**FACTORS ASSOCIATED WITH HIGH-RISK DRINKING IN OLDER ADULTS: EVIDENCE FROM A
NATIONAL SURVEY IN JAPAN**

Running title: CHARACTERISTICS OF HIGH-RISK DRINKERS

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ABSTRACT

Aim: This study aimed to clarify the association between high-risk drinking and health outcomes (e.g., physical and psychosocial factors including help-seeking behavior) among older Japanese adults.

Methods: Data were obtained from the 2013 Comprehensive Survey of Living Conditions in Japan (CSLC 2013), which surveyed 295,367 households. We restricted analyses to 55,147 current drinkers. Multinomial logistic regression models were used to examine associations between alcohol consumption and various factors.

Results: Overall, 35.3% of participants were in the low-risk group, 13.1% were in the at-risk group, and 1.0% were in the high-risk group. Those in the at-risk and high-risk groups were more likely to be younger, male, employed, and tobacco users. They were also more likely to report sleeping 9+ hours per night, and they were more likely to report unhealthy eating habits. Being in the high-risk drinking group was significantly associated with being divorced (OR: 1.51; 95% CI: 1.11-2.05) and having poor mental health (OR: 1.57; 95% CI: 1.13-1.68). The high-risk drinking group was more likely to include those who endorsed experiencing challenges without seeking aid (OR: 1.87; 95% CI: 1.39-2.53) or felt no need to seek aid (OR: 1.39; 95% CI: 1.15-1.68).

Conclusions: Being at high-risk for drinking is associated with poorer help-seeking behavior, suggesting a need for more aggressive outreach.

Keywords: Aged; Alcohol Drinking; Binge Drinking; Help-Seeking Behavior; Public Health

INTRODUCTION

Adverse health and social consequences caused by harmful alcohol use are key societal issues. In 2012, approximately 3.3 million deaths (5.9% of deaths worldwide) were directly related to alcohol consumption.¹ Harmful alcohol use is an avoidable risk factor contributing to cardiovascular disease, liver disease, cancer, dementia, and depression.²

The definition of heavy drinking and recommended limits vary cross-culturally. In Japan, the Ministry of Health, Labour and Welfare (MHLW) defines heavy drinking as consuming 60g or more of ethyl alcohol within a single occasion, recommending a limit of 20g.³ Defining heavy drinking, and applying a threshold, is challenging, partially due to individual variation in alcohol's biological influences.

Older adults are vulnerable to alcohol's adverse effects;⁴ general recommendations suggest that they should drink less than younger adults.⁵ However, recently, older adults' prevalence of drinking has increased.⁶ Therefore, there is a significant need to research drinking behaviors and consequences for older adults.

There is insufficient large-scale research on drinking among older adults, and the few existing studies claim equivocal findings, including differing effects on physical and mental conditions, socioeconomic status, and psychosocial factors.^{6,7,8,9,10} Additionally, to our knowledge, no large-scale data-driven research has evaluated the relationship between alcohol consumption and older adults' help-seeking behaviors. If help-seeking behaviors differ depending on the amount of alcohol consumption, effective interventions may also

1 differ. Thus, drinking interventions should take differences in older adults' help-seeking
2 skills into account. In this study, we used data from Japan's National Health Survey to
3 examine alcohol consumption among older adults and to clarify the association between
4 high-risk drinking and various physical and psychosocial factors, including help-seeking
5 behavior.

7 **METHODS**

8 **PARTICIPANTS**

9 A cross-sectional study was conducted using the 2013 Comprehensive Survey of
10 Living Conditions in Japan (CSLC, 2013), which randomly sampled individuals from 5,530
11 districts from the National Census in 2010. The database represents a nationwide survey of
12 households and household members. Excluded individuals include those who are absent
13 from households for the following reasons: residents of institutional facilities such as
14 prisons, social welfare facilities, and long-term hospitals. Respondents completed self-
15 administered questionnaires that investigators later collected.

16 The CSLC 2013 surveyed 295,367 households, with the Household and Health
17 Questionnaires, and collected questionnaires from 234,383 households (79.4% of the
18 sample), including 603,211 household members. Of the 159,303 individuals who were ≥ 65
19 years of age, 111,604 completed all items required for the present study. The main analyses
20 excluded 56,457 non-drinkers and ex-drinkers, restricting the sample to 55,147 current

1 drinkers to alleviate difficulties associated with potential biases. Ex-drinkers included
2 people who abstained from alcohol because of poor health. Non-drinkers also included
3 individuals with special reasons for being unable to drink. Sample inclusion and exclusion
4 breakdowns are shown in Figure 1. [Insert Figure 1]

5 STUDY VARIABLES

6 Study variables were extracted from the database and included socio-demographic,
7 alcohol use, help-seeking, and other variables. Social and demographic variables included
8 age, sex, educational level, current marital status, current employment status, and
9 residential status. Information was also collected on alcohol usage, help-seeking behavior,
10 and additional factors.

