Risk factors of problem drinking in the chronic phase among evacuees in Fukushima following the Great East Japan Earthquake based on a two-year cohort study: The Fukushima Health Management Survey

学　位　論　文

Risk factors of problem drinking in the chronic phase among evacuees in Fukushima following the Great East Japan Earthquake based on a two-year cohort study: The Fukushima Health Management Survey

（東日本大震災後の避難住民における問題飲酒になる要因

2年間のコホート研究：福島県県民健康調査）

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論　文　内　容　要　旨（和文）

学位論文題名	Risk factors of problem drinking in the chronic phase among evacuees in Fukushima following the Great East Japan Earthquake based on a two-year cohort study: The Fukushima Health Management Survey 東日本大震災後の避難住民における問題飲酒になる要因 2年間のコホート研究：福島県県民健康調査

【目的】先行研究では、震災後における問題飲酒と精神健康に関連があると報告されている。しかし、震災後、どのような危険因子が問題飲酒の発展に関連するかについては明らかでなはい。本研究は、東日本大震災後の慢性時期に、避難住民おける問題飲酒になる社会心理的要因及び生活習慣を男女別に明らかにした。

【方法】東日本大震災後に避難区域指示になった13市町村の避難住民に「こころの健康度・生活習慣に関する調査」を送付した。本研究の対象者は、調査票を送付した2012年・2013年ともに回答した20歳以上の22,774人とした。その対象者のうち、自身で調査票を回答しておらず、かつアルコール依存症尺度（CAGE）が無回答者を除外したため、本研究のデータ分析対象者は12,490人となった。性別、年齢階級、健康状態、運動状態、生活習慣病関連、精神科既往歴、睡眠状態、笑い、仕事の変化の有無、経済状態、精神健康度(K6)、トラウマ反応、社会的孤立(LSN-6)、飲酒量を独立変数としたロジスティック回帰分析を行い、問題飲酒と有意な関連を持つ要因を明らかにした。

【結果】男女共に、睡眠問題（オッズ比1.63　95%信頼区間：1.21-2.19）と4ドリンク以上の多量飲酒（オッズ比2.26　95%信頼区間：1.82-2.80）は、2012年から2013年の問題飲酒になる要因であった。男性の避難住民においては、家計の悪化（オッズ比1.81　95%信頼区間：1.36-2.42）、トラウマ反応（オッズ比2.08　95%信頼区間：1.52-2.84）が問題飲酒になる危険因子であった。一方で、女性の避難住民においては、過去の精神科既往歴（オッズ比1.99　95%信頼区間：1.06-3.74）が問題飲酒につながる要因であった。

【結論】本研究では、震災後の慢性期に問題飲酒につながる危険因子には男女の差があることが分かった。男性では、震災後の家計の悪化、トラウマ反応が高値であることが問題飲酒の危険因子になることが示唆された。一方で、女性の避難住民では、精神科既往の有無が問題飲酒の構築の要因であることが考えられた。したがって、複合震災後には、問題飲酒になる性差の違いを配慮した避難住民特有の防止対策を開発する必要がある。

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Risk factors of problem drinking among evacuees in Fukushima following the Great East Japan Earthquake based on a two-year cohort study: The Fukushima Health Management Survey

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Abstract

Rationale: A bidirectional relationship between problem drinking and psychological distress after a disaster has been consistently reported in research, but the risk factors of problem drinking following disasters remain unclear.

Objectives: This population-based longitudinal study aimed to examine the risk factors associated with the incidence of problem drinking among evacuees after the Great East Japan Earthquake on March 11, 2011.

Methods: This study was used the data from the Mental Health and Lifestyle Survey for evacuees of the Fukushima Daiichi Nuclear Power Plant accident. A total of 22,774 individuals from 13 municipalities ordered to evacuate after the accident by the government in Japan, participated in the surveys in 2012 and 2013. The CAGE (Cutting down, Annoyed by criticism, Guilty feeling, and Eye-opener) Questionnaire was used to evaluate problem drinking. Bivariate logistic regression models were applied to investigate the possible predictors of problem drinking development in 2013.

Findings: Sleep insufficiency (very dissatisfied to quite problem) (odds ratio [OR]=1.63, 95% confidence interval [CI]: 1.21-2.19) and heavy drinking (>4 drinks; odds ratio [OR]=2.26, 95% confidence interval [CI]: 1.82-2.80) was risk factor for incidence of problem drinking from 2012 to 2013 in both men and women. Additionally,

among men, family finance (severe) due to disaster (OR=1.81, 95% CI: 1.36-2.42), and trauma symptoms (OR=2.08, 95% CI: 1.52-2.84) were significant; among women, diagnosed history of mental illness (OR=1.99, 95% CI: 1.06-3.74) was significant factors for development of problematic drinking.

Conclusions: Our findings illustrate the risk factors for problematic drinking in both sex in the chronic phase after a disaster. The results could help develop a primary intervention to prevent the development of problem drinking focused on considering sex differences after a compound disaster, such as Great East Japan Earthquake and Fukushima Nuclear Accident.

Keywords: problem drinking, CAGE, disaster, evacuees, epidemiology

Introduction

Alcohol and mental health are interrelated and known to influence each other (Bell et al. 2014).Verplaetse et al. (2018) explained that substance use disorders are often associated with stressful events, and it is common for individuals with an alcohol use disorder to have comorbid posttraumatic stress disorder (PTSD) or past experience of traumatic events (Petrakis and Simpson 2017). Particularly, individuals who experience a disaster tend to be at risk for increased alcohol consumption (Fullerton et al. 2013; Welch et al. 2014). In the first and second years after the 9/11 terrorist attacks, alcohol consumption, binge drinking, and alcohol misuse were associated with posttraumatic stress disorder onset (Boscarino et al. 2011).

The Great East Japan Earthquake of March 11, 2011 and the subsequent Fukushima nuclear accident constituted a compound disaster that caused problem drinking and psychological stress among evacuees from Fukushima (Oe et al. 2016). In

our previous study on Fukushima evacuees, those who started drinking after the disaster showed a higher risk of serious mental illness after the disaster (Ueda et al. 2016).

Attention and intervention for alcohol-related issues are essential after disasters. However, the risk factors underlying the problem drinking of disaster evacuees remain unclear. Understanding these factors would help us support evacuees trying to reconstruct their lives, and enable the integration of alcohol-misuse prevention programs into global disaster preparation and response efforts. This prospective study, therefore, assessed how trauma exposure and various psychological and social risk factors influenced problem drinking among evacuees of the Great East Japan Earthquake. Previous studies have linked demographic characteristics, socioeconomic factors, and disaster-related factors with problem drinking (Boscarino et al. 2006, 2011; Gray et al. 2016). Therefore, our a priori hypothesis is that family financial problems and employment changes due to disaster, as well as physical and psychological problems including sleep insufficiency, will be predictors of the incidence of problem drinking among evacuees.

