Outpatient treatment following alcohol screening at health checkups and change in drinking patterns among excessive drinkers with lifestyle-related diseases

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1. Introduction

Excessive alcohol use is a significant cause of mortality, morbidity and social problems. Alcohol consumption causes digestive diseases, cardiovascular diseases, and cancers (World Health Organization, 2018). Health risks associated with alcohol consumption rise along with an increase in the amount of daily drinking (Day & Rudd, 2019; Degenhardt et al., 2018). Although alcohol dependence is a severe alcohol-related problem, most alcohol-related problems occur in a large number of drinkers who are not alcohol-dependent (Anderson, 1991). Therefore, a population-based approach for drinkers has a significant impact on reduction in overall alcohol-related harm (Knox et al., 2019; World Health Organization, 2001).

Screening and brief interventions (SBI) in primary care settings have been implemented as a strategy to reduce hazardous or harmful drinking (World Health Organization, 2001; World Health Organization, 2018; Kaner et al., 2009; Beyer et al., 2019; Knox et al., 2019). A systematic review of trials of SBI provided at general healthcare facilities, emergency departments, and trauma centers revealed that people who received SBI consumed less alcohol and reduced their frequency of drinking than participants with minimal or no intervention after one year (Kaner et al., 2018). The systematic review also revealed that extended intervention, which was comprised of either more than five sessions or more than 60 min in total and based on motivational interviewing or cognitive behavioral therapy, had a limited impact compared with standard SBI (Kaner et al., 2018).

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In Japan, employers are obliged to provide annual health checkups for their employees based on the Industrial Safety and Health Act. Employees have this mandatory health checkup at least once a year, and the participation rate among employees is approximately 80% (Ministry of Health and Labour and Welfare, 2008). One of the objectives of this health checkup is early detection and intervention for lifestyle-related diseases among workers. The standard health checkup includes height and weight measurements, blood pressure measurement, vision and hearing tests, blood tests including liver function, urinary tests, and chest X-ray (Ministry of Health, Labour and Welfare, 2018). Lifestyle and habits, including drinking patterns, are also assessed using standardized self-reported questionnaires (Ministry of Health, Labour and Welfare, 2018). If a person is diagnosed as being at risk of lifestyle-related diseases, recommendations are made to receive treatment or health guidance at outpatient services. Although this system of health checkups and recommendations may allow early intervention for hazardous or harmful drinkers who are also at risk for lifestyle-related diseases, its effectiveness has not been evaluated. Additionally, most studies assessed the effectiveness of SBI using self-reported alcohol drinking levels (Kaner et al., 2009; 2018; Schmidt et al., 2016). Laboratory findings should also be used to evaluate the effect of SBI.

The aim of this study was to assess the effectiveness of general outpatient treatment following alcohol consumption screening at health checkups. The population of interest was risky or heavy drinkers who also met the threshold to be given a recommendation to seek outpatient treatment for lifestyle-related diseases. We utilized a large-scale database of health checkups and medical claims data and used self-reported alcohol consumption and laboratory findings as outcomes.

2. Methods

2.1. Data source

A retrospective cohort study was performed using the JMDC Claims Database, a database of health checkups and medical claims constructed by JMDC Inc. (Tokyo, Japan). JMDC Inc. has collected claims information from occupation-based health insurance agencies for corporate employees and their dependents since 2005 (Kimura et al., 2010). The JMDC Claims Database includes anonymous data of inpatient, outpatient, and pharmacy claims and health checkups from about 7,300,000 individuals as of April 2020 (JMDC Inc., 2020). The database includes information about patient characteristics, diagnoses, drug prescriptions, medical procedures, characteristics of medical facilities, and reimbursement fees. The diagnoses are based on the International Classification of Diseases, 10th revision (ICD-10) diagnostic codes. The health checkup data consist of results for anthropometric measurements, blood tests, medical interviews, and lifestyle questionnaires, including questions about alcohol drinking patterns (frequency [none, rarely, sometimes, or every day] and consumption per day) and motivation to change lifestyle. Alcohol consumption per day is assessed in the questionnaire by a glass of sake (approximately 20 g of pure ethanol) as a unit and as a reference for converting from other types of alcohol. This categorization is based on the results of a previous cohort study (Tsugane et al., 1999) and is also utilized in the “Health Japan 21” policy (Ministry of Health, Labour and Welfare, 2012). We converted this into <20 g, 20–40 g, 40–60 g, >60 g of ethanol per day. We used data from April 1st, 2015, through March 31st, 2018.

