87	2.8	3010	97.2		5288	95.0	293	5.5	4995	94.5	
Drinking status						0.5796								0.0054
No	1533	35.1	52	3.4	1481	96.6		3442	61.8	182	5.3	3260	94.7	
Yes	2834	64.9	86	3.0	2748	97.0		2127	38.2	152	7.1	1975	92.9	
Perceived level of stress on a daily basis						<0.0001								<0.0001
No	3418	78.3	30	0.9	3388	99.1		4060	72.9	52	1.3	4008	98.7	
Yes	949	21.7	108	11.4	841	88.6		1509	27.1	282	18.7	1227	81.3	

with GAD in this study aptly reflect the characteristics of GAD in the Korean population (Table 1).

Table 2 shows that within single-person households, the prevalence of GAD among men was approximately 1.23 times higher than that among women, compared to those residing in multi-person households (male: OR: 1.92, 95 % CI: 1.15–3.20; female: OR: 1.56, 95 % CI:

Table 2
Results of factors associated between number of household members and generalized anxiety disorder(GAD).

Variables	Generalized Anxiety Disorder (GAD)			
	Male		Female	
	OR	95% CI	OR	95% CI
Number of household members				
Multi-Person Households	1.00		1.00	
Single-Person Households	1.92	(1.15–3.20)	1.56	(1.03–2.36)
Age (year)				
19–29	1.00		1.00	
30–39	0.75	(0.37–1.49)	1.06	(0.61–1.82)
40–49	0.71	(0.30–1.63)	0.68	(0.38–1.20)
50–59	0.84	(0.36–1.95)	0.52	(0.28–0.94)
60+	0.74	(0.30–1.81)	0.76	(0.37–1.54)
Marital status				
Married	1.00		1.00	
Single	0.73	(0.37–1.44)	0.93	(0.58–1.48)
Personal income level				
High	1.00		1.00	
Middle	1.49	(0.86–2.56)	1.21	(0.84–1.74)
Low	1.57	(0.87–2.86)	1.14	(0.71–1.82)
Region				
Urban	1.00		1.00	
Rural	1.04	(0.69–1.59)	1.01	(0.75–1.35)
Body mass index (BMI)				
Normal	1.00		1.00	
Underweight	1.14	(0.39–3.33)	1.50	(0.86–2.63)
Obese	1.03	(0.66–1.62)	1.06	(0.80–1.42)
Occupational categories				
White	1.00		1.00	
Pink	1.26	(0.63–2.51)	0.94	(0.60–1.47)
Blue	0.63	(0.33–1.19)	0.92	(0.53–1.59)
Inoccupation	1.71	(0.96–3.05)	1.25	(0.86–1.83)
Education level				
University graduate or higher	1.00		1.00	
High school graduation	0.98	(0.59–1.63)	1.17	(0.80–1.70)
Middle school graduate or less	1.03	(0.49–2.18)	1.47	(0.81–2.65)
Physical activity				
Yes	1.00		1.00	
No	0.88	(0.59–1.30)	0.84	(0.64–1.10)
Current smoking of cigarettes				
No	1.00		1.00	
Yes	0.87	(0.56–1.35)	1.84	(1.13–3.00)
Drinking status				
No	1.00		1.00	
Yes	1.04	(0.68–1.61)	1.24	(0.88–1.73)
Perceived level of stress on a daily basis				
Yes	1.00		1.00	
No	0.06	(0.04–0.10)	0.05	(0.03–0.08)

1.03–2.36). This means that there is a significant association with GAD depending on sex when living in a single-person household. Regarding the occupational groups, compared with white-collar workers, unemployed men were approximately 1.37 times, unemployed women were approximately 1.25 times more likely to have GAD (male: OR: 1.71, 95 % CI: 0.96–3.05; female: OR: 1.25, 95 % CI: 0.86–1.83).

