

Social predictors of alcohol use and cessation during pregnancy among Japanese women: the Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study

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Abstract

Background: Most studies on social predictors of alcohol use have been conducted at one time point during pregnancy or using postpartum retrospective reports. Furthermore, the studies were mainly conducted in Western countries. We aimed to prospectively examine social predictors of alcohol use and cessation during pregnancy in Japan.

Methods: This prospective study was part of the Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study from 2013 to 2017. Pregnant women were recruited at approximately 50 obstetric clinics and hospitals in Miyagi Prefecture in Japan. We analyzed 11592 pregnant women who completed the questionnaires administered in early pregnancy and middle pregnancy. Women were dichotomized as current drinkers or non-drinkers in both early and middle pregnancy. Age, education, income, work status, and psychological distress were used as social predictors. Multivariate logistic regression analyses were conducted to examine associations between these predictors and alcohol use in early and middle pregnancy. Associations with alcohol cessation between early pregnancy and middle pregnancy were also examined.

Results: Prevalence of alcohol use in early and middle pregnancy was 20.9% and 6.4%, respectively. Higher education was associated with alcohol use in early pregnancy and alcohol cessation during pregnancy; the odds ratios (ORs) of \geq university education compared with \leq high school education were 1.47 (95% confidence interval [CI], 1.30–1.66) and 1.31 (95% CI, 1.00–1.71), respectively. Work status was associated with alcohol use in both periods and alcohol cessation during pregnancy; for alcohol cessation, the OR of working in early pregnancy only compared with not working in both periods was 1.72 (95% CI, 1.03–2.88).

Conclusions: Women with higher education were more likely to consume alcohol in early pregnancy and to cease between early pregnancy and middle pregnancy. Working women were more likely to consume alcohol throughout pregnancy in Japan.

Background

Alcohol is a teratogen that can readily cross the placenta, which results in damage to the brain and other organs of the developing embryo and fetus. Alcohol use during pregnancy can cause pregnancy complications such as low birth weight, preterm birth, and small for gestational age [1,2], and can result in a range of lifelong physical, behavioral, and intellectual disabilities known as fetal alcohol spectrum disorders [2,3]. Because no amount of alcohol and no time to drink can be considered safe during pregnancy [2,4], recommendations for alcohol use during pregnancy advocate abstinence in most countries [5]. Despite such recommendations, the global prevalence of alcohol use during pregnancy was estimated at 9.8% [6].

Identification of pregnant women who are most likely to consume alcohol is essential for targeted interventions. Although a wide range of social factors, including age, education, income, work status, and

psychiatric symptoms, have been examined as potential predictors of alcohol use during pregnancy [7], two points have not been fully examined. First, most studies examining social predictors of alcohol use have been conducted at only one time point during pregnancy or using postpartum retrospective reports. Differences in prevalence of alcohol use have been reported between early pregnancy and middle/late pregnancy [8–12]. Although this suggests that predictors of alcohol use may differ by pregnancy stage, very few studies have been conducted at different points during pregnancy [13–16]. Furthermore, predictors of alcohol cessation between early and middle/late pregnancy have rarely been examined among women who had already become aware of their pregnancy [14,16], while studies have determined predictors of alcohol cessation between pre-awareness and post-awareness of pregnancy [14,16–19].

Second, evidence on predictors of alcohol use during pregnancy has mainly been obtained in Western countries [7]. Social predictors may be different in Asian countries, including Japan, because social and cultural contexts influence varying social patterns of alcohol use in different countries [20]. There are two characteristics of alcohol use in Japan. One is that there are many opportunities to inform pregnant women of the health risks of alcohol use from very early pregnancy, including the distribution of maternal and child health handbooks as soon as pregnancy is confirmed, and health checkups for all pregnant women [21,22]. The other is that there is the custom of drinking with work colleagues because alcohol use is often an integral part of social life [23,24]. It is possible that these characteristics can affect the associations of education and work status with alcohol use during pregnancy.

Considering these circumstances, we conducted a prospective cohort study to examine social predictors of alcohol use in early and middle pregnancy and alcohol cessation between early and middle pregnancy in Japan, with a particular focus on education and work status.