11 *Alcohol use variables.* Two questions regarding alcohol consumption were selected.
12 The first assessed the frequency of drinking based using a multiple-choice response (“How
13 many times a week do you drink alcohol?”), and the average amount consumed per day
14 (“How much do you drink on an average day when you consume alcohol?”). The second
15 question was limited to people who drank alcohol once or more monthly. The unit of alcohol
16 quantity in the questionnaire is “go,” which is the Japanese unit used to measure sake
17 (Japanese rice wine) and contains approximately 20g ethyl alcohol. We classified
18 respondents into five mutually-exclusive groups according to the most recent definitions of
19 alcohol consumption in large-scale research⁵ showing the relationships between the
20 amount of drinking and all-cause mortality for current middle-aged and older drinkers: Non-

Drinker, Ex-Drinker, and Low-Risk Drinking groups (no more than 100g ethyl alcohol per week), as well as At-Risk ($>100 \leq 350$ g ethyl alcohol per week) and High-Risk Drinking groups (>350 g ethyl alcohol per week). Weekly alcohol consumption was calculated by multiplying the frequency and amount per questionnaire responses.

Help-seeking variables. Help-seeking skills emanated from two questions: 1) A yes-no question “Do you have troubles and stresses in your daily life?”; and 2) A multiple-choice question asking “How, and with whom, do you consult about troubles and stress?” We combined these questions to create four groups: 1) “I have no troubles”; 2) “I have troubles, but I can consult with someone”; 3) “I have troubles, but I cannot consult with someone”; and 4) “I have troubles, but I need not consult with someone.” Help-seeking behavior was not limited to the context of drinking.

Other variables. Data on physical functional status, regular attendance at an outpatient facility, self-rated physical health, mental health, smoking habits, sleep habits, sleep satisfaction, and lifestyle habits were selected from the questionnaires. Physical and mental status, smoking, and lifestyle habits may influence alcohol consumption.^{6,7,11} Since alcohol’s effect on sleep is important, sleep time and sleep satisfaction were included.¹² Physical functional status was assessed using criteria for evaluating the degree of independence for older adults with disabilities in performing activities of daily living (ADL).¹³ Mental health status was evaluated with the Kessler Screening Scale for Psychological Distress (K6),¹⁴ which has been used widely to screen for symptoms of psychological distress,

including depression and anxiety. We used a cut-off score of above 12/13, which indicated distress.¹⁵ Regarding lifestyle, we focused on questions surrounding diet and exercise habits.

STATISTICAL ANALYSES

We first examined the prevalence of weekly alcohol consumption according to each variable. We then analyzed the prevalence of alcohol use by sex and frequency and amount of drinking by group classification. We conducted multinomial logistic regression analyses to understand how each variable related to alcohol consumption, including drinking group classifications. Because there were few women in the high-risk group, we did not conduct logistic regression analyses by sex. The adjusted odds ratios (ORs), with 95% confidence intervals, were estimated. All analyses were conducted using SPSS ver. 24.0. Although two significance levels ($p < 0.05$ and $p < 0.01$) were provided in the study, we considered the threshold for statistical significance to be $p < 0.01$ because of the large sample size.

RESULTS

PREVALENCE OF ALCOHOL CONSUMPTION

The current drinkers analyzed in this study ($n=55,147$) were similar in number to the non-drinkers ($n=53,134$) and ex-drinkers ($n=3,323$); 70.2% ($n=34,585$) were men, and 33.0% ($n=20,562$) were women. Most current drinkers fell into the low-risk group ($n=39,409$); men were the majority in both the at-risk (13,112 of 14,569) and high-risk group (1,089 of 1,169; see Table 1). [Insert Table 1 here]

Most current drinkers drank alcohol daily ($n=18,897$; 34.3%). More men drank daily ($n=16,330$; 47.2%) than women ($n=2,607$; 12.7%). Less than 20g of ethyl alcohol was the most common daily amount ($n=37,106$; 67.3%), although 1,446 current drinkers (2.6%) indicated that they drank more than 60g per day. Of the heavy drinkers, 1,331 out of 1,446 (92.0%) were men (See Table 2). [Insert Table 2 here]