Table 3 demonstrates that the likelihood of experiencing GAD in single-person households varied depending on marital status, while multi-person households exhibited the opposite trend. Compared to women, men were approximately 3.73 times more likely to develop GAD when they were single (male: OR: 3.21, 95 % CI: 1.37–7.50; female: OR: 0.86, 95 % CI: 0.44–1.68). Conversely, married women were approximately 1.45 times more likely to develop GAD compared to married men (male: OR: 1.62, 95 % CI: 0.76–3.46; female: OR: 2.35, 95 % CI: 1.45–3.78). Among individuals in different income groups, men and women in single-person households in the middle-income bracket were more prone to GAD than their counterparts in multi-person households. Additionally, while the risk of GAD increased with extreme income levels (excluding cases in which income was very low for men), the highest risk was observed at the middle-income level. Regarding personal income, men from single-person households in the middle-income group exhibited a higher likelihood of experiencing GAD compared to those from multi-person households (male: OR: 3.00, 95 % CI: 1.44–6.26). Conversely, education level displayed a contrasting trend for both sexes; men who possessed a higher educational level faced an increased risk of GAD in single-person households compared to multi-person households (university graduate or higher male: OR: 2.04; 95 % CI 0.87–4.79; university graduate or higher female: OR 0.86, 95 % CI: 0.42–2.78). However, among women, the risk of GAD in single-person households escalated with lower educational levels compared to that in multi-person households (middle school graduate or less male: OR: 1.71, 95 % CI: 0.50–5.79; middle school graduate or less female: OR: 2.67, 95 % CI: 1.58–4.49).

Last, individuals who were physically inactive exhibited a heightened risk of developing GAD than those who engaged in physical activity, with the risk being higher in single-person households (no physical activity male: OR: 2.51, 95 % CI: 1.28–4.91; no physical activity female: OR: 2.00, 95 % CI: 1.15–3.48).

Fig. 1 depicts the results of the multinomial regression, examining the shift in GAD between single- and multi-person households. These households were categorized into three groups based on participants' GAD scores. The figure illustrates the correlation between GAD and household size, segregated by sex. The cutoff delineated the groups into those without GAD, moderate anxiety, and severe anxiety, corresponding to 0–9, 10–14, and 15–21 points, respectively on the GAD-7. Table 3 exhibits a discernible trend wherein GAD increased incrementally among women residing in single-person households compared with multi-person households. However, a similar trend was not observed for men residing in single-person households. Furthermore, irrespective of sex, the variation in GAD in single-person households based on the severity level did not yield statistically significant differences.

4. Discussion

In this study, following adjustments for potential covariates, we observed that individuals from single-person households in Korea exhibited a heightened propensity to develop GAD compared with those from multi-person households. Notably, there was a discernible sex disparity in the risk of developing GAD in single-person households. Specifically, men in single-person households had a higher likelihood of experiencing GAD than women with similar living arrangements. Hence, living alone was correlated with an elevated risk of developing GAD (Huang et al., 2023). GAD is a mental illness characterized by fear and worry, which distinguishes it from other mental disorders(Mishra and Varma, 2023).

Previous studies have consistently demonstrated that single-person

Table 3
Results of subgroup analysis stratified by independent variables.