METHODS

Study design

We used data from the Mental Health and Lifestyle Survey, which assessed the mental health and lifestyle of evacuees of the Fukushima Daiichi nuclear power plant accident. The complete survey protocol was published in 2012 (Yasumura et al. 2012). Target participants lived in the 12 municipalities that were issued evacuation orders by the government at the time of the accident (Hirono, Naraha, Tomioka, Kwauchi, Okuma, Futaba, Namie, Katsurao, Iitate, Tamura, Minami-Soma, and Kawamata) and in

evacuated hot-spot areas in Date. While all residents of Hirono, Naraha, Tomioka, Kwauchi, Okuma, Futaba, Namie, Katsurao, and Iitate were ordered to evacuate, the municipalities of Minami-Soma, Tamura, and Kawamata included both evacuees and non-evacuees. These residents have received questionnaires yearly since January 18, 2012 (Yasumura et al. 2012). This paper used data only from 2012 and 2013 to elucidate the development of problem drinking in the first two years post-disaster. The Ethics Review Committee of Fukushima Medical University approved this study (No. 1316).

Participants

Figure 1 shows the participant flow chart. The target population was 52,602 adults aged 20 years old or older, who responded to the 2012 survey (response rate 29.9%; n=184,507). We excluded respondents who failed to answer the CAGE (Cut down, Annoyed, Guilty, and Eye-opener) questionnaire (n=12,247) or who did not respond to the questionnaire on their own (n=3,662) for 2012. We again excluded respondents who failed to answer the CAGE questionnaire (n=9,805) and who did not respond on their own (n=479) for 2013. Participants reporting a CAGE score<2 accounted for 95.3% of the sample (n=9,802), while 482 (4.7%) participants who reported a CAGE score≥2. Therefore, we ultimately obtained longitudinal data for 12,490 participants.

Measures

Alcohol consumption and problem drinking. Respondents rated their current drinking behavior as “don’t drink or only rarely drink (less than once a month),” “quit drinking,” or “drink (once or more times a month).” If they responded, “drink (once or

more times a month),” they were asked to specify how much they drank in a year. To be consistent with our previous research (Ueda et al. 2016), heavy drinking/drinking consumption that would enhance the risk for a lifestyle disease was defined as 4 or more drinks per day (≥ 44 g of ethanol); lower consumption levels were defined as “light drinking.” A drink, by this definition, meant 120 mL of spirits (e.g., whisky or brandy), 480 mL of wine, 1,000 mL of beer, or 360 mL of sake. This definition is consistent with the reported median of moderate and proper drinking (20 g of ethanol per day) and heavy drinking (60 g of ethanol per day) reported by the Japanese Ministry of Health, Labor and Welfare (2019) .

The CAGE questionnaire was administered only to those with the responses “don’t drink or only rarely drink (less than once a month)” and “drink (once or more times a month)” to assess whether they were problem drinkers. The CAGE questionnaire was designed to screen for alcohol dependency (Castells and Furlanetto 2005), and its validity and effectiveness have been confirmed by past research. It can also aid in the diagnosis of alcoholism (Ewing 1984). It comprises four questions: “Have you ever felt you ought to Cut down on your drinking?”, “Have people Annoyed you by criticizing your drinking?”, “Have you ever felt bad or Guilty about your drinking?”, and “Have you ever had a drink first thing in the morning to steady your nerves or to get rid of a hangover (Eye-opener)?” (Ewing 1984). Participants with two or more positive answers were classified as heaving alcohol dependence irrespective of their sex in accordance with the previous studies (Castells and Furlanetto 2005). For the purpose of this research, we defined a CAGE score of ≥2 as problem drinking. We also categorized participants according to whether they experienced changes in CAGE score

from 2012 to 2013 as "emerging problem drinkers," comprising individuals without alcohol dependence in 2012, but with alcohol dependence (i.e., incidence of problem drinking) in 2013, and "maintaining non-problem drinkers," comprising individuals who demonstrated alcohol dependence in neither 2012 nor 2013.

General and socioeconomic status variables. Previous studies have linked various demographic characteristics, socioeconomic factors, and disaster-related factors with problem drinking (Boscarino et al. 2006, 2011; Gray et al. 2016). Demographic factors considered here included sex, age (20–49, 50–64, or ≥65 years), and any history of a diagnosed mental illness (yes or no), high blood pressure (yes or no), diabetes mellitus (yes or no), or hyperlipidemia (yes or no). Socioeconomic factors included employment change (i.e., change in work from pre- to post-disaster; yes or no) and family financial situation post-disaster (severe, somewhat severe, average, or not severe).

Current social network status. To assess current social network status, we used the Lubben Social Network Scale (LSNS-6). This scale assesses family and friendship ties and has been empirically validated for screening for risk of social isolation (Lubben et al. 2006; Nordløkken et al. 2016).The scale was constructed from three items for each of the two ties, as follows: 1) "How many relatives do you see or hear from at least once a month?; 2) How many relatives do you feel close to such that you could call on them for help?; 3) How many relatives do you feel at ease with that you can talk about private matters?; 4) How many of your friends do you see or hear from at least once a month?; 5) How many friends do you feel close to such that you could call on them for help?; and 6) How many friends do you feel at ease with that you

can talk about private matters?" (Nordløkken et al. 2016). Each item is rated on a 6-point scale: 0 (none), 1 (one), 2 (two), 3 (three or four), 4 (five to eight), and 5 (nine or more). We classified participants with scores of <12/30 points as being at risk of social isolation (Lubben et al. 2006). The Japanese version of the LSNS-6 has shown adequate reliability and validity (Kurimoto et al. 2011).

Sleep insufficiency. Traumatic events also lead to sleep-related problems (Lavie 2001). Sleep disruption was one of the most frequently cited issues after the Great East Japan Earthquake (Matsumoto et al. 2014). Alcohol is also often used as a (poor) coping mechanism for insomnia (Karz et al. 2014). In the questionnaire, we asked "Are you satisfied with the quality of your sleep over the past month (regardless of sleep duration)?" Participants indicated if they were "satisfied," "slightly dissatisfied," "quite dissatisfied," or "very dissatisfied or have barely slept all."