The requirement for informed consent was waived because of the anonymous nature of the data. The study was approved by the Institutional Review Board of The University of Tokyo (No. 10862).

2.2. Participant selection

We first identified individuals who received a health checkup in 2016. If an individual received two or more health checkups in a year, we selected data from the first health checkup. Participants were selected if they fit the following inclusion criteria: 1) insured employees, 2) continuous enrollment in health insurance from April 2015 to March 2018, 3) alcohol consumption based on the 2016 health checkup, and 4) meeting the threshold of recommendation to receive treatment for lifestyle-related diseases (high blood pressure, diabetes, liver diseases, dyslipidemia, or hyperuricemia) during the 2016 health checkup. The thresholds were based on health checkup guidelines (Ministry of Health, Labour and Welfare, 2018): systolic blood pressure ≥ 140 mmHg, diastolic blood pressure ≥ 90 mmHg, hemoglobin A1c (HbA1c) ≥ 6.5%, fasting blood glucose ≥ 126 mg/dL, casual blood glucose ≥ 126 mg/dL, glutamate oxaloacetate transaminase (GOT) ≥ 51 U/L, glutamate pyruvate transaminase (GPT) ≥ 51 U/L, gamma-glutamyl transpeptidase (γ-GT) ≥ 101 U/L, triglycerides ≥ 300 mg/dL, high-density lipoprotein (HDL) < 34 mg/dL, low-density lipoprotein (LDL) < 140 mg/dL, or uric acid ≥ 8 mg/dL. We excluded those who had received treatment for lifestyle-related diseases at any institution during one year preceding the 2016 health checkup, those who had received treatment for alcohol-related diseases at psychiatry during one year preceding the 2016 health checkup, those without data from a 2017 health checkup, and those with missing data on alcohol consumption or frequency in the 2017 health checkup.

We divided the people into three groups: low-risk drinkers (not drinking every day, or drinking < 40 g/day for male and < 20 g/day for female), risky drinkers (drinking every day at 40–60 g/day for male and 20–60 g/day for female), or heavy drinkers (drinking every day at > 60 g/day) (Ministry of Health, Labour and Welfare, 2012). We included risky drinkers or heavy drinkers for the analysis separately.

2.3. Measures

The primary outcome was alcohol drinking patterns (frequency and consumption per day) assessed at the 2017 health checkup. The frequency of alcohol drinking and the alcohol consumption per day was assessed using three categories (no or rarely, sometimes, or every day) and four classes (< 20 g, 20–40 g, 40–60 g, or > 60 g), respectively. We identified whether participants improved in their drinking patterns or not. Improvement in frequency was defined by the frequency as sometimes, rarely, or none in 2017. Participants were considered to have improved alcohol consumption when the category of consumption in 2017 was lower than that in 2016. For example, in risky male drinkers, those who reduced the amount of drinking to less than 40 g per day in 2017 were considered to have improved. In heavy drinkers, those who reduced the amount to less than 60 g per day were considered to have improved in both males and females. The secondary outcome was laboratory results associated with liver conditions in 2017 (GOT, GPT, and γ-GT). We also defined liver dysfunction in 2017 (binary variable) as at least one of GOT, GPT, or γ-GT meeting the threshold of recommendation for treatment.

The exposure variable was whether participants received outpatient treatment for lifestyle-related diseases between the 2016 and 2017 health checkups or not (treatment or no treatment). We identified outpatient treatment for lifestyle-related diseases or outpatient nutrition guidance using claim records of a specific reimbursement for the continuous outpatient management of lifestyle-related diseases conducted by primary care physicians at clinics or small hospitals (< 200 beds). To receive this reimbursement, primary care physicians must provide patients with comprehensive treatment and health guidance, such as medication and advice for exercise or nutrition.