CHARACTERISTICS OF CURRENT DRINKERS

Table 3 shows details of each variable's distribution among current drinkers. Participants ($n=55,147$) ranged in age from 65–104 years ($M=73.2$ years). Most were men ($n=34,585$; 62.7%), married ($n=41,709$; 75.6%), non-smokers ($n=43,716$; 79.3%), and only had a high school diploma ($n=29,763$; 54.0%). Less than half ($n=17,246$; 31.3%) were employed, and few lived alone ($n=7,428$; 13.5%). Most ($n=50,078$; 90.8%) commonly slept 5–9 hours per night. A few participants ($n=6,282$; 11.4%) were dissatisfied with their sleep habits. Most followed healthy eating habits ($n=49,091$; 80.9%), and approximately half habitually exercised ($n=29,587$; 53.7%). A small proportion rented their residences ($n=6,190$; 11.2%). Most ($n=51,434$; 93.3%) did not require care, and approximately half indicated a normal subjective health status ($n=28,534$; 51.7%). Many regularly visited hospitals owing to one or more diseases ($n=38,748$; 70.3%). While 37.4% ($n=20,649$) indicated that they experienced some troubles, 69.8% had sought consultation ($n=14,410$). Only 2.2% ($n=1,215$) suffered from severe psychological distress ($K6 \geq 13$). [Insert Table 3 here]

1 MULTIPLE LOGISTIC REGRESSION ANALYSES

2 Multinomial logistic regression analyses were conducted to investigate factors
3 affecting alcohol consumption (Table 4).

4 *At-risk drinking group vs. low-risk drinking group.* Relative to the low-risk drinking
5 group, significant increases in likelihood of moving into the at-risk drinking group were
6 being male (OR: 7.47; 95% CI: 7.02-7.95), being employed (OR: 1.24; 95% CI: 1.18-1.29),
7 reporting a good subjective health status (OR: 1.09; 95% CI: 1.04-1.14), tobacco use (OR:
8 1.77; 95%; CI: 1.68-1.87), and sleeping >9 hours (OR: 1.28; 95% CI: 1.15-1.43). However, a
9 diminished likelihood was observed for being >75 years of age (OR: 0.56; 95% CI: 0.53-0.59),
10 poor subjective health status (OR: 0.86; 95% CI: 0.81-0.92), requiring care (low activities of
11 daily living, ADLs; OR: 0.43; 95% CI: 0.37-0.52), healthy eating habits (OR: 0.79; 95% CI: 0.74-
12 0.84), and exercising (OR: 0.94; 95% CI: 0.90-0.99). There was a negative association
13 between at-risk drinking and having troubles but seeking consultation (help-seeking; OR:
14 0.87; 95% CI: 0.82-0.92). [Insert Table 4 here]

15 *High-risk drinking group vs. low-risk drinking group.* Relative to low-risk drinking,
16 there was a greater likelihood of high-risk drinking for men (OR: 10.62; 95% CI: 8.37-13.47),
17 being divorced (OR: 1.51; 95% CI: 1.11-2.05), being employed (OR: 1.32; 95% CI: 1.16-1.49),
18 tobacco use (OR: 2.30; 95% CI: 2.01-2.63), and sleeping >9 hours (OR: 3.00; 95% CI: 2.39-
19 3.79). Negative associations were observed for being >75 years of age (OR: 0.34; 95% CI:
20 0.29-0.40) and reporting healthy eating habits (OR: 0.43; 95% CI: 0.37-0.50). Poor mental

health was associated with a greater likelihood of high-risk drinking (OR: 1.57; 95% CI: 1.13-1.68). High-risk drinking was more likely in those who experienced troubles but who had not sought consultation (OR: 1.87; 95% CI: 1.39-2.53) or felt the need to do so (absence of help-seeking behavior; OR: 1.39; 95% CI: 1.15-1.68).

DISCUSSION

We examined older adults' alcohol consumption behaviors and factors related to high-risk drinking. Details of the results are discussed below.

PREVALENCE OF ALCOHOL CONSUMPTION

The frequency and amount of drinking were greater among men than women, consistent with previous studies.^{6,7} Regarding average alcohol consumption per week, the proportion of high-risk drinkers (>350g/week) was lower in the present study (2%) than a European prospective population-based study (7-10%)⁵ including middle-aged adults under the age of 65. Average alcohol consumption is higher in Europe than Japan;¹⁶ regional variation in consumption is due to various factors, including cultural background.¹⁷

COMMON FACTORS FOR AT-RISK AND HIGH-RISK DRINKING

The at-risk and high-risk drinking groups shared several factors influencing alcohol consumption in comparison to the low-risk drinking group. The demographic and socioeconomic risk factors for excessive drinking included younger age, being male, and

being employed. Several articles have demonstrated the influence of these factors on drinking.^{6,7,9} Education level did not affect alcohol consumption in this study, and this relationship has been equivocal in previous studies.^{6,9}

Smoking, extended sleep durations, and unhealthy lifestyle characteristics were related to both at-risk and high-risk drinking. Many previous studies have demonstrated that smoking is a risk factor for excessive drinking.^{18,19} Cross-sectional studies have also demonstrated a relationship between insomnia and heavy drinking.^{8,9} In this study, longer sleep durations were associated with both at-risk and high-risk drinking, while subjective sleep satisfaction was not. People may utilize the sedative effects of alcohol to combat pre-existing insomnia through self-medication.¹⁰ Furthermore, older adults who are heavy drinkers may compensate for deteriorated sleep quality by extending their sleep durations.