Methods

Study population

Data were obtained from the Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study (TMM BirThree Cohort Study), which has been described elsewhere [25]. Pregnant women and their family members were contacted in obstetric clinics or hospitals when they scheduled their deliveries from 2013 to 2017. Approximately 50 obstetric clinics and hospitals in Miyagi Prefecture participated in the recruitment process. Tohoku University Tohoku Medical Megabank Organization established seven community support centers in Miyagi Prefecture as local facilities for voluntary admission-type recruitment and health assessment of the participants [26]. Trained genome medical research coordinators were placed in each clinic, hospital, or community support center to provide information on the TMM BirThree Cohort Study to potential participants and to receive signed informed consent forms from those who agreed to participate. Of 32986 pregnant women who were contacted, 22493 agreed to participate and 20879 completed the questionnaires in early and middle pregnancy. Among them, 9287 women were excluded because of missing values in equivalent household income, work status, psychological distress, alcohol use, or educational attainment. The remaining 11592 pregnant women

were included in the present study. Figure 1 shows the flow diagram of the present study. The TMM BirThree Cohort Study protocol was reviewed and approved by the Ethics Committee of Tohoku University Tohoku Medical Megabank Organization (2013–1–103–1). The characteristics of 11592 analyzed women and 9287 excluded women are shown in Supplementary Table 1.

Measures

As social predictors, we chose age, education, income, work status, and psychological distress [7]. Age in early pregnancy was categorized into three groups: ≤29, 30–34, and ≥35 years. Educational attainment was categorized into three groups: high school or lower (elementary, junior high school, or senior high school), college (2-year college or special training school), and university or higher (university or graduate school). Women were asked to select their total annual household income among seven categories: <2, 2–4, 4–6, 6–8, 8–10, 10–12, and >12 million Japanese yen. Equivalent household income was calculated as the household income divided by the square root of the number of family members [27], and categorized into four groups: <2, 2–3, 3–4, and >4 million Japanese yen, which nearly corresponded to quartiles. Women were asked how many days per week they worked during early and middle pregnancy, and a response of >0 days was defined as working. Work status during pregnancy was additionally categorized as not working in early and middle pregnancy, working in early pregnancy only, and working in both early and middle pregnancy. Women provided responses to the Japanese version of the K6 scale, consisting of six items for assessment of depressive moods and anxiety during the past 30 days. Responses ranged from 0 (none of the time) to 4 (all of the time), with total scores ranging from 0 to 24 [28,29]. Psychological distress was defined as scores ≥5 [29,30]. Psychological distress during pregnancy was additionally categorized as none in early and middle pregnancy, in early pregnancy only, in middle pregnancy only, and in both early and middle pregnancy.

Women were asked to choose one of the following response options for alcohol use in early and middle pregnancy: current drinker, past drinker, never drinker, and constitutionally never drinker. Alcohol use in the present study was defined as response “current drinker” based on the idea that there is no known safe amount of alcohol to drink during pregnancy [2,4]. Alcohol cessation between early and middle pregnancy was defined as alcohol use in early pregnancy, but not in middle pregnancy.

Statistical analysis

Multivariate logistic regression analyses were conducted to examine the associations between social predictors (age, education, income, work status, psychological distress) and alcohol use in both early pregnancy and middle pregnancy. We calculated the odds ratio (OR) and 95% confidence interval (CI) for each social predictor after adjustment for age, as well as other predictors. We also examined the associations between social predictors and alcohol cessation among women who consumed alcohol in early pregnancy.

All analyses were conducted with SAS version 9.4 software (SAS Institute Inc., Cary, NC). For all analyses, a two-tailed *P* value <0.05 was considered statistically significant.

Results

Table 1 shows the characteristics of the pregnant women. About 30% of women had graduated from university or higher. Prevalence of working in early and middle pregnancy was 66.0% and 61.4%, respectively. Prevalence of alcohol use in early and middle pregnancy was 20.9% and 6.4%, respectively.