We assessed the following variables as potential predictors of receiving outpatient treatment. Participant characteristics included sex and age. Health conditions were evaluated using blood pressure, body mass index (BMI), fasting blood glucose, results of blood test (HbA1c, fasting blood glucose, casual blood glucose, GOT, GPT, γ-GT, triglycerides, HDL, LDL, and uric acid), and conditions of recommendation to receive treatment (systolic blood pressure, diastolic blood pressure, HbA1c, fasting blood glucose, casual blood glucose, GOT, GPT,
\( \gamma \)-GT, triglycerides, HDL, LDL, and uric acid). The motivation for lifestyle change was also assessed using two questions: intention to change lifestyles such as exercise and diet (no intention, intention to change within 6 months, intention to change within one month, changed and maintained for <6 months, changed and maintained for \( \geq 6 \) months, or missing), and intention to receive health guidance about the lifestyle improvement (yes, no, or missing).

2.4. Statistical analysis

We analyzed risky drinkers and heavy drinkers separately. Propensity scores were utilized to balance the backgrounds between the groups (treatment or no treatment). In order to estimate the propensity score, logistic regression models were constructed with the treatment condition as the dependent variable and the following factors as independent variables: participant characteristics, motivation for lifestyle change, blood pressure, BMI, abdominal circumference, results of blood test (triglycerides, HDL, LDL, GOT, GPT, \( \gamma \)GT), and conditions of recommendation to receive treatment. People with missing data for the calculation of propensity score were excluded from the analysis. Propensity score matching was performed using 1:1 nearest-neighbor matching without replacement with a caliper distance of 0.2 for the standard deviation of the propensity score. We confirmed standardized differences between the groups before and after the propensity score matching. A standardized difference of less than 0.1 was considered indicative of balance. Chi-squared test and Student’s \( t \)-test were used to compare categorical and continuous outcomes, respectively.

The threshold for significance was \( p < 0.05 \). Stata version 16 (StataCorp, College Station, TX, USA) was used for all statistical analyses.

![Fig. 1. Participant selection process.](image-url)
3. Results

3.1. Participant characteristics

Fig. 1 shows participant selection. We identified 1,821,892 individuals (1,191,634 males, 630,258 females) who received health checkup in 2016. Among 599,560 participants (514,030 males, 85,530 females) with alcohol consumption, 184,529 (173,727 males, 10,802 females) met the threshold for recommendation to receive treatment for lifestyle-related diseases. We excluded those who had received treatment for lifestyle-related or alcohol-related diseases during the one year preceding the 2016 health checkup (n = 64,093) and those without data from the 2017 health checkup (n = 6221). Moreover, we excluded people with any missing data of variables for alcohol consumption or frequency in 2017 (n = 4800) and variables required for the calculation of the propensity score (n = 3020). We included 23,347 individuals for analysis (17,959 risky drinkers and 5388 heavy drinkers) after excluding low-risk drinkers (n = 83,048).

Table 1 shows the treatment characteristics in both risky drinkers and heavy drinkers before propensity score matching. Among the 17,959 risky drinkers, 1991 individuals (11.1%) received treatment for lifestyle-related diseases between the 2016 and 2017 health checkups. Among the 5388 heavy drinkers, 579 individuals (10.7%) received treatment for lifestyle-related or alcohol-related diseases during the one year before propensity score matching. Among the 17,959 risky drinkers and 5388 heavy drinkers after excluding low-risk drinkers (n = 83,048), we assessed changes in drinking patterns and evaluated liver dysfunction.

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3.2. Propensity score-matched participants and adjusted outcomes

Propensity score matching selected 1990 pairs of risky drinkers and 575 pairs of heavy drinkers (Table 2). The standardized differences between the groups were less than 0.1 for most of the variables. In both the risky drinkers and heavy drinkers, a majority of participants were male, the mean age was about 51 years, and the mean BMI was approximately 24. The major reasons for treatment recommendation were high blood pressure or high γ-GT. Detailed results of blood tests after propensity score matching are shown in Supplementary Table 3.