Laughter. We also analyzed the frequency of laughter. Laugher enhances individual's emotional well-being and life satisfaction (Hasen and Hasen 2009). The participants of this study were asked how often they had laughed in the previous month: "every day," "1–5 times per week," "1–3 times per month," or "none." Greater frequency of laughter can promote the general and mental health of older adults in Japan (Hayashi et al. 2015). This question has proven to have adequate test-retest reliability (Hirosaki et al. 2018).

Risk of serious mental illness and psychological distress (K6). We used the 6-item Kessler Psychological Distress Scale (K6) as a screener for non-specific serious mental illness (Kessler et al. 2003). Scores of 13–24 were classified as "probable serious mental illness," while scores of 0–12 were classified as "probable

mild-moderate/probable no mental illness" (Kessler et al. 2006). The current study used the Japanese version of the K6, which was validated in a previous study (Furukawa et al. 2008).

Trauma symptoms. We used the PTSD Checklist-Specific (PCL-S) to measure current traumatic symptoms among participants, to analyze how they were related to drinking behavior. The PCL-S comprises 17 items assessing PTSD symptoms, all of which are rated on a Likert scale from 1 (not at all) to 5 (extremely). A cutoff of 44 was able to correctly identify individuals with a PTSD diagnosis (Blanchard et al. 1996). We used the Japanese version of the PCL-S, which was previously validated (Iwasa et al. 2016; Suzuki et al. 2017).

Statistical analysis

First, we performed a chi-squared test to investigate associations between risk factors and the proportion of individuals who were emerging problem drinkers. The data were then analyzed only for those who did not have a drinking problem (CAGE<2) in 2012. Bivariate logistic regression models were applied to investigate the possible predictors of problem drinking development (i.e., emerging problem drinkers). We further conducted a multivariate logistic regression analysis that included the significant variables from the bivariate analysis. We excluded missing data from the statistical analysis.

Furthermore, to confirm the representativeness of the participants, we performed a chi-squared test to compare socio-demographic, health-related, and disaster-related status in 2012 between those who completed the CAGE in 2012 (n = 36,693) and those who responded in 2012, excluding participants with missing CAGE

data or failure to respond (n = 15,909). Further, we performed a bivariate logistic regression model to compare the odds ratios of individual risk factors for the prevalence of problem drinking in 2012 between the participants analyzed in this study (n=12,490), and those who were excluded because they responded only in 2012, but not 2013 (n=13,946).

Significance was set at $p<.05$. All statistical analyses were conducted using IBM SPSS Statistics 24.0 (IBM Corp. Armonk, NY).

RESULTS

Table 1 shows the breakdown of variables according to change (or lack thereof) in problem drinking (low score to high score defined as emerging problem drinkers; continuous low score defined as maintaining non-problem drinkers) from 2012 to 2013, revealing what characteristics were associated with these changes. The total number of emerging problem drinkers was 902, while the number of maintaining non-problem drinkers was 9,693. Importantly, 8.5% of the sample developed problem drinking from 2012 to 2013, the year following the disaster.

More men than women developed problem drinking from 2012 to 2013. Emerging problem drinkers also included a higher proportion of those with K6, PCL-S, and LSN-6 scores of ≥13, ≥44, and <12, respectively, and were heavy drinkers compared to maintaining non-problem drinkers. Furthermore, we found becoming a problem drinker to be associated with age, subjective health, history of a serious mental illness, high blood pressure, diabetes mellitus, sleep insufficiency, laughter frequency, employment change, and family financial status (p <.05).

Table 2 shows an overview of the bivariate logistic regression analysis of both emerging problem drinkers and maintaining non-problematic drinkers, conducted to identify possible predictors for developing problem drinking from 2012 to 2013. None of the variance inflation factors exceeded two, indicating no collinearity. We found that the development of problem drinking was significantly predicted by sex, subjective health conditions, diagnosed mental illness history, blood pressure, diabetes mellitus, sleep insufficiency, laughing frequency, employment change due to disaster, family finances, alcohol consumption, and specific scores on the K6, PCL-S, and LSN-6.

In the multivariate logistic regression analysis (Table 3), sex (odds ratio [OR]=1.77, 95%CI: 1.44-2.21), age (20-49 years old) (odds ratio [OR]=1.38, 95% CI: 1.04-1.82), sleep insufficiency (OR=1.63, 95% CI: 1.21-2.19), PCL-S≥44 (OR=1.75, 95% CI: 1.33-2.31), family finances ([severe] OR=1.71, 95% CI: 1.33-2.20; [not severe] OR=0.22, 95% CI: 0.08-0.59) and heavy drinking (OR=2.26, 95% CI: 1.82-2.80) remained significantly associated with the development of problem drinking. There were also some differences in the predictors by sex. Among men, age (OR=1.29 95%CI: 1.00-1.66), family finances ([severe] OR=1.81, 95%CI: 1.36-2.42; [not severe] OR=0.15, 95%CI: 0.04-0.60), and PCL≥44 (OR=2.08, 95% CI: 1.52-2.84) were also risk factors for problem drinking. Among women, history of a diagnosed mental illness (OR=1.99, 95% CI: 1.06-3.74) was a significant risk factor.

As there were particularly strong correlations between the K6 and PCL-S, we conducted separate multivariate logistic regression analyses for these predictors to identify their independent predictive ability for problem-drinking development (Table 4 and Table 5). While there were no significant associations between K6 and the

development of problem drinking from 2012 to 2013 (Table 4), PCL-S was a risk factor for both men and women (Table 5).

DISCUSSION

This study examined the risk factors for developing problem drinking from 2012 to 2013, after the Great East Japan Earthquake, among Fukushima evacuees. North et al. (2011) suggested that the clinically significant risk factors for problem drinking have not been systematically evaluated, and that the development of problem drinking following disasters need to be considered in terms of both pathological and social factors. Additionally, a study conducted in the second year after this compound disaster showed that the risk factors for developing post-disaster problem drinking included being male, less than 65 years, having sleep insufficiency, psychological distress, and drinking heavily (Orui et al., 2017).

In this study, a sizable proportion of the sample (8.5%) developed problem drinking within a year (from 2012 to 2013) of the compound disaster. These results highlight the importance of developing primary prevention plans in public health for alcohol problems during the chronic phase post-disaster. We hypothesized that disaster-related factors such as employment changes due to disasters and physical and psychological problems are associated with an increased risk of developing problem drinking from the second to the third year post-disaster.