Table 2 presents the prevalences, ORs, and 95% CIs for alcohol use in early pregnancy. Higher educational attainment was associated with alcohol use in early pregnancy after adjustment for age, as well as income, work status, and psychological distress; the multivariate-adjusted OR of university education or higher compared with high school education or lower was 1.47 (95% CI, 1.30–1.66). Working in early pregnancy was associated with alcohol use in early pregnancy after adjustment for age, as well as education, income, and psychological distress; the multivariate-adjusted OR of working compared with not working was 1.53 (95% CI, 1.38–1.70). Higher equivalent household income was associated with alcohol use in early pregnancy, while age and psychological distress in early pregnancy were not associated with alcohol use in early pregnancy.

Table 3 presents the prevalences, ORs, and 95% CIs for alcohol use in middle pregnancy. Educational attainment was not associated with alcohol use in middle pregnancy after adjustment for age, as well as income, work status, and psychological distress; the multivariate-adjusted OR of university education or higher compared with high school education or lower was 0.95 (95% CI, 0.77–1.17). Working in middle pregnancy was associated with alcohol use in middle pregnancy after adjustment for age, as well as education, income, and psychological distress; the multivariate-adjusted OR of working compared with not working was 1.38 (95% CI, 1.18–1.63). Higher age and psychological distress in middle pregnancy were associated with alcohol use in middle pregnancy, while equivalent household income was not associated with alcohol use in middle pregnancy.

Table 4 presents the prevalences, ORs, and 95% CIs for alcohol cessation between early and middle pregnancy among women who consumed alcohol in early pregnancy. The prevalence of alcohol cessation was 77.7%. Higher educational attainment was associated with alcohol cessation after adjustment for age, as well as income, work status, and psychological distress; the multivariate-adjusted OR of university education or higher compared with high school education or lower was 1.31 (95% CI, 1.00–1.71). Working in early pregnancy only was associated with alcohol cessation after adjustment for age, as well as education, income, and psychological distress; the multivariate-adjusted OR of working in early pregnancy only compared with not working in both periods was 1.72 (95% CI, 1.03–2.88). Working in both periods was not associated with alcohol cessation; the corresponding OR was 1.09 (95% CI, 0.87–1.36). Higher equivalent household income was associated with alcohol cessation, while age and psychological distress were not associated with alcohol cessation.

Discussion

The present study prospectively examined social predictors of alcohol use in early and middle pregnancy and alcohol cessation between early and middle pregnancy in Japan. Prevalence of alcohol use decreased from 20.9% in early pregnancy to 6.4% in middle pregnancy. Women with higher education were more likely to consume alcohol in early pregnancy, but were more likely to cease between early and middle pregnancy. Working women were more likely to consume alcohol in early and middle pregnancy, and women who worked in early pregnancy but not middle pregnancy were more likely to cease between early and middle pregnancy. Higher age, higher income, and psychological distress were associated with alcohol use during pregnancy.

In early pregnancy, the prevalence of alcohol use was 20.9% and higher education was associated with an increased risk of alcohol use. We could not directly compare the prevalence of alcohol use in early pregnancy with corresponding data in Japan, because there is little information on alcohol use according to pregnancy stage. The 2013 national survey among the general population of Japan, who may be non-pregnant or pregnant, revealed that women who reported alcohol use comprised 79.4% in their twenties, 77.0% in their thirties, and 77.9% in their forties [24]. Previous studies in Japan showed that about half of pregnant women retrospectively reported alcohol use before they became aware of their pregnancy [8,9,19]. Taken together, it is assumed that many women in the present study had already ceased drinking when they filled out the questionnaires administered in early pregnancy. We were able to show an association between higher education and alcohol use in early pregnancy when alcohol cessation due to pregnancy awareness had already started.

There are several possible explanations for the association between higher education and alcohol use in early pregnancy. First, alcohol use may be more acceptable among women with higher education. Specifically, more years spent in education, improved labor market prospects, increased opportunities for socialization, and delayed pregnancy mean that alcohol use has easily found a place among these women [31]. Second, social networks among highly educated people may increase the risk of alcohol use. Alcohol use can follow social networking paths [32] and highly educated women tend to associate with other highly educated people [33] who are more likely to consume alcohol [34]. Third, highly educated women may have better-paid jobs involving higher degrees of responsibility and stress as well as more chances to go out drinking with male colleagues with higher limits of drinking [35]. However, the present study showed that the association between higher education and alcohol use remained after adjustment for work status and psychological distress during pregnancy.