Those with healthy eating habits were less likely to be categorized into the at-risk or high-risk group, consistent with previous studies.²⁰ A similar trend was observed for exercise habits, contrary to other studies that have reported positive associations with alcohol intake.^{21,22} However, results of the present study may have been skewed owing to our specialized sample of older adults. Furthermore, our results may have been affected by the sample questions that referred to customary exercise habits rather than frequency of activity.

DIFFERENCES BETWEEN THE AT-RISK AND HIGH-RISK DRINKING GROUPS

Differences between the at-risk and high-risk group were observed. Those with poor ADLs and subjective health statuses were less likely to fall into the at-risk group. However, no effect of these factors was observed for the high-risk group. In previous studies, this type of relationship between subjective health status, ADLs, and drinking behavior is inconsistent.^{7,23} Therefore, although there is no clear relationship between these factors and heavy drinking, it is important to understand that those who drink alcohol heavily may not refrain owing to poor physical health. On the other hand, many individuals in the high-risk group reported mental health problems. Although some cross-sectional studies have reported that the relationship between depression and consumption amount/frequency is irrelevant,^{6,7} a relationship between depression and alcohol use disorders is commonly reported.^{24,25} Furthermore, alcohol consumption represents one method of coping with stress,²⁶ and it is reasonable to assume that some individuals at high-risk for drinking continue this pattern. Compared to individuals at-risk for excessive drinking, those at high-risk seemed to be affected by mental, rather than physical, problems.

People experiencing personal life challenges, but who could not consult or seek help, were more likely to fall into the high-risk drinking group. However, this tendency was not observed for those who did seek assistance. Although it is well known that help-seeking behavior for drinking problems is lower among patients with alcohol use disorders,²⁷ an important finding is that, regardless of whether alcohol use disorders have been diagnosed, high-risk drinking is related to poor help-seeking. People who have difficulty consulting with doctors or seeking help are sometimes socially isolated or have insufficient social support

1 networks. In such cases, alcohol consumption may increase as a coping behavior.
2 Additionally, a high perceived stigma in people diagnosed with an alcohol use disorder
3 reduces their probability of using health care services.²⁸ Furthermore, among older adults,
4 drinking problems tend not to become apparent due to feelings of shame or guilt.²⁹ The
5 results of this study could have been influenced by such stigma.

6 On the other hand, those who stated that they did not need to seek help were also
7 likely to be in high-risk drinking groups. The notion that there is no need to seek help may
8 not indicate that the problem is unimportant, but may indicate potential denial about the
9 severity of these problems. Although the meaning of help-seeking behavior used in the
10 present study was more comprehensive and included behaviors regarding problems other
11 than alcohol use, our findings are also consistent with the fact that alcoholism patients tend
12 to deny having a problem with alcohol use. In addition, since alcohol intake is associated
13 with increased risks of adverse brain outcomes and cognitive decline,³⁰ it is possible that
14 people with such behaviors may lack the ability to recognize heavy drinking as a problem.

15 In either case, these results indicate that those in need of intervention tend not seek
16 help. Therefore, our findings support the need for active outreach to high-risk populations
17 in order to link high-risk drinking among older adults to treatments and interventions.

18 A few study limitations should be noted. First, although the survey was conducted
19 nationwide, those who were hospitalized or entering facilities were excluded. Moreover,
20 many of the people in the high-risk group were men. Therefore, although we used sex as an

1 explanatory variable in logistic regression analyses, we did not conduct separate analyses
2 by sex. Further studies are needed to clarify whether the pattern of this association differs
3 between men and women. In terms of alcohol consumption, the average amount consumed
4 per day was calculated and recorded based on self-reported information, and we could not
5 verify this through objective means. Furthermore, older adults with potential declines in
6 cognitive functioning, or who may underreport their alcohol consumption, were included.
7 This may have impacted the accuracy of the reported alcohol consumption levels. While the
8 questionnaire was designed to be completed by each participant, it is unknown whether
9 the questionnaire was actually completed by the participant or a family member. In addition
10 to these limitations, many respondents were excluded because of missing data, some of
11 whom may have been high-risk drinkers resistant to accurately declaring their alcohol
12 consumption. Lastly, since this study was a cross-sectional survey, we cannot infer causal
13 relationships between the factors examined and alcohol consumption.