Table 3 shows the outcomes in the matched individuals. In the risky drinkers, individuals in the outpatient screening and treatment group were more likely to reduce the frequency of alcohol drinking than the screening alone group (11.7% vs. 8.7%, p = 0.002). However, there was no significant difference in the proportion of individuals who reduced consumption per day (26.1% vs. 25.7%, p = 0.772). The treatment group showed lower GOT (mean: 29.6 vs. 30.7, p = 0.034), lower GPT (mean: 30.8 vs. 32.2, p = 0.034), and lower γ-GT (mean: 97.6 vs. 102.8, p = 0.005). There was no significant difference in the proportion of individuals with liver dysfunction.

In the heavy drinkers, there were no significant differences in either the proportion of individuals who reduced the frequency of alcohol drinking (8.9% vs. 8.2%, p = 0.673) or the proportion of individuals who reduced consumption per day (40.2% vs. 36.0%, p = 0.145). There were no significant differences in either laboratory results or the proportion of individuals with liver dysfunction.

4. Discussion

We assessed changes in drinking patterns and evaluated liver dysfunction.
functions in people who sought outpatient services after receiving a recommendation to receive outpatient treatment for lifestyle-related diseases following an alcohol consumption screening at a health checkup. The comparison group was comprised of people who were given a recommendation to receive outpatient treatment, but did not do so. In the risky drinkers, outpatient treatment was associated with a greater reduction in the frequency of alcohol drinking and lower GOT, GPT, and γ-GT at one year after a health checkup. In the heavy drinkers, however, there was no significant association between outpatient treatment and reduction in frequency or amount of drinking, and treatment was also not associated with improved liver function.

The majority of the participants were middle-aged males. Especially, over 95% of the heavy drinkers were male. A nationwide survey revealed that about 20% of middle-aged males were excessive drinkers with risks of lifestyle-related diseases, and this proportion was higher than those of other age groups (Ministry of Health, Labour and Welfare, 2020). Even though the participants of this study were the major targeted population of the intervention for excessive drinking and lifestyle-related diseases, only about 10% of the participants sought outpatient services after the recommendation to receive treatment. Approximately

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**Table 2**

Demographic characteristics and health conditions at the first health checkup after propensity score matching.

| Risky drinker (n = 3,980) | Heavy drinker (n = 1,150) |
|---------------------------|---------------------------|
|                            | Treatment | No treatment | p          | Treatment | No treatment | p          |
|                            | (n = 1,990) | (n = 1,990) |           | (n = 575) | (n = 575) |           |
| Sex (male) | 1,798 | 90.4% | 1,780 | 89.5% | 0.030 | 560 | 97.4% | 560 | 97.4% | 0.000 |
| Age | 52.0 | 7.2 | 52.0 | 7.7 | 0.008 | 51.0 | 7.2 | 51.0 | 7.4 | 0.007 |
| BMI (kg/m²) | 24.2 | 3.4 | 24.2 | 3.6 | 0.020 | 24.4 | 3.6 | 24.3 | 3.4 | 0.027 |
| Abdominal circumference (cm) | 86.0 | 8.9 | 86.1 | 9.2 | 0.013 | 86.9 | 9.2 | 86.8 | 9.0 | 0.017 |
| Alcohol consumption per day* | 20-40 g | 135 | 6.8% | 152 | 7.6% | 0.033 | -- | -- | -- | -- |
|                            | 40-60 g | 1,855 | 93.2% | 1,838 | 92.4% | 0.033 | -- | -- | -- | -- |

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**Table 3**

Alcohol drinking patterns and liver function in subsequent annual health checkup after propensity score matching.

| Risky drinker (n = 3,980) | Heavy drinker (n = 1,150) |
|---------------------------|---------------------------|
|                            | Treatment | No treatment | p          | Treatment | No treatment | p          |
|                            | (n = 1,990) | (n = 1,990) |           | (n = 575) | (n = 575) |           |
| Alcohol: frequency | Improved | 233 | 11.7% | 173 | 8.7% | 0.002* | 51 | 8.9% | 47 | 8.2% | 0.673* |
|                            | No change/Worsened | 1,757 | 88.3% | 1,817 | 91.3% | 0.524 | 524 | 91.1% | 528 | 91.8% |
| Alcohol: consumption/day | Improved | 520 | 26.1% | 512 | 25.7% | 0.772* | 231 | 40.2% | 207 | 36.0% | 0.145* |
|                            | No change/Worsened | 1,470 | 73.9% | 1,478 | 74.3% | 0.344 | 338 | 59.8% | 368 | 64.0% |
| Liver function | Dysfunction | 728 | 36.6% | 768 | 38.6% | 0.191* | 253 | 44.0% | 272 | 47.3% | 0.261* |
|                            | GOT (U/L) | 29.6 | 17.4 | 30.7 | 23.1 | 0.034* | 33.1 | 26.3 | 34.6 | 22.4 | 0.146* |
|                            | GPT (U/L) | 30.8 | 21.2 | 32.2 | 26.7 | 0.034* | 32.9 | 23.3 | 34.6 | 26.4 | 0.134* |
|                            | γ-GT (U/L) | 97.6 | 94.3 | 102.8 | 102.7 | 0.050* | 119.8 | 115.2 | 130.9 | 127.8 | 0.061* |