Higher education was also associated with alcohol cessation between early and middle pregnancy, and therefore education was not associated with alcohol use in middle pregnancy. There is some evidence that highly educated women were more likely to consume alcohol before becoming aware of their pregnancy, and more likely to continue or reduce rather than cease alcohol use during pregnancy in Western countries [12,14,16–18]. Meanwhile, two studies in Japan showed that highly educated women were more likely to cease alcohol use after becoming aware of their pregnancy [9,19]. Our finding is consistent with the previous findings in Japan. In Japan, it is mandatory for women to notify the municipal office of their pregnancy as soon as it is confirmed. At the municipal office, they receive

maternal and child health handbooks [21] and tickets to use for pregnant woman health checkups at public expense. They also have access to counseling services with public health nurses, mother/parent classes, and various information services [22]. Knowledge on the health risks of alcohol use for the fetus was shown to be associated with a decreased risk of alcohol use during pregnancy [9]. Psychological and educational interventions such as supportive counselling and brief educational sessions were suggested to encourage pregnant women to cease alcohol use [36]. It is possible that highly educated women are more receptive to messages offered during the above opportunities than less educated women, because education conveys factual health-related knowledge and raises cognitive skills that affect health-promoting decisions [33,37]. However, early pregnancy is the time of greatest neurological vulnerability for the fetus [2,38]. The message that alcohol can damage a fetus even during the earliest weeks of pregnancy should be spread more widely.

Working was associated with alcohol use in early and middle pregnancy, and working in early pregnancy but not middle pregnancy was associated with alcohol cessation between these periods. Work status has been examined in many studies but was only infrequently found to be predictive [7]. Our finding are inconsistent with these previous findings that were mainly obtained in Western countries. One possible explanation for the observed association between working and alcohol use is that working people, who are more likely to have higher income, can afford to purchase alcoholic beverages [35]. However, the present study showed that the association between working and alcohol use remained after adjustment for income. Another possible explanation is that working may increase the opportunity for alcohol use. In Japan, there is a relatively high tolerance of alcohol and drinking is an important event in some working environments. For example, some working people socialize with colleagues after work in drinking meetings [23,24]. Our finding that leaving work between early and middle pregnancy was associated with alcohol cessation between these periods would support this explanation. If so, it is recommended that work colleagues should take care of pregnant women when they go out to socialize with one another.

Preconception abstinence from alcohol is preferred but difficult, because a large proportion of women of reproductive age consume alcohol [24] and women do not always plan to get pregnant [39]. It is therefore recommended that pregnant women who have already consumed alcohol during pregnancy should stop to minimize further risk [4]. A national campaign in Japan, the second term of Healthy Parents and Children 21, aims to eradicate alcohol use among pregnant women [40]. However, the present study showed that pregnant women consumed alcohol after becoming aware of their pregnancy: 20.9% in early pregnancy and 6.4% in middle pregnancy. Our findings about social predictors of alcohol use and cessation during pregnancy will be helpful for designing interventions to prevent alcohol use among pregnant women.

The present study has several limitations. First, we were able to analyze approximately half of the pregnant women who agreed to participate in the TMM BirThree Cohort Study. Women who were excluded from the analysis were less educated and more likely to be non-drinkers (Supplementary Table 1), which could lead to underestimation of the association between education and alcohol use during pregnancy. Second, the study was conducted in one of the 47 prefectures in Japan, and therefore the

generalizability of the present findings is limited. A national survey reported that the prevalences of alcohol use during pregnancy were 4.3% in 2013, 1.6% in 2015, 1.3% in 2016, and 1.2% in 2017, although these were retrospective reports from mothers after childbirth [40]. Finally, alcohol use was self-reported and this can be a source of uncertainty because women may be influenced by social desirability, a bias that tends to be important when questions deal with socially undesirable attitudes and behaviors. However, the superiority of self-administered questionnaires over face-to-face interviews in measuring alcohol use during pregnancy has been supported [41].