14 In conclusion, based on the present findings, it was apparent that specific
15 characteristics are related to drinking behaviors among Japanese older adults. In particular,
16 those at high-risk for excessive drinking exhibited unique characteristics that differed
17 significantly from those at-risk. Falling into the high-risk group, as compared to the at-risk
18 group, was more likely for divorced people, those who do not seek help when experiencing
19 difficulties, and individuals with poor mental health. This is the first study to clarify the
20 association between alcohol consumption and various physical and psychosocial factors,
21 including help-seeking behavior among older adults, using large scale data. Moreover, the

1 association between high-risk drinking and help-seeking behavior, which has been clarified
2 in this research, is an important finding for alcohol consumption measures. Although the
3 general population's approach to persons at-risk for high alcohol consumption is important
4 as a countermeasure against potential drinking problems among older adults, the present
5 results also confirmed the importance of active outreach those at high-risk.

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DISCLOSURE STATEMENT

The authors declare no conflicts of interest.

REFERENCES

1. World Health Organization. Management of substance abuse. [Cited 25 December 2018]. Available from: http://www.who.int/substance_abuse/facts/alcohol/en.
2. Schwarzing M, Pollock BG, Hasan OSM, Dufouil C, Rehm J. QalyDays Study Group. Contribution of alcohol use disorders to the burden of dementia in France 2008-13: A nationwide retrospective cohort study. *Lancet Public Health* 2018; 3: e124-e132.
3. Ministry of Health, Labour and Welfare, Japan. National Health Promotion Movement in the 21st Century (Healthy Japan 21). [Cited 25 December 2018]. Available from: <http://www.kenkounippon21.gr.jp>.
4. Moore AA, Whiteman EJ, Ward KT. Risks of combined alcohol/medication use in older adults. *Am J Geriatr Pharmacotherapy* 2007; 5: 64-74.

- 1 5. Wood AM, Kaptoge S, Butterworth AS, Willeit P, Warnakula S, Bolton T, et al. Risk
2 thresholds for alcohol consumption: combined analysis of individual-participant data for
3 599 912 current drinkers in 83 prospective studies. *Lancet* 2018; 391: 1513-1523.
- 4 6. Blazer DG, Wu LT. The epidemiology of at-risk and binge drinking among middle-aged
5 and elderly community adults: National Survey on Drug Use and Health. *Am J Psychiatry*
6 2009; 166: 1162-1169.
- 7 7. Merrick EL, Horgan CM, Hodgkin D, Garnick DW, Houghton SF, Panas L, et al. Unhealthy
8 drinking patterns in older adults: prevalence and associated characteristics. *J Am Geriatr*
9 *Soc* 2008; 56: 214-223.
- 10 8. Canham SL, Kaufmann CN, Mauro PM, Mojtabai R, Spira AP. Binge drinking and
11 insomnia in middle-aged and older adults: the Health and Retirement Study. *Int J Geriatr*
12 *Psychiatry* 2015; 30: 284-291.
- 13 9. Chaput JP, McNeil J, Després JP, Bouchard C, Tremblay A. Short sleep duration is
14 associated with greater alcohol consumption in adults. *Appetite* 2012; 59: 650-655.
- 15 10. Stein MD, Friedmann PD. Disturbed sleep and its relationship to alcohol use. *Subst*
16 *Abus* 2005; 26: 1-13.
- 17 11. Parikh RB, Junquera P, Canaan Y, Oms JD. Predictors of binge drinking in elderly
18 Americans. *Am J Addict* 2015; 24: 621-627.

- 1 12. Ebrahim IO, Shapiro CM, Williams AJ, Fenwick PB. Alcohol and sleep I: effects on
2 normal sleep. *Alcohol Clin Exp Res* 2013; 37: 539-549.
- 3 13. Tsuboi A, Murakami T, Kurumadani H, Shimizu J, Fujiwara N. Relationship between
4 criteria for evaluating the degree of independence of disabled elderly persons in
5 performing activities of daily living. [in Japanese]. *J Jpn Occup Therapy Assoc* 2002; 21:
6 455-462.
- 7 14. Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SL, Walters EE,
8 Zaslavsky AM. Short screening scales to monitor population prevalences and trends in
9 non-specific psychological distress. *Psychol Med* 2002; 32: 959-976.
- 10 15. Sakurai K, Nishi A, Kondo K, Yanagida K, Kawakami N. Screening performance of
11 K6/K10 and other screening instruments for mood and anxiety disorders in Japan.
12 *Psychiatry Clin Neurosci*. 2011; 65: 434-441.
- 13 16. World Health Organization. Global strategy to reduce the harmful use of alcohol.
14 [Cited 25 December 2018]. Available from:
15 [http://www.who.int/substance_abuse/publications/global_strategy_reduce_harmful_use](http://www.who.int/substance_abuse/publications/global_strategy_reduce_harmful_use_alcohol/en)
16 [_alcohol/en](http://www.who.int/substance_abuse/publications/global_strategy_reduce_harmful_use_alcohol/en).
- 17 17. Bloomfield K, Stockwell T, Gmel G, Rehn N. International comparisons of alcohol
18 consumption. *Alcohol Res Health* 2003; 27: 95-109.
- 19 18. DiFranza JR, Guerrera MP. Alcoholism and smoking. *J Stud Alcohol* 1990; 51: 130-135.