According to our prospective analysis, sleep insufficiency and heavy drinking were major predictors of developing problem drinking from 2012 to 2013 in both sexes. Additionally, we observed some differences between the sexes in the predictors of problem-drinking development. Among men, having trauma symptoms (PCL-S≥44) and

a severe change in family finances due to the disaster were significant risk factors for problem-drinking development; among women, mental illness history was a significant predictor. It is important to consider such differences in risk factors between sexes when devising intervention plans for problem drinking.

Our findings counter those of some previous studies that investigated the risk factors for alcohol problems in the post-disaster period (Cerda et al. 2011; Kachadourian et al. 2014). Several previous studies found that a low-income trajectory was a factor for changing alcohol consumption (Vlahov et al. 2002; Cerda et al. 2008, 2011). Additionally, having low income post-disaster has been associated with depression (Ahern and Galea, 2006). In this study, however, we found that family financial situation was a significant predictor only for men. Additionally, a previous national study found that trauma exposure/PTSD was more strongly associated with problem drinking in women compared to men (Kachadourian et al. 2014). This contrasts with our result that trauma influenced problem drinking only in men. However, our results support, to a certain extent, a study stating that women show increased use of pharmaceuticals after a disaster while men show increased use of alcohol (Vetter et al. 2008). Additionally, Boscarino et al. (2011) examined the experiences of the 9/11 terrorist attack victims from 2002–2004 and noted that men were more likely than women to begin drinking during stressful times during the second to the fourth year after the disaster. Accordingly, men may be at greater risk of developing problem drinking after traumatic events compared to women.

There are several potential reasons for the sex differences observed. Jayawickreme et al. (2012) examined sex differences in association with trauma

cognition and alcohol cravings among individuals diagnosed with PTSD and alcohol dependence and found that negative beliefs about the world and oneself related to traumatic experiences explained alcohol problems in men, while interpersonal relationship problems were a better explanation of problem drinking in women. Therefore, the fact that trauma symptoms (PCL-S) were stronger predictors of problem-drinking development in men might be the result of negative cognitions related to traumatic experiences; conversely, the risk factors among women might be due to the symptoms of an existing illness resulting from long-term evacuation.

The necessity of having to accommodate to a new living style due to long-term evacuation might therefore be inferred as a cause of deterioration in mental functioning in women. Matsumoto et al. (2011) reported that women with problem drinking had severe depression and exhibited greater suicidality than men. Alcohol and depression are interdependent in women and exert a strong influence on each other compared to their effects in men. We presented key data on the risk factors of problem-drinking development among Fukushima evacuees following the Great East Japan Earthquake. The prevalence of CAGE scores ≥ 2 in this study after adjusting for the age and sex distribution of Japan in 2002 was 10.6%, which is higher than the 3.8% reported by a nationwide survey in 2002 (Osaki et al. 2005). Thus, the prevalence of problem drinking in the post-disaster period was roughly three times larger than that under non-disaster conditions. However, it should be noted that there may be differences in other risk factors for problem drinking (e.g., survey year, economic status), in addition to controlling for age and sex

To the best of our knowledge, this is the first study to examine the risk factors of problem drinking in both sexes using the CAGE questionnaire based on a prospective study after the Great East Japan Earthquake. The findings emphasize that problem drinking in the post-disaster period is not a personal issue but a social one. Developing social facilities in evacuation areas that provide physical, psychological, social, and economical support for evacuees is crucial to prevent problem drinking after a disaster. Since sleep insufficiency, history of a diagnosed mental illness, trauma symptoms, and heavy drinking were associated with the development of problem drinking from the second to the third year after the disaster, it is important for practitioners to assess what evacuees need to alleviate mental illness, trauma symptoms, and sleeping issues as a primary measure for the prevention of problem drinking. Additionally, we found that employment change due to disasters is associated with risk factors for problem drinking in men. Therefore, the government should consider methods to better stabilize occupational situations and economic issues in evacuation areas to support evacuees.

On the other hand, the present study has several limitations. First, the response rate was 29.9% in 2012; therefore, the results might not represent the wider population of evacuees within the evaluation areas specified by the government. Further, we have excluded participants who failed to answer the CAGE or did not respond to the questionnaire personally. Respondents who completed the CAGE in 2012 reported better status in terms of problem drinking risk factors, except alcohol consumption (e.g., sleep insufficiency, family finance, trauma symptom), than those who responded in 2012, but were excluded due to missing CAGE data or failure to respond on their own (Table 6). This suggested that the prevalence and incidence of problem drinking

obtained in this study might be an underestimate of the true incidence rate following the disaster. In this regard, however, bivariate logistic regression analysis showed no large differences in odds ratios for prevalence of problem drinking except for sex and family finances between those included in the data analysis and those excluded due to not responding to the survey in 2013 (Table 7). The associations of problem drinking with sex and family finances were weaker and stronger in those included in this study than those excluded, respectively. Even though the response rate was only 29.9% in 2012, this study has gleaned important perspectives of the evacuees residing in the designated evacuation area from the second to third year after the Great East Japan Earthquake on what risk factors led them to develop problem drinking behavior.

Second, we assessed participants' problem drinking using the CAGE questionnaire, which is not equivalent to a clinical diagnosis. Still, the CAGE questionnaire has proven useful as a screening test for alcoholism (Ewing, 1984). Third, we did not evaluate the impact of disaster on problem drinking immediately after the disaster because of the lack of the pre-earthquake advent data for this cohort study; however, our study evaluated the risk factors of problem dinking accounting for sex differences in the chronic phase after the compound disaster.

In conclusion, this study suggested that the consequences of long-term evacuation and the resulting physical, psychological, and economic issues contributed to the development of problem drinking from the second to the third-year post-disaster. The findings of this study may be of use for future disaster preparedness and responses, particularly in terms of policy planning and interventions for evacuees. The government

should consider these risk factors in order to provide support and improve evacuees' health and lives after the disaster.

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Author Contributions: YU, MM, HY, and TO conceived and designed the study, collected the data, analyzed and interpreted the data, and drafted the manuscript. MM, YS, MO, MM, and SY conceived and designed the study, analyzed and interpreted the data, and critically revised the manuscript. All authors read and approved the final manuscript.