* By definition, all heavy drinkers had alcohol consumption of > 60 g/day.
BMI: body mass index, HbA1c: hemoglobin A1c, GOT: glutamate oxaloacetate transaminase, GPT: glutamate pyruvate transaminase, γ-GT: gamma-glutamyl transpeptidase, HDL: high-density lipoprotein, LDL: low-density lipoprotein.
30% of the participants answered at health checkups that they did not intend to change their lifestyle. Most appeared to be unmotivated to receive treatment.

In general treatment for lifestyle-related diseases, primary care physicians provide advice about prescription, diet, and exercise based on a treatment plan. If a patient has an alcohol problem, a physician helps the patient understand the risks or adverse effects of excessive drinking and advises on possible ways to reduce alcohol consumption. These interventions may guide the patient to improve drinking behavior. In addition, other interventions for lifestyle-related diseases, such as motivational advice to be physically more active, may also have indirect effects that improve drinking behavior. Among the risky drinkers evaluated in the present study, participants who received outpatient treatment were more likely to reduce the frequency of drinking compared to those without treatment. However, there was no significant reduction in the amount of drinking. In a meta-analysis (Hu et al., 2020; Chi et al., 2017; Timko et al., 2016), comprehensive screening and recommendation to receive general outpatient treatment in this study is different from a typical brief intervention because treatment intensity for alcohol-related problems might depend on clinics or physicians. Third, some participants may have received health guidance from healthcare professionals during health checkups. However, we could not analyze data regarding health guidance. Fourth, the frequency and amount of drinking were self-reported and could be underreported. Additionally, drinking patterns were assessed by categories of frequency and amount. People with different patterns of consumption could be included in the same category, and people with episodic binge drinking could not be identified. Lastly, the study population consisted of predominantly male employees. Therefore, generalizability to females may be limited.

5. Conclusion

This study suggested that general outpatient treatment for lifestyle-related diseases following screening for excessive alcohol consumption at health checkups may reduce the frequency of alcohol drinking and improve liver function among risky drinkers after one year. Further study is needed to evaluate the effectiveness of screening and general treatment for heavy drinkers.

Author contributions

AT, HaY, SO, and HiY devised the study protocol. AT, HaY, SO, HM and HiY contributed to data collection and analysis and drafted the manuscript. All authors have contributed to interpretation and critically reviewed the manuscript. All authors approved the final version of the manuscript.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpmerd.2021.101549.

This study has some possible limitations. First, the participants who received treatment for lifestyle-related diseases after the health checkup screening might also be highly motivated to improve drinking behavior. Although we used their intention to change lifestyles for adjustment, the variable was for intention to change lifestyles in general and not specifically alcohol drinking behavior. There could also be residual confounding. Second, actual treatment for lifestyle-related diseases was provided by different clinics or physicians. Intervention at outpatient treatment in this study is different from a typical brief intervention because treatment intensity for alcohol-related problems might depend on clinics or physicians. Third, some participants may have received health guidance from healthcare professionals during health checkups. However, we could not analyze data regarding health guidance. Fourth, the frequency and amount of drinking were self-reported and could be underreported. Additionally, drinking patterns were assessed by categories of frequency and amount. People with different patterns of consumption could be included in the same category, and people with episodic binge drinking could not be identified. Lastly, the study population consisted of predominantly male employees. Therefore, generalizability to females may be limited.

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