- 1 19. Miller NS, Gold MS. Comorbid cigarette and alcohol addiction: epidemiology and
2 treatment. *J Addict Dis* 1998; 17: 55-66.
- 3 20. Kesse E, Clavel-Chapelon F, Slimani N, van Liere M, E3N Group. Do eating habits differ
4 according to alcohol consumption? Results of a study of the French cohort of the
5 European Prospective investigation into cancer and nutrition (E3N-EPIC). *Am J Clin Nutr*
6 2001; 74: 322-327.
- 7 21. French MT, Popovici I, Maclean JC. Do alcohol consumers exercise more? Findings
8 from a national survey. *Am J Health Promot* 2009; 24: 2-10.
- 9 22. Leasure JL, Neighbors C, Henderson CE, Young CM. Exercise and alcohol consumption:
10 What we know, what we need to know, and why it is important. *Front Psychiatry* 2015; 6:
11 156.
- 12 23. Ruchlin HS. Prevalence and correlates of alcohol use among older adults. *Prev Med*
13 1997; 26: 651-657.
- 14 24. Sullivan LE, Fiellin DA, O'Connor PG. The prevalence and impact of alcohol problems in
15 major depression: a systematic review. *Am J Med* 2005; 118: 330-341.
- 16 25. Hasin DS, Grant BF. Major depression in 6050 former drinkers: association with past
17 alcohol dependence. *Arch Gen Psychiatry* 2002; 59: 794-800.
- 18 26. Keyes KM, Hatzenbuehler ML, Grant BF, Hasin DS. Stress and alcohol: epidemiologic
19 evidence. *Alcohol Res* 2012; 34: 391-400.

- 1 27. Glass JE, Grant JD, Yoon HY, Bucholz KK. Alcohol problem recognition and help seeking
2 in adolescents and young adults at varying genetic and environmental risk. *Drug Alcohol*
3 *Depend* 2015; 153: 250-257.
- 4 28. Keyes KM, Hatzenbuehler ML, McLaughlin KA, et al. Stigma and treatment for alcohol
5 disorders in the United States. *Am J Epidemiol* 2010; 172: 1364–1372.
- 6 29. Alpert PT. Alcohol abuse in older adults: an invisible population. *Home Health Care*
7 *Manag Pract* 2014; 26: 269-272.
- 8 30. Topiwala A, Allan CL, Valkanova V, et al. Moderate alcohol consumption as risk factor
9 for adverse brain outcomes and cognitive decline: longitudinal cohort study. *BMJ* 2017; 357:
10 j2353.

1 Figure legends

2 Figure 1. Flow chart for this study.

Figure 1. Flow Diagram of Exclusion Process

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1 **Tables****Table 1. The prevalence of alcohol consumption**

	Never drank, No. (%)	Past drinker, No. (%)	Current drinker, No. (%)			
			Low-risk group (>0-≤100g)	At-risk group (>100-≤350g)	High-risk group (>350g-)	All
All (n=111,604)	53,134 (47.6%)	3,323 (2.9%)	39,409 (35.3%)	14,569 (13.1%)	1,169 (1.0%)	55,147 (49.4%)
Men (n=49,288)	11,976 (24.3%)	2,727 (5.5%)	20,384 (41.4%)	13,112 (26.6%)	1,089 (2.2%)	34,585 (70.2%)
Women (n=62,316)	41,158 (66.0%)	596 (1.0%)	19,025 (30.5%)	1,457 (2.3%)	80 (0.1%)	20,562 (33.0%)

Table 2. The frequency and amount of drinking

	Frequency			Amount		
	≤4 day/week	≥5-≤6 day/week	Every day	<20g/day	≥20-<60g/day	≥60g/day
All (n=55,147)	31,163 (56.5%)	5,047 (9.2%)	18,937 (34.3%)	37,106 (67.3%)	16,595 (30.1%)	1,446 (2.6%)
Men (n=34,585)	14,319 (41.4%)	3,936 (11.4%)	16,330 (47.2%)	18,777 (54.3%)	14,477 (41.9%)	1,331 (3.8%)
Women (n=20,562)	16,844 (81.9%)	1,111 (5.4%)	2,607 (12.7%)	18,329 (89.1%)	2,118 (10.3%)	115 (0.6%)