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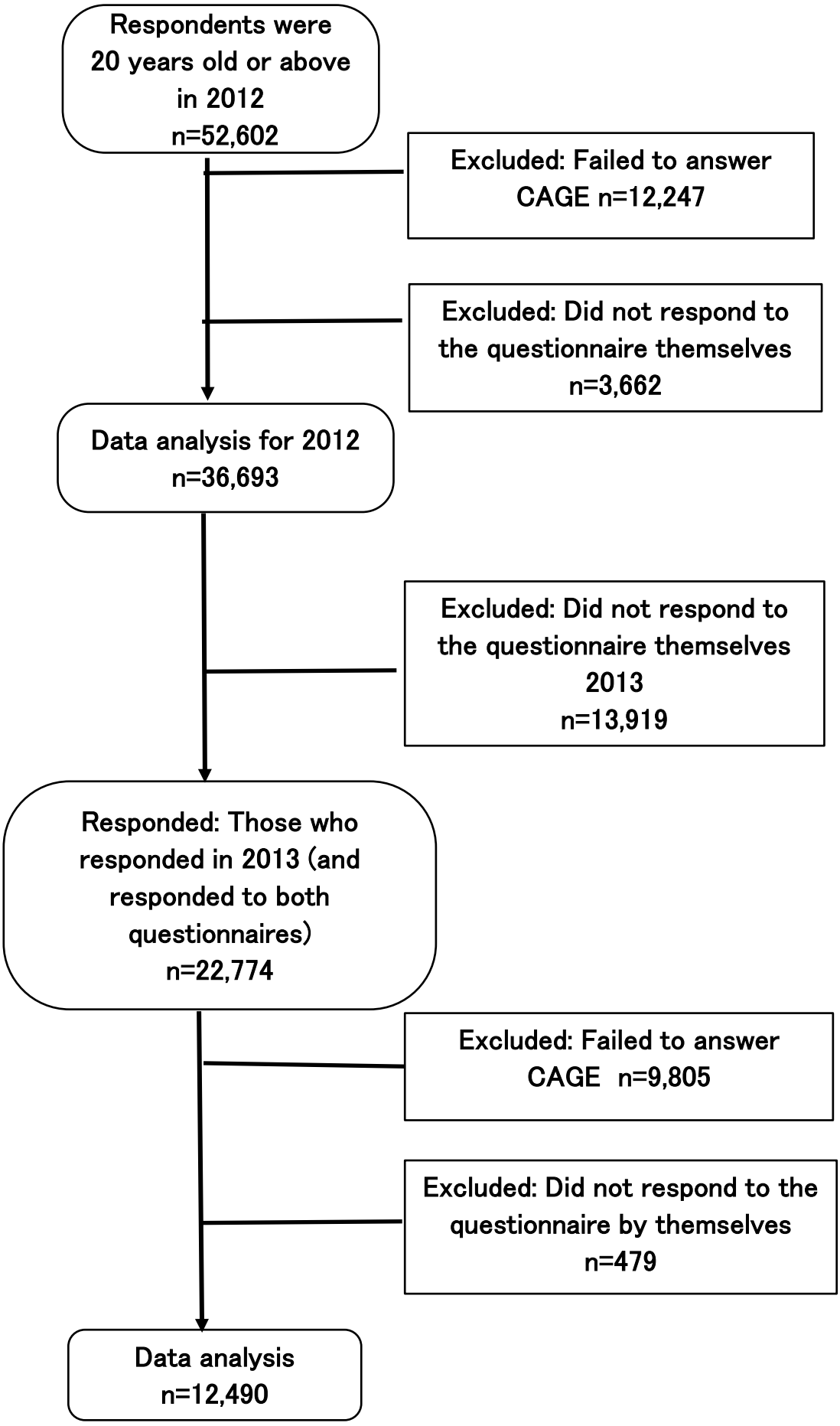

Figure 1. Participant Flow Chart.

Table 1. Relationships among possible risk factors for problem drinking according to increases in CAGE Scores.

	Total	Emerging problem drinkers CAGE < 2 in 2012→ CAGE ≥ 2 in 2013	%	Maintaining non-problem drinkers CAGE < 2 in 2012→ CAGE < 2 in 2013	%	df	χ^2	*p*
Sex	10,595							
Male	6,264	701	77.7	5,563	57.4	1	141	<0.001
Female	4,331	201	22.3	4,130	42.6			
Age	10,595							
20–49 years old	3,054	227	25.2	2,827	29.2			
50–64 years old	3,758	335	37.1	3,423	35.3	2	6.4	0.04
≥ 65 years old	3,783	340	37.7	3,443	35.5			
Subjective health condition	10,353							
Very good–Good	2,374	153	17.3	2,221	23.5			
Normal	6,521	558	63.3	5,963	63	2	32.4	<0.001
Poor–Very poor	1,458	171	19.4	1,287	13.6			
Diagnosed history of mental illness	10,425							
No	9,790	803	90.7	8,987	94.2	1	17	<0.001
Yes	635	82	9.3	553	5.8			
Diagnosed with high blood pressure	10,504							
No	5,780	406	45.7	5,374	55.9	1	33.9	
Yes	4,724	482	54.3	4,242	44.1			<0.001
Diagnosed with diabetes mellitus	10,429							
No	8,375	661	75.2	7,714	80.8	1	15.8	<0.001
Yes	2,054	218	24.8	1,836	19.2			
Diagnosed with hyperlipidemia	10,430							
No	6,322	514	58.7	5,808	60.8	1	1.4	0.24
Yes	4,108	361	41.3	3,747	39.2			
Exercise	10,457							
Every day	1,505	143	16.2	1,362	14.2			
2–4 times a week	2,397	208	23.5	2,189	22.9	3	4.6	0.21
Once a week	1,705	127	14.4	1,578	16.5			
None	4,850	406	45.9	4,444	46.4			
Sleep insufficiency	10,310							
Satisfied	4,030	289	33	3,741	39.7			
A little dissatisfied	4,711	403	46.1	4,308	45.7	2	29.4	<0.001
Very dissatisfied to quite problematic	1,569	183	20.9	1,386	14.7			
Laughing frequency	10,529							
Almost every day	2,845	198	22.1	2,647	27.5			
1–5 days per week	4,424	373	41.6	4,051	42.1	3	19.5	<0.001
1–3 days per month	2,070	198	22.1	1,872	19.4			
Almost never	1,190	128	14.3	1,062	11			
Employment change	9,732							
Yes	5,199	491	60	4,708	52.8	1	15.3	<0.001
No	4,533	328	40	4,205	47.2			
Family finances	10,041							
Severe	1,574	222	26.2	1,352	14.7			
Below average	2,996	277	32.7	2,719	29.6	3	110.9	<0.001
Average	5,085	342	40.4	4,743.00	51.6			
Not severe	386	6	0.7	380	4.1			
Psychological distress	10,251							
K6<13	9,412	747	87	8,665	92.3	1	29.4	<0.001
K6≥13	839	112	13	727	7.7			
Trauma symptoms	9,778							
PCL<44	8,466	621	75.3	7,845	87.6	1	99.2	<0.001
PCL≥44	1,312	204	24.7	1,108	12.4			
Social network	10,268							
LSN_6<12	3,874	356	41.1	3,518	37.4	1	4.5	<0.001
LSN_6≥12	6,394	511	58.9	5,883	62.6			
Alcohol consumption (drinks)	8,074							
<4	6,917	553	72.4	6,364	87.1	1	121.4	<0.001
≥4	1,157	211	27.6	946	12.9			

CAGE, cutting down, annoyed by criticism, guilty feeling, and eye-opener questionnaire; LSN, Lubben Social Network Scale; PCL, PTSD Checklist-specific; K6, Kessler psychological distress scale.