Conclusions

Women with higher education were more likely to consume alcohol in early pregnancy and to cease between early and middle pregnancy, while working women were more likely to consume alcohol throughout pregnancy in Japan. Alcohol use during pregnancy is a completely preventable cause of birth defects and developmental disabilities. Our findings indicate that determination of social predictors for alcohol use at different points during pregnancy will be useful for public health interventions to prevent alcohol use among pregnant women.

Abbreviations

95% CI: 95% confidence interval; OR: odds ratio; TMM BirThree Cohort Study: Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study

Declarations

Ethics approval and consent to participate

The TMM BirThree Cohort Study protocol was reviewed and approved by the Ethics Committee of Tohoku University Tohoku Medical Megabank Organization (2013-1-103-1). Trained genome medical research coordinators were placed in each clinic, hospital, or community support center to provide information on the TMM BirThree Cohort Study to potential participants and to receive signed informed consent forms from those who agreed to participate.

Consent for publication

There are no details on individual participants within the manuscript.

Availability of data and material

A biobank is being constructed based on the TMM BirThree Cohort Study. Although we are planning to share the full baseline data by the end of 2020, a portion of the data have been distributed to researchers

who have been approved by the Sample and Data Access Committee of the Biobank since 2017.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

KM was responsible for the study conception, design, analysis, and interpretation of the data, as well as the drafting of the manuscript. SK provided advice regarding critically important intellectual content and helped to draft the manuscript. All authors acquired the data and intensively revised the manuscript.

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References

1. Patra J, Bakker R, Irving H, Jaddoe VW, Malini S, Rehm J. Dose-response relationship between alcohol consumption before and during pregnancy and the risks of low birthweight, preterm birth and small for gestational age (SGA)-a systematic review and meta-analyses. 2011;118:1411–21.
2. Oei JL. Alcohol use in pregnancy and its impact on the mother and child. 2020.
doi:10.1111/add.15036.
3. Hoyme HE, Kalberg WO, Elliott AJ, Blankenship J, Buckley D, Marais AS, et al. Updated clinical guidelines for diagnosing fetal alcohol spectrum disorders. Pediatrics. 2016;138:e20154256.
4. S. Department of Health and Human Services. U.S. Surgeon General Releases Advisory on Alcohol Use in Pregnancy. 21 February 2005.
<http://come-over.to/FAS/SurGenAdvisory.htm>. Accessed 6 July 2020.
5. Dejong K, Olyaei A, Lo JO. Alcohol use in pregnancy. Clin Obstet Gynecol. 2019;62:142–55.