Variables*	Number of household members					
	Generalized Anxiety Disorder (GAD)					
	Male			Female		
	Multi-Person Households		Single-Person Households	Multi-Person Households		Single-Person Households
	OR	OR	95 % CI	OR	OR	95 % CI
Age (year)						
19–29	1.00	4.45	(1.08–18.25)	1.00	0.97	(0.35–2.65)
30–39	1.00	3.23	(0.90–11.59)	1.00	0.23	(0.05–1.04)
40–49	1.00	2.35	(0.35–15.47)	1.00	1.47	(0.48–4.45)
50–59	1.00	1.69	(0.48–5.94)	1.00	10.79	(3.39–34.28)
60+	1.00	1.50	(0.55–4.07)	1.00	2.12	(1.28–3.50)
Marital status						
Married	1.00	1.62	(0.76–3.46)	1.00	2.35	(1.45–3.78)
Single	1.00	3.21	(1.37–7.50)	1.00	0.86	(0.44–1.68)
Personal income level						
Low	1.00	0.55	(0.07–3.96)	1.00	1.67	(0.91–3.04)
Middle	1.00	3.00	(1.44–6.26)	1.00	1.73	(0.94–3.16)
High	1.00	1.70	(0.82–3.50)	1.00	1.20	(0.28–5.11)
Region						
Urban	1.00	2.79	(1.30–5.97)	1.00	1.57	(0.87–2.85)
Rural	1.00	1.54	(0.76–3.13)	1.00	1.78	(0.99–3.21)
Body mass index (BMI)						
Underweight	1.00	–	–	1.00	4.47	(0.69–28.88)
Normal	1.00	2.51	(1.01–6.27)	1.00	1.20	(0.57–2.54)
Obese	1.00	1.72	(0.90–3.27)	1.00	1.75	(0.99–3.08)
Occupational categories						
White	1.00	3.36	(1.37–8.24)	1.00	0.79	(0.35–1.76)
Pink	1.00	1.48	(0.42–5.24)	1.00	1.11	(0.37–3.29)
Blue	1.00	2.52	(0.79–8.01)	1.00	4.61	(1.60–13.27)
Inoccupation	1.00	2.34	(0.92–5.93)	1.00	2.14	(1.17–3.93)
Education level						
Middle school graduate or less	1.00	1.71	(0.50–5.79)	1.00	2.67	(1.58–4.49)
High school graduation	1.00	2.01	(0.94–4.27)	1.00	1.72	(0.69–4.25)
University graduate or higher	1.00	2.04	(0.87–4.79)	1.00	0.86	(0.42–1.78)
Physical activity						
No	1.00	2.51	(1.28–4.91)	1.00	2.00	(1.15–3.48)
Yes	1.00	1.44	(0.66–3.15)	1.00	1.24	(0.66–2.34)
Current smoking of cigarettes						
No	1.00	1.95	(1.05–3.61)	1.00	1.69	(1.09–2.62)
Yes	1.00	2.12	(0.92–4.87)	1.00	1.26	(0.26–6.02)
Drinking status						
No	1.00	1.41	(0.54–3.64)	1.00	1.54	(0.94–2.54)
Yes	1.00	2.34	(1.32–4.15)	1.00	1.64	(0.85–3.15)
Perceived level of stress on a daily basis						
No	1.00	0.84	(0.24–2.86)	1.00	2.32	(1.03–5.23)
Yes	1.00	2.58	(1.43–4.66)	1.00	1.33	(0.83–2.13)

* Adjusted for all covariates.

households have a more detrimental impact on mental health compared to multi-person households. Notably, men living alone may experience more severe adverse effects on their mental health than their female counterparts. Additionally, research has indicated correlations between mental health outcomes and factors such as employment status and alcohol consumption (Bertrais et al., 2021; Guckel et al., 2022).

However, contrasting results were obtained in prior studies, diverging from the current findings. Research conducted during the

COVID-19 pandemic revealed a surge in depression and GAD within multi-person households compared to single-person households. Nevertheless, the contradictory outcomes of previous studies and the current study may be owing to the unique circumstances of the COVID-19 pandemic, which imposed severe limitations on external environments, while the data used in this study pertained to the post-COVID-19 period. This distinction is significant as it delves into mental health, particularly GAD, relative to household size among Koreans.

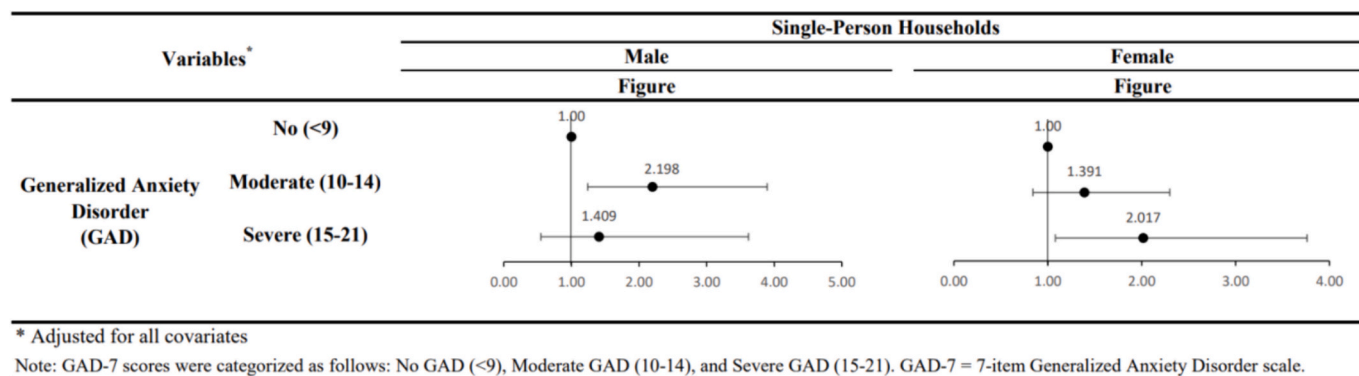


Fig. 1. Results of the multinomial regression analysis for severity of generalized anxiety disorder.