Table 2. Bivariate analysis: possible risk factors for problem drinking according to increase in CAGE score.

	All		Male		Female	
	OR	95%CI	OR	95%CI	OR	95%CI
Sex (Reference: Female)						
Male	2.64	2.24−3.12				
Age (Reference: ≥65 years old)						
20–49 years old	1.08	0.90−1.29	0.92	0.74−1.14	1.62	1.08−2.42
50–64 years old	1.15	0.98−1.35	1.16	0.97−1.38	1.27	0.83−1.94
Subjective health condition (Reference: Very good–Good)						
Normal	1.44	1.19−1.73	1.34	1.09−1.65	1.94	1.25−3.03
Poor–Very poor	2.05	1.62−2.58	1.92	1.48−2.49	2.73	1.62−4.62
Exercise (Reference: Every day)						
2–4 times a week	0.97	0.78−1.22	1.01	0.79−1.29	0.86	0.47−1.55
Once a week	0.84	0.65−1.08	0.79	0.60−1.06	1.02	0.56−1.86
None	0.98	0.79−1.21	0.97	0.77−1.23	0.99	0.58−1.71
Diagnosed history of mental illness (Reference: No)						
Yes	1.79	1.40−2.28	1.64	1.21−2.22	2.17	1.42−3.32
Diagnosed with high blood pressure (Reference: None)						
Yes	1.38	1.17−1.61	1.39	1.16-1.66	1.34	0.94−1.90
Diagnosed with diabetes mellitus (Reference: No)						
Yes	1.26	1.06−1.49	1.29	1.07−1.55	1.08	0.68−1.71
Diagnosed with hyperlipidemia (Reference: No)						
Yes	1.02	0.89−1.19	1.08	0.92−1.27	0.90	0.64−1.26
Sleep insufficiency (Reference: Satisfied)						
A little dissatisfied	1.33	1.13−1.56	1.3	1.09−1.56	1.51	1.05−2.18
Very dissatisfied to quite problematic	1.94	1.59−2.37	1.86	1.47−2.35	2.34	1.56−3.55
Laughing frequency (Reference: Almost every day)						
1–5 days per week	1.17	0.98−1.40	1.15	0.93−1.42	1.21	0.85−1.74
1–3 days per month	1.27	1.03−1.56	1.15	0.90−1.46	1.75	1.15−2.65
Almost never	1.38	1.08−1.74	1.23	0.94−1.61	2.13	1.29−3.51
Employment change (Reference: No)						
Yes	1.37	1.18−1.59	1.42	1.19−1.68	1.22	0.90−1.65
Family finances (Reference: Average)						
Severe	2.19	1.83-2.63	2.38	1.94-2.92	1.67	1.13-2.48
Below average	1.36	1.15-1.61	1.31	1.08-1.59	1.51	1.09-2.10
Not severe	0.22	0.10-0.49	0.10	0.02-0.39	0.6	0.22-1.65
Psychological distress (Reference: K6<13)						
K6≥13	1.96	1.58−2.44	1.89	1.45−2.45	2.18	1.49−3.18
Trauma symptom (Reference: PCL<44)						
PCL≥44	2.51	2.11−3.00	2.66	2.18−3.25	2.16	1.51−3.08
Social network (Reference: LSN_6≥12)						
LSN_6<12	1.15	1.00−1.33	1.11	0.93−1.31	1.33	1.00−1.78
Alcohol consumption (Reference: <4 drinks)						
≥4 drinks	2.21	1.85−2.64	2.01	1.67−2.43	4.41	2.71−7.19

CAGE, cutting down, annoyed by criticism, guilty feeling, and eye-opener questionnaire; LSN, Lubben Social Network Scale; PCL, PTSD Checklist-specific; K6, Kessler psychological distress scale.

Table 3. Multivariate analysis: possible risk factors for problem drinking according to increase in CAGE score.

	All		Male		Female	
	OR	95%CI	OR	95%CI	OR	95%CI
Sex (Reference: Female)						
Male	1.77	1.41–2.21				
Age (Reference: ≥65 years old)						
20–49 years old	1.38	1.04−1.82	1.25	0.91−1.72	1.88	0.93−3.80
50–64 years old	1.25	0.98−1.58	1.29	1.00−1.66	1.27	0.64−2.53
Subjective health condition (Reference: Very good–Good)						
Normal	1.19	0.93−1.52	1.2	0.91−1.58	1.12	0.66−1.91
Poor–Very poor	1.04	0.73−1.48	1.1	0.73−1.65	0.86	0.41−1.81
Diagnosed history of mental illness (Reference: No)						
Yes	1.27	0.87−1.84	1.02	0.64−1.63	1.99	1.06−3.74
Diagnosed with high blood pressure (Reference: No)						
Yes	1.13	0.91−1.40	1.14	0.90−1.45	1.03	0.63−1.70
Diagnosed with diabetes mellitus (Reference: No)						
Yes	1.16	0.90−1.48	1.18	0.90−1.53	1.01	0.49−2.11
Sleep insufficiency (Reference: Satisfied)						
A little dissatisfied	1.34	1.08−1.66	1.19	0.94−1.52	2.35	1.36−4.05
Very dissatisfied to quite problematic	1.63	1.21−2.19	1.41	1.00−2.00	3.01	1.59-5.66
Laughing frequency (Reference: Almost every day)						
1–5 days per week	1.21	0.96−1.53	1.19	0.90−1.57	1.29	0.82−2.03
1–3 days per month	1.16	0.88−1.54	1.09	0.78−1.50	1.50	0.85−2.66
Almost never	0.89	0.62−1.26	0.86	0.58−1.28	0.95	0.42−2.17
Employment change (Reference: No)						
Yes	1.10	0.91−1.34	1.16	0.93−1.44	0.95	0.64−1.39
Family finances (Reference: Average)						
Severe	1.71	1.33−2.20	1.81	1.36−2.42	1.31	0.76−2.27
Below average	1.22	0.98−1.51	1.18	0.92−1.51	1.25	0.82−1.90
Not severe	0.22	0.08−0.59	0.15	0.04−0.60	0.42	0.10−1.76
Psychological distress (Reference: K6<13)						
K6≥13	0.98	0.69−1.39	0.87	0.60−1.33	1.28	0.67−2.45
Trauma (Reference: PCL<44)						
PCL≥44	1.75	1.33−2.31	2.08	1.52−2.84	1.07	0.60−1.90
Social network (Reference: LSN_6≥12)						
LSN_6<12	0.85	0.70−1.03	0.87	0.70−1.10	0.81	0.55−1.20
Alcohol consumption (Reference: <4 drinks)						
≥4 drinks	2.26	1.82−2.80	2.12	1.69−2.66	3.54	1.92−6.52