Table 3. Demographics and characteristics of the study participants

	All	Low-risk drinking	At-risk drinking	High-risk drinking
Characteristics	(n = 55,147)	>0-≤100g/week (n = 39,409)	>100-≤350g/week (n = 14,569)	>350g-/week (n = 1,169)
Age, No. (%)				
>65-<75	34467 (62.5)	22908 (66.5)	10611 (30.8)	948 (2.8)
≥75-	20680 (37.5)	16501 (79.8)	3958 (19.1)	221 (1.1)
Sex, No. (%)				
Men	34585 (62.7)	20384 (58.9)	13112 (37.9)	1089 (3.1)
Education completed, No. (%)				
Less than high school	18303 (33.2)	13463 (73.6)	4441 (24.3)	399 (2.2)
High school	29763 (54.0)	21501 (72.2)	7665 (25.8)	597 (2.0)
Undergraduate school	7081 (12.8)	4445 (62.8)	2463 (34.8)	173 (2.4)
Marital status, No. (%)				
Married	41709 (75.6)	28576 (68.5)	12194 (29.2)	939 (2.3)
Never married	1518 (2.8)	1092 (71.9)	378 (24.9)	48 (3.2)
Bereaved	9786 (17.7)	8247 (84.3)	1441 (14.7)	98 (1.0)
Divorced	2134 (3.9)	1494 (70.0)	556 (26.1)	84 (3.9)
Employment status, No. (%)				
Employed	17264 (31.3)	10711 (62.0)	6031 (34.9)	522 (3.0)
Living alone, No. (%)				
Yes	7428 (13.5)	5727 (77.1)	1541 (20.7)	160 (2.2)
Residential status, No. (%)				
Tenant	6190 (11.2)	4356 (70.4)	1648 (26.6)	186 (3.0)
Activities of daily living, No. (%)				
Independence	51434 (93.3)	36262 (70.5)	14062 (27.3)	1110 (2.2)
Dependence (not bed-ridden)	2038 (3.7)	1667 (81.8)	337 (16.5)	34 (1.7)
Bed-ridden	1675 (3.0)	1480 (88.4)	170 (10.1)	25 (1.5)
Regular outpatient, No. (%)				
Yes	38748 (70.3)	28095 (72.5)	9919 (25.6)	734 (1.9)
Subjective health status, No. (%)				
Excellent, good	16359 (29.7)	11315 (69.2)	4718 (28.8)	326 (2.0)
Normal	28534 (51.7)	20308 (71.2)	7628 (26.7)	598 (2.1)
Poor, bad	10254 (18.6)	7786 (75.9)	2223 (21.7)	245 (2.4)
Trouble and help-seeking behavior, No. (%)				
Having no trouble	34498 (62.6)	23988 (69.5)	9818 (28.5)	692 (2.0)
Having trouble and consulting	14410 (26.1)	11182 (77.6)	2965 (20.6)	263 (1.8)
Having trouble but not consulting	1325 (2.4)	906 (68.4)	359 (27.1)	60 (4.5)
Having trouble but feeling no need for consulting	4914 (8.9)	3333 (67.8)	1427 (29.0)	154 (3.1)
Mental health (K6), No. (%)				
≥13	1215 (2.2)	910 (74.9)	256 (21.1)	49 (4.0)
Smoking, No. (%)				
Current smoker	8168 (14.8)	4143 (50.7)	3612 (44.2)	413 (5.1)
Past smoker	3263 (5.9)	1870 (57.3)	1304 (40.0)	89 (2.7)
Never smoked	43716 (79.3)	33396 (76.4)	9653 (22.1)	667 (1.5)
Sleeping hours, No. (%)				
<5 hours	2944 (5.3)	2255 (76.6)	625 (21.2)	64 (2.2)
≥5 hours-<9 hours	50078 (90.8)	35736 (71.4)	13343 (26.6)	999 (2.0)
≥9 hours	2125 (3.9)	1418 (66.7)	601 (28.3)	106 (5.0)
Subjective sleep satisfaction, No. (%)				
Poor	6282 (11.4)	4617 (73.5)	1519 (24.2)	146 (2.3)
Lifestyle habit, No. (%)				
Healthy eating habits	49091 (89.0)	35634 (72.6)	12599 (25.7)	858 (1.7)
Regular exercise habits	29587 (53.7)	21390 (72.3)	7687 (26.0)	510 (1.7)