In the subgroup analysis of the independent variables in this study, the association between single-person households and GAD varied according to marital status, education level, and physical activity. First, marital status influenced the risk of GAD in single-person households, contingent on sex. Among men, those who were unmarried and residing alone exhibited a heightened risk of developing GAD, compared to women in similar circumstances. Conversely, among married individuals living alone, the risk of developing GAD was higher in women than in men (Vaingankar et al., 2020). This implies that approaches to marriage vary according to sex. This may be attributed to the understanding of Korea’s social and cultural context and the expectations regarding gender roles after marriage, which have traditionally been characteristic of Asian countries (Chung and Kim, 2014).

Moreover, the impact on GAD in single-person households varied depending on the education level. For men in single-person households, there was a positive correlation between higher education levels and an increased risk of GAD. Particularly noteworthy was the escalation in GAD severity in single-person households between individuals with a middle school diploma and those with a high school diploma compared to the contrast between those with a university degree or higher and those with a high school diploma. Conversely, women exhibit entirely different trends. With a decrease in education level, decreased, the prevalence of GAD among women in single-person households increased, whereas the disparity in GAD across different educational levels remained relatively constant. For men, higher educational levels were associated with heightened GAD in single-person households, whereas for women, lower educational level was linked to increased GAD in single-person households (Chazelle et al., 2011). This phenomenon can be elucidated through the Korean social and cultural dynamics. In Korean society, men are subjected to higher social expectations and pressures than women. Specifically, highly educated men residing in single-person households may experience inherent pressure to attain financial success or adhere to the traditional gender roles. Consequently, in the context of single-person households (McFarland and Wagner, 2015), highly educated men are perceived to be at a greater risk of developing GAD than women (Li et al., 2022). Conversely, women exhibited a distinct trend, characterized by the opposite trajectory. This may be attributed to the fact that women in single-person households with lower educational levels encounter restricted employment prospects, potentially leading to financial challenges or anxiety (Quesnel-Vallée and Taylor, 2012).

Results of the subgroup analysis regarding physical activity revealed an increase in GAD in single-person households for both men and women, regardless of participation in physical activity. Similarly, the absence of physical activity was associated with heightened GAD in single-person households for both sexes. However, the risk of GAD in single-person households decreased among both men and women who engaged in physical activity compared to those who did not exercise (Joo et al., 2023). Physical activity promotes physical health and positively

influences mental wellbeing. Given that the correlation between physical activity and mental illness holds for both sexes, the occurrence of GAD in single-person households can be elucidated through the lens of exercise (White et al., 2017).

Severity was categorized based on GAD level, revealing distinct patterns depending on sex. Among women, the severity of GAD was higher in single-person households than in multi-person households (Faravelli et al., 2013). Conversely, there was no consistent increase in GAD severity among men living in single-person households. Nevertheless, these findings indicate that the severity of GAD in single-person households in Korea tends to be higher than that in multi-person households (Sangalang and Gee, 2012). Moreover, in single-person households, the quality of social relationships is notably influenced by shared meal habits. Individuals who do not dine together are deemed to be at a heightened risk of developing GAD compared with those who engage in communal meals (Mykyta, 2024). This perspective suggests that individuals who avoid communal dining are perceived as more socially isolated, thus exhibiting elevated anxiety levels (Kimura et al., 2012).

The findings suggest that it is necessary to explore the correlation between GAD in single-person households and marital status, education level (Olsson et al., 2022), and physical activity.

4.1. Limitations

This study had certain limitations. First, owing to the use of cross-sectional data from the KNHANES, only correlations could be established, and causal relationships could not be inferred. Consequently, further longitudinal research is warranted to investigate the causal associations. Second, as the KNHANES began including surveys related to GAD only two years prior, the sample size remains limited. Thus, the subgroup analyses were hindered by an insufficient number of participants, particularly among underweight men based on BMI and women aged 50–59 years. This scarcity resulted in a disparity between the number of participants with and without GAD, leading to potential errors in the odds ratio values. Third, due to data constraints, there is a potential risk that unaccounted variables may influence the relationship between single-person households and GAD (Nguyen et al., 2024).