CAGE, cutting down, annoyed by criticism, guilty feeling, and eye-opener questionnaire; LSN, Lubben Social Network Scale; PCL, PTSD Checklist-specific; K6, Kessler psychological distress scale.

Table 4. Multivariate analysis: possible risk factors for problem drinking according to increase in CAGE score (K6 Only).

	All		Male		Female	
	OR	95%CI	OR	95%CI	OR	95%CI
Sex (Reference: Female)						
Male	1.66	1.34–2.06				
Age (Reference: ≥65 years old)						
20–49 years old	1.29	0.99–1.69	1.17	0.86–1.59	1.86	0.98–3.52
50–64 years old	1.18	0.94–1.48	1.20	0.93–1.52	1.31	0.71–2.43
Subjective health condition (Reference: Very good–Good)						
Normal	1.21	0.96–1.53	1.21	0.93–1.58	1.17	0.70–1.96
Poor–Very poor	1.16	0.83–1.62	1.23	0.84–1.81	0.97	0.48–1.96
Diagnosed history of mental illness (Reference: None)						
Yes	1.31	0.91–1.86	1.06	0.68–1.66	2.05	1.13–3.72
Diagnosed with high blood pressure (Reference: None)						
Yes	1.18	0.96–1.45	1.21	0.96–1.53	1.07	0.68–1.70
Diagnosed with diabetes mellitus (Reference: No)						
Yes	1.14	0.90–1.44	1.16	0.90–1.49	1.03	0.52–2.02
Sleep insufficiency (Reference: Satisfied)						
A little dissatisfied	1.25	1.01–1.53	1.14	0.91–1.45	1.91	1.17–3.14
Very dissatisfied to quite problematic	1.58	1.19–2.10	1.43	1.02–2.00	2.43	1.36–4.36
Laughing frequency (Reference: Almost every day)						
1–5 days per week	1.22	0.97–1.54	1.18	0.90–1.54	1.36	0.87–2.11
1–3 days per month	1.15	0.87–1.51	1.05	0.76–1.43	1.53	0.88–2.65
Almost never	0.92	0.65–1.29	0.86	0.59–1.26	1.16	0.55–2.45
Employment change (Reference: No)						
Yes	1.11	0.92–1.34	1.17	0.94–1.45	0.94	0.65–1.36
Family finances (Reference: Average)						
Severe	1.80	1.42–2.30	1.94	1.47–2.56	1.34	0.79–2.26
Below average	1.25	1.02–1.53	1.19	0.94–1.52	1.35	0.91–2.02
Not severe	0.20	0.07–0.55	0.14	0.03–0.55	0.40	0.10–1.67
Psychological distress (Reference: K6<13)						
K6≥13	1.19	0.87–1.64	1.16	0.78–1.70	1.19	0.67–2.10
Social network (Reference: LSN_6≥12)						
LSN_6<12	0.89	0.74–1.08	0.91	0.73–1.14	0.87	0.60–1.26
Alcohol consumption (Reference: <4 drinks)						
≥4 drinks	2.29	1.86–2.81	2.10	1.68–2.61	3.94	2.26–6.85

CAGE, cutting down, annoyed by criticism, guilty feeling, and eye-opener questionnaire; LSN, Lubben Social Network Scale; PCL, PTSD Checklist-specific; K6, Kessler psychological distress scale.

Table 5. Multivariate analysis: possible risk factors for problem drinking according to increase in CAGE Score (PCL Only).

	All		Male		Female	
	OR	95%CI	OR	95%CI	OR	95%CI
Sex (Reference: Female)						
Male	1.79	1.43–2.23				
Age (Reference: ≥65 years old)						
20–49 years old	1.37	1.04–1.80	1.25	0.91–1.71	1.79	0.90–3.54
50–64 years old	1.23	0.97–1.55	1.28	1.00–1.65	1.17	0.60–2.29
Subjective health condition (Reference: Very good–Good)						
Normal	1.22	0.95–1.55	1.22	0.93–1.61	1.15	0.70–1.96
Poor–Very poor	1.08	0.76–1.52	1.14	0.77–1.70	0.91	0.44–1.90
Diagnosed history of mental illness (Reference: None)						
Yes	1.23	0.85–1.77	0.95	0.60–1.51	2.15	1.18–3.94
Diagnosed with high blood pressure (Reference: No)						
Yes	1.11	0.90–1.38	1.14	0.90–1.44	0.99	0.60–1.62
Diagnosed with diabetes mellitus (Reference: No)						
Yes	1.15	0.91–1.47	1.18	0.91–1.52	0.96	0.46–2.00
Sleep insufficiency (Reference: Satisfied)						
A little dissatisfied	1.33	1.08–1.65	1.2	0.94–1.52	2.24	1.32–3.82
Very dissatisfied to quite problematic	1.57	1.17–2.10	1.34	0.95–1.89	2.92	1.57–5.42
Laughing frequency (Reference: Almost every day)						
1–5 days per week	1.24	0.98–1.57	1.22	0.92–1.61	1.32	0.84–2.07
1–3 days per month	1.23	0.94–1.63	1.14	0.83–1.58	1.66	0.95–2.89
Almost never	0.92	0.65–1.29	0.88	0.60–1.30	1.01	0.45–2.27
Employment change (Reference: No)						
Yes	1.08	0.89–1.30	1.12	0.90–1.39	0.96	0.66–1.41
Family finances (Reference: Average)						
Severe	1.7	1.33–2.19	1.79	1.35–2.38	0.93	0.55–1.58
Below average	1.21	0.98–1.49	1.16	0.91–1.49	0.74	0.74–1.27
Not severe	0.21	0.08–0.58	0.15	0.04–0.59	0.31	0.07–1.36
Trauma (Reference: PCL<44)						
PCL≥44	1.77	1.38–2.27	2.05	1.54–2.74	1.14	0.68–1.92
Social network (Reference: LSN_6≥12)						
LSN_6<12	0.83	0.68–1.00	0.85	0.68–1.07	0.80	0.54–1.17
Alcohol consumption (Reference: <4 drinks)						
≥4 drinks	2.23	1.81–2.76	2.06	1.65–2.58	3.78	2.08–6.86

CAGE, cutting down, annoyed by criticism, guilty feeling, and eye-opener questionnaire; LSN, Lubben Social Network Scale; PCL, PTSD Checklist-specific; K6, Kessler psychological distress scale.