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Table 4. Multinomial logistic regression analysis of alcohol consumption

Characteristics	n=55,147			
	Low-risk vs At-risk		Low-risk vs High-risk	
	Adjusted Odds Ratio (95% CI)	P value	Adjusted Odds Ratio (95% CI)	P value
Age (years)				
>65 to <75	1 [Reference]	NA	1 [Reference]	NA
≥75	0.56 (0.53-0.59)	< 0.01	0.34 (0.29-0.40)	< 0.01
Sex				
Women	1 [Reference]	NA	1 [Reference]	NA
Men	7.47 (7.02-7.95)	< 0.01	10.62 (8.37-13.47)	< 0.01
Education completed				
Less than high school	1 [Reference]	NA	1 [Reference]	NA
High school	1.02 (0.97-1.07)	0.40	0.93 (0.81-1.06)	0.26
Undergraduate school	1.00 (0.94-1.07)	0.92	0.87 (0.72-1.05)	0.14
Marital status				
Married	1 [Reference]	NA	1 [Reference]	NA
Never married	0.85 (0.73-0.98)	0.03	0.95 (0.66-1.38)	0.80
Bereaved	1.01 (0.93-1.10)	0.74	0.90 (0.69-1.16)	0.41
Divorced	1.10 (0.97-1.26)	0.14	1.51 (1.11-2.05)	< 0.01
Employment status				
Unemployed	1 [Reference]	NA	1 [Reference]	NA
Employed	1.24 (1.18-1.29)	< 0.01	1.32 (1.16-1.49)	< 0.01
Living alone				
No	1 [Reference]	NA	1 [Reference]	NA
Yes	1.04 (0.95-1.15)	0.38	1.05 (0.81-1.37)	0.69
Residential status				
Owned	1 [Reference]	NA	1 [Reference]	NA
Tenant	1.07 (1.00-1.15)	0.07	1.23 (1.03-1.47)	0.03
Activities of daily living				
Independence	1 [Reference]	NA	1 [Reference]	NA
Dependence (not bed-ridden)	0.73 (0.64-0.83)	< 0.01	0.81 (0.56-1.17)	0.26
Bed-ridden	0.43 (0.37-0.52)	< 0.01	0.63 (0.41-0.96)	0.03
Regular outpatient				
No	1 [Reference]	NA	1 [Reference]	NA
Yes	1.04 (0.99-1.09)	0.10	0.88 (0.77-1.00)	0.05
Subjective health status				
Normal	1 [Reference]	NA	1 [Reference]	NA
Excellent, good	1.09 (1.04-1.14)	< 0.01	1.03 (0.90-1.19)	0.64
Poor, bad	0.86 (0.81-0.92)	< 0.01	1.04 (0.87-1.24)	0.65
Trouble and help-seeking behavior				
Having no trouble	1 [Reference]	NA	1 [Reference]	NA
Having trouble and consulting	0.87 (0.82-0.92)	< 0.01	1.05 (0.90-1.24)	0.53
Having trouble but not consulting	1.07 (0.93-1.23)	0.38	1.87 (1.39-2.53)	< 0.01
Having trouble but feeling no need for consulting	1.06 (0.98-1.14)	0.15	1.39 (1.15-1.68)	< 0.01
Mental health (K6)				
<13	1 [Reference]	NA	1 [Reference]	NA
≥13	1.08 (0.92-1.26)	0.38	1.57 (1.13-2.19)	< 0.01
Smoking				
Never smoked	1 [Reference]	NA	1 [Reference]	NA
Past smoker	1.41 (1.30-1.52)	< 0.01	1.24 (0.98-1.56)	0.07
Current smoker	1.77 (1.68-1.87)	< 0.01	2.30 (2.01-2.63)	< 0.01
Sleeping hours				
≥5 hours to <9 hours	1 [Reference]	NA	1 [Reference]	NA
<5 hours	0.93 (0.84-1.04)	0.20	1.04 (0.78-1.38)	0.81
≥9 hours	1.28 (1.15-1.43)	< 0.01	3.00 (2.39-3.76)	< 0.01
Subjective sleep satisfaction				
Good	1 [Reference]	NA	1 [Reference]	NA
Poor	1.04 (0.97-1.13)	0.25	0.93 (0.75-1.14)	0.47
Lifestyle habit				
Healthy eating habits				
No	1 [Reference]	NA	1 [Reference]	NA
Yes	0.79 (0.74-0.84)	< 0.01	0.43 (0.37-0.50)	< 0.01
Regular exercise habits				
No	1 [Reference]	NA	1 [Reference]	NA
Yes	0.94 (0.90-0.99)	< 0.01	0.87 (0.77-0.99)	0.04