Despite these limitations, this study had several strengths. First, the use of representative sample data from the KNHANES provides findings indicative of the broader situation in Korea. These results can inform the development of mental health policies. Second, the focus on single-person households aligns with the contemporary shift in the household structure in Korea, thereby offering insights that accurately reflect the dynamics of Korea’s modern society. Finally, this study highlighted a link between GAD and mealtime companionship, indicating a potential avenue for future research.

5. Conclusion

Our findings revealed the association between single-person households and GAD in Korea. In particular, through a meticulous analysis of variables such as marital status, education level, and physical activity by sex, we deduced that the presence of GAD in single-person households may be mitigated by physical activity. Rigorous exercise can potentially alleviate the severity of most mental illnesses (Hussenoeder et al., 2023). Hence, it is imperative to formulate health policies aimed at actively promoting exercise among single-person households to prevent the occurrence of mental illnesses such as GAD in the Korean society.

Future research should focus on developing customized physical activity interventions that account for the unique characteristics and lifestyle patterns of single-person households, as well as conducting rigorous evaluations of their efficacy. Subsequent studies in this domain could facilitate the formulation of targeted health intervention strategies aimed at enhancing both the physical and mental well-being of individuals in single-person households.

Funding

None.

CRediT authorship contribution statement

Su Min Park: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Dan Bi Kim:** Writing – review & editing, Resources, Methodology. **Min Jeong Joo:** Writing – review & editing, Resources, Methodology. **Eun-Cheol Park:** Writing – review & editing, Resources, Methodology.

Declaration of competing interest

This manuscript has not been published or presented elsewhere in part or in entirety and is not under consideration by another journal. All study participants provided informed consent. We have read and understood your journal's policies, and we believe that neither the manuscript nor the study violates any of these.

Acknowledgments

We extend our gratitude to the Korean National Health and Nutrition Examination Survey for generously providing the data. We also express our sincere appreciation to all individuals who participated in the survey.

References

- Basowitz, H., Persky, H., Korchin, S.J., Grinker, R.R., 1955. *Anxiety and Stress*. McGraw-Hill, New York, NY, US.
- Bertrais, S., Mauroux, A., Chastang, J.-F., Niedhammer, I., 2021. Associations of multiple occupational exposures with major depressive and generalized anxiety disorders: findings from the French National Working Conditions Survey. *Depress. Anxiety* 38 (3), 337–350. <https://doi.org/10.1002/da.23111>.
- Chazelle, E., Lemogne, C., Morgan, K., Kelleher, C.C., Chastang, J.-F., Niedhammer, I., 2011. Explanations of educational differences in major depression and generalised anxiety disorder in the Irish population. *J. Affect. Disord.* 134 (1), 304–314. <https://doi.org/10.1016/j.jad.2011.05.049>.
- Chung, W., Kim, R., 2014. Does marriage really matter to health? Intra- and inter-country evidence from China, Japan, Taiwan, and the Republic of Korea. *PLoS One* 9 (8), e104868. <https://doi.org/10.1371/journal.pone.0104868>.
- Dommaraju, P., 2015. One-person households in India. *Demogr. Res.* S15 (45), 1239–1266. <https://doi.org/10.4054/DemRes.2015.32.45>.
- Faravelli, C., Alessandra Scarpato, M., Castellini, G., Lo Sauro, C., 2013. Gender differences in depression and anxiety: the role of age. *Psychiatry Res.* 210 (3), 1301–1303. <https://doi.org/10.1016/j.psychres.2013.09.027>.
- Freeston, M.H., Rhéaume, J., Letarte, H., Dugas, M.J., Ladouceur, R., 1994. Why do people worry? *Personal. Individ. Differ.* 17 (6), 791–802. [https://doi.org/10.1016/0191-8869\(94\)90048-5](https://doi.org/10.1016/0191-8869(94)90048-5).
- Guckel, T., Miller, C.L., Longo, M., Cooke, R., Bowden, J.A., 2022. Alcohol consumption and mental health conditions: insights from a south Australian population survey to