Table 6. Comparison of socio-demographic, health-related, and disaster-related status in 2012 between individuals whose data were analyzed and those who were excluded.

	Those who answered CAGE in 2012 (36,693)		Those who responded in 2012 but were excluded (15,909)				
	n	%	n	%	df	χ^2	*p*
Sex							
Male	17,788	48.5	5,428	34.1	1	928.0	<0.001
Female	18,905	51.5	10,481	65.9			
Age							
20–49 years old	12,553	34.2	1,631	10.3			
50–64 years old	12,285	33.5	2,927	18.4	2	7069.5	<0.001
≥ 65 years old	11,855	32.3	11,351	71.3			
Subjective health condition							
Very good–Good	7,383	20.6	1,707	11.4			
Normal	22,515	62.9	9,028	60.5	2	1220.3	<0.001
Poor–Very poor	5,875	16.4	4180	28.0			
Diagnosed history of mental illness							
No	33,207	92.3	12,576	86.1	1	464.4	<0.001
Yes	2,760	7.7	2,024	13.9			
Sleep insufficiency							
Satisfied	13,054	36.6	6,140	41.9			
A little dissatisfied	16,626	46.6	6,002	41.0	2	151.1	<0.001
Very dissatisfied to quite problematic	5,979	16.8	2,506	17.1			
Laughing frequency							
Almost every day	10,059	27.6	3,883	25.3			
1–5 days per week	14,981	41.1	5,956	38.9	3	143.8	<0.001
1–3 days per month	7,045	19.3	3,103	20.3			
Almost never	4,361	12.0	2,380	15.5			
Socioeconomic factors							
Employment change							
Yes	17,756	52.7	4,931	44.7	1	217.1	<0.001
No	15,917	47.3	6,112	55.3			
Family finances							
Severe	5,648	16.3	2,438	18.6			
Below average	10,942	31.6	3,949	30.2	3	44.8	<0.001
Average	16,879	48.7	6,311	48.2			
Not severe	1,196	3.5	383	2.9			
Psychological distress							
K6<13	31,536	89.4	10,692	83.2	1	339.0	<0.001
K6≥13	3,745	10.6	2,165	16.8			
Trauma symptom							
PCL<44	28,527	84.7	8,810	75.2	1	536.8	<0.001
PCL≥44	5,147	15.3	2,902	24.8			
Social network							
LSN_6<12	14,101	39.9	5,173	38.7	1	6.612	0.010
LSN_6≥12	21,216	60.1	8,211	61.3			
Alcohol consumption (drinks)							
<4	16,427	83.8	2,809	87.9	1	35.2	<0.001
≥4	3,174	16.2	386	12.1			

CAGE, cutting down, annoyed by criticism, guilty feeling, and eye-opener questionnaire; LSN, Lubben Social Network Scale; PCL, PTSD Checklist-specific; K6, Kessler psychological distress scale.

Table 7. Comparison of odds ratios for the prevalence of problem drinking in 2012 between individuals whose data were analyzed and those who were excluded.

	Data analysis 2012 (12,490)		Excluded (13,946)	
	OR	95%CI	OR	95%CI
Sex (Reference: Female)				
Male	2.64	2.24–3.12	5.35	4.60–6.23
Age (Reference: ≥65 years old)				
20–49 years old	1.08	0.90–1.29	0.71	0.60–0.84
50–64 years old	1.15	0.98–1.35	0.91	0.77–1.07
Subjective health condition (Reference: Very good–Good)				
Normal	1.44	1.19–1.73	1.22	0.98–1.50
Poor–Very poor	2.05	1.62–2.58	1.77	1.39–2.23
Exercise (Reference: Every day)				
2–4 times a week	0.97	0.78–1.22	0.91	0.71–1.15
Once a week	0.84	0.65–1.08	1.04	0.80–1.35
None	0.98	0.79–1.21	1.10	0.89–1.36
Diagnosed history of mental illness (Reference: None)				
Yes	1.79	1.40–2.28	1.75	1.43–2.15
Diagnosed with high blood pressure (Reference: None)				
Yes	1.38	1.17–1.61	1.44	1.23–1.68
Diagnosed with diabetes mellitus (Reference: No)				
Yes	1.26	1.06–1.49	1.42	1.21–1.67
Diagnosed with hyperlipidemia (Reference: No)				
Yes	1.02	0.89–1.19	1.10	0.95–1.28
Sleep insufficiency (Reference: Satisfied)				
A little dissatisfied	1.33	1.13–1.56	1.15	0.98–1.36
Very dissatisfied to quite problematic	1.94	1.59–2.37	1.70	1.40–2.07
Laughing frequency (Reference: Almost every day)				
1–5 days per week	1.17	0.98–1.40	1.24	1.02–1.50
1–3 days per month	1.27	1.03–1.56	1.42	1.15–1.76
Almost never	1.38	1.08–1.74	1.45	1.16–1.83
Employment change (Reference: No)				
Yes	1.37	1.18–1.59	1.23	1.05–1.44
Family finances (Reference: Average)				
Severe	2.19	1.83–2.63	1.58	1.30–1.92
Below average	1.36	1.15–1.61	1.31	1.11–1.55
Not severe	0.22	0.10–0.49	0.88	0.56–1.39
Psychological distress (Reference: K6<13)				
K6≥13	1.96	1.58–2.44	2.03	1.68–2.44
Trauma symptoma (Reference: PCL<44)				
PCL≥44	2.51	2.11–3.00	2.22	1.87–2.64
Social network (Reference: LSN_6≥12)				
LSN_6<12	1.15	1.00–1.33	1.08	0.93–1.24
Alcohol consumption (Reference: <4 drinks)				
≥4 drinks	2.21	1.85–2.64	2.92	2.30–3.70

CAGE, cutting down, annoyed by criticism, guilty feeling, and eye-opener questionnaire; LSN, Lubben Social Network Scale; PCL, PTSD Checklist-specific; K6, Kessler psychological distress scale.