6. Popova S, Lange S, Probst C, Gmel G, Rehm J. Estimation of national, regional, and global prevalence of alcohol use during pregnancy and fetal alcohol syndrome: a systematic review and meta-analysis. *Lancet Glob Health*. 2017;5:e290–e299.
7. Skagerström J, Chang G, Nilsen P. Predictors of drinking during pregnancy: a systematic review. *J Womens Health (Larchmt)*. 2011;20:901–13.
8. Tamaki T, Kaneita Y, Ohida T, Harano S, Yokoyama E, Osaki Y, Takemura S, Hayashi K. Alcohol consumption behavior of pregnant women in Japan. *Prev Med*. 2008;47:544–9.
9. Yamamoto Y, Kaneita Y, Yokoyama E, Sone T, Takemura S, Suzuki K, et al. Alcohol consumption and abstention among pregnant Japanese women. *J Epidemiol*. 2008;18:173–82.
10. Hutchinson D, Moore EA, Breen C, Burns L, Mattick RP. Alcohol use in pregnancy: prevalence and predictors in the Longitudinal Study of Australian Children. *Drug Alcohol Rev*. 2013;32:475–82.
11. Oh S, Reingle Gonzalez JM, Salas-Wright CP, Vaughn MG, DiNitto DM. Prevalence and correlates of alcohol and tobacco use among pregnant women in the United States: Evidence from the NSDUH 2005-2014. *Prev Med*. 2017;97:93–9.
12. Shmulewitz D, Hasin DS. Risk factors for alcohol use among pregnant women, ages 15-44, in the United States, 2002 to 2017. *Prev Med*. 2019;124:75–83.
13. Murphy DJ, Dunney C, Mullally A, Adnan N, Fahey T, Barry J. A prospective cohort study of alcohol exposure in early and late pregnancy within an urban population in Ireland. *Int J Environ Res Public Health*. 2014;11:2049–63.
14. Pfänder M, Kunst AE, Feldmann R, van Eijsden M, Vrijkotte TG. Educational differences in continuing or restarting drinking in early and late pregnancy: role of psychological and physical problems. *J Stud Alcohol Drugs*. 2014;75:47–55.
15. Tran NT, Najman JM, Hayatbakhsh R. Predictors of maternal drinking trajectories before and after pregnancy: evidence from a longitudinal study. *Aust N Z J Obstet Gynaecol*. 2015;55:123–30.
16. Muggli E, O'Leary C, Donath S, Orsini F, Forster D, Anderson PJ, et al. "Did you ever drink more?" A detailed description of pregnant women's drinking patterns. *BMC Public Health*. 2016;16:683.
17. Kitsantas P, Gaffney KF, Wu H, Kastello JC. Determinants of alcohol cessation, reduction and no reduction during pregnancy. *Arch Gynecol Obstet*. 2014;289:771–9.
18. McCormack C, Hutchinson D, Burns L, Wilson J, Elliott E, Allsop S, et al. Prenatal alcohol consumption between conception and recognition of pregnancy. *Alcohol Clin Exp Res*. 2017;41:369–78.
19. Ishitsuka K, Hanada-Yamamoto K, Mezawa H, Saito-Abe M, Konishi M, Ohya Y; Japan Environment and Children's Study Group. Determinants of alcohol consumption in women before and after awareness of conception. *Matern Child Health J*. 2020;24:165–76.
20. Sudhinaraset M, Wigglesworth C, Takeuchi DT. Social and cultural contexts of alcohol use: influences in a social-ecological framework. *Alcohol Res*. 2016;38:35–45.
21. Nakamura Y. Maternal and Child Health Handbook in Japan. *JMAJ* 2010; 53: 259–65.

22. Akashi H, Ishioka M, Hagiwara A, Akashi R, Osanai Y. Core factors promoting a continuum of care for maternal, newborn, and child health in Japan. *Biosci Trends*. 2018;12:1–6.
23. Ikeda A, Kawachi I, Iso H, Inoue M, Tsugane S; JPHC Study Group. Gender difference in the association between social support and metabolic syndrome in Japan: the 'enkai' effect? *J Epidemiol Community Health*. 2011;65:71–7.
24. Kinjo A, Kuwabara Y, Minobe R, Maezato H, Kimura M, Higuchi S, et al. Different socioeconomic backgrounds between hazardous drinking and heavy episodic drinking: Prevalence by sociodemographic factors in a Japanese general sample. *Drug Alcohol Depend*. 2018;193:55–62.
25. Kuriyama S, Metoki H, Kikuya M, Obara T, Ishikuro M, Yamanaka C, et al., Tohoku Medical Megabank Project Study Group. Cohort Profile: Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study (TMM BirThree Cohort Study): Rationale, Progress and Perspective. *Int J Epidemiol*. 2020;49:18–
26. Kuriyama S, Yaegashi N, Nagami F, Arai T, Kawaguchi Y, Osumi N, et al., Tohoku Medical Megabank Project Study Group T, Yamamoto M. The Tohoku Medical Megabank Project: Design and Mission. *J Epidemiol*. 2016;26:493–
27. Atkinson AB, Rainwater L, Smeeding TM. Income distribution in OECD countries: evidence from the Luxembourg Income Study. Paris, France: Organization for Economic Co-operation and Development; 1995.
28. Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SL, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med*. 2002;32:959–76.
29. Furukawa TA, Kawakami N, Saitoh M, Ono Y, Nakane Y, Nakamura Y, et al. The performance of the Japanese version of the K6 and K10 in the World Mental Health Survey Japan. *Int J Methods Psychiatr Res*. 2008;17:152–
30. Sakurai K, Nishi A, Kondo K, Yanagida K, Kawakami N. Screening performance of K6/K10 and other screening instruments for mood and anxiety disorders in Japan. *Psychiatry Clin Neurosci*. 