- inform policy and practice. *Aust. N. Z. J. Public Health* 46 (5), 668–675. <https://doi.org/10.1111/1753-6405.13277>.
- Huang, M., Liu, K., Liang, C., Wang, Y., Guo, Z., 2023. The relationship between living alone or not and depressive symptoms in older adults: a parallel mediation effect of sleep quality and anxiety. *BMC Geriatr.* 23 (1), 506. <https://doi.org/10.1186/s12877-023-04161-0>.
- Hussenoeder, F.S., Conrad, I., Pabst, A., Engel, C., Zachariae, S., Zeynalova, S., Glaesmer, H., Hinze, A., Witte, V., Schomerus, G., Löffler, M., Villringer, A., Sander, C., Riedel-Heller, S.G., 2023. Physical activity and mental health: the connection between step count and depression, anxiety and quality of sleep. *Psychol. Health Med.* 28 (9), 2419–2429. <https://doi.org/10.1080/13548506.2022.2159453>.
- Hussenoeder, F.S., Conrad, I., Pabst, A., Engel, C., Zachariae, S., Zeynalova, S., Yahiaoui-Doktor, M., Glaesmer, H., Hinze, A., Witte, V., Wichmann, G., Kirsten, T., Löffler, M., Villringer, A., Riedel-Heller, S.G., 2024. Connecting chronic stress and anxiety: a multi-dimensional perspective. *Psychol. Health Med.* 29 (3), 427–441. <https://doi.org/10.1080/13548506.2022.2124292>.
- Joo, M.J., Jang, Y.S., Jang, Y.S., Park, E.-C., 2023. Association between work-related physical activity and depressive symptoms in Korean workers: data from the Korea national health and nutrition examination survey 2014, 2016, 2018, and 2020. *BMC Public Health* 23 (1), 1752. <https://doi.org/10.1186/s12889-023-16631-6>.
- Jung, Y.H., Jang, B.N., Park, M., Park, E.-C., 2022. Association between family financial decline due to COVID-19 and generalized anxiety disorder among Korean adolescents. *J. Affect. Disord.* 309, 411–417. <https://doi.org/10.1016/j.jad.2022.04.154>.
- Kim, S., Ryu, S., Kim, Y.-S., Lee, M.-H., 2023. How housing welfare policies impact housing cost burdens: an analysis of housing welfare policy efficacy and household characteristics. *Habitat Int.* 140, 102923. <https://doi.org/10.1016/j.habitatint.2023.102923>.
- Kimura, Y., Wada, T., Okumiya, K., Ishimoto, Y., Fukutomi, E., Kasahara, Y., Chen, W., Sakamoto, R., Fujisawa, M., Otsuka, K., Matsubayashi, K., 2012. Eating alone among community-dwelling Japanese elderly: association with depression and food diversity. *J. Nutr. Health Aging* 16 (8), 728–731. <https://doi.org/10.1007/s12603-012-0067-3>.
- Li, L., Sun, W., Luo, J., Huang, H., 2022. Associations between education levels and prevalence of depressive symptoms: NHANES (2005–2018). *J. Affect. Disord.* 301, 360–367. <https://doi.org/10.1016/j.jad.2022.01.010>.
- Lin, S., 2022. Generalized anxiety disorder during COVID-19 in Canada: gender-specific association of COVID-19 misinformation exposure, precarious employment, and health behavior change. *J. Affect. Disord.* 302, 280–292. <https://doi.org/10.1016/j.jad.2022.01.100>.
- McFarland, M.J., Wagner, B.G., 2015. Does a college education reduce depressive symptoms in American young adults? *Soc. Sci. Med.* 146, 75–84. <https://doi.org/10.1016/j.socscimed.2015.09.029>.
- Mishra, A.K., Varma, A.R., 2023. A comprehensive review of the generalized anxiety disorder. *Cureus* 15 (9), e46115. <https://doi.org/10.7759/cureus.46115>.
- Mykyta, L., 2024. Living alone and feelings of depression among adults age 18 and older. *Natl Health Stat Report* 199, 1–11.
- Nguyen, A.W., Taylor, H.O., Taylor, R.J., Ambrose, A.Z., Hamler, T., Qin, W., Chatters, L.M., 2024. The role of subjective, interpersonal, and structural social isolation in 12-month and lifetime anxiety disorders. *BMC Public Health* 24 (1), 760. <https://doi.org/10.1186/s12889-024-18233-2>.
- Olfson, M., Cosgrove, C.M., Altekruze, S.F., Wall, M.M., Blanco, C., 2022. Living alone and suicide risk in the United States, 2008–2019. *Am. J. Public Health* 112 (12), 1774–1782. <https://doi.org/10.2105/ajph.2022.307080>.
- Park, B.-Y., Kwon, H.-J., Ha, M.-N., Burm, E.-A., 2016. A comparative study on mental health between elderly living alone and elderly couples - focus on gender and demographic characteristics. *Journal of Korean Public Health Nursing* 30 (2), 195–205.
- Park, J.H., Min, S., Eoh, Y., Park, S.H., 2021. The elderly living in single-person households in South Korea: a latent profile analysis of self-esteem, life satisfaction, and depression. *Qual. Life Res.* 30 (4), 1083–1092. <https://doi.org/10.1007/s11136-020-02693-1>.
- Park, S., Cho, J., 2022. Young people are medically invulnerable to COVID-19 but vulnerable in the labor market: Korean evidence. *Heal. Econ. Rev.* 12 (1), 16. <https://doi.org/10.1186/s13561-022-00360-4>.
- Penninx, B.W.J.H., Pine, D.S., Holmes, E.A., Reif, A., 2021. Anxiety disorders. *Lancet* 397 (10277), 914–927. [https://doi.org/10.1016/S0140-6736\(21\)00359-7](https://doi.org/10.1016/S0140-6736(21)00359-7).
- Quesnel-Vallée, A., Taylor, M., 2012. Socioeconomic pathways to depressive symptoms in adulthood: evidence from the National Longitudinal Survey of youth 1979. *Soc. Sci. Med.* 74 (5), 734–743. <https://doi.org/10.1016/j.socscimed.2011.10.038>.
- Sangalang, C.C., Gee, G.C., 2012. Depression and anxiety among Asian Americans: the effects of social support and strain. *Soc. Work* 57 (1), 49–60. <https://doi.org/10.1093/sw/swr005>.
- Shams Ghahfarokhi, M., 2022. Rising living alone among the elderly in Iran: prevalence and associated factors. *BMC Geriatr.* 22 (1), 622. <https://doi.org/10.1186/s12877-022-03309-8>.
- Smith, K.J., Victor, C., 2019. Typologies of loneliness, living alone and social isolation, and their associations with physical and mental health. *Ageing Soc.* 39 (8), 1709–1730. <https://doi.org/10.1017/S0144686X18000132>.
- Vaingankar, J.A., Abidin, E., Chong, S.A., Shafie, S., Sambasivam, R., Zhang, Y.J., Chang, S., Chua, B.Y., Shahwan, S., Jeyagurunathan, A., Kwok, K.W., Subramaniam, M., 2020. The association of mental disorders with perceived social support, and the role of marital status: results from a national cross-sectional survey. *Arch. Public Health* 78 (1), 108. <https://doi.org/10.1186/s13690-020-00476-1>.

- White, R.L., Babic, M.J., Parker, P.D., Lubans, D.R., Astell-Burt, T., Lonsdale, C., 2017. Domain-specific physical activity and mental health: a Meta-analysis. *Am. J. Prev. Med.* 52 (5), 653–666. <https://doi.org/10.1016/j.amepre.2016.12.008>.
- Williams, N., 2014. The GAD-7 questionnaire. *Occup. Med.* 64 (3), 224. <https://doi.org/10.1093/occmed/kqt161>.
- Xue, Y., Lu, J., Zheng, X., Zhang, J., Lin, H., Qin, Z., Zhang, C., 2021. The relationship between socioeconomic status and depression among the older adults: the mediating role of health promoting lifestyle. *J. Affect. Disord.* 285, 22–28. <https://doi.org/10.1016/j.jad.2021.01.085>.
- Yeung, W.-J.J., Cheung, A.K.-L., 2015. Living alone: one-person households in Asia. *Demographic Research* S15 (40), 1099–1112. <https://doi.org/10.4054/DemRes.2015.32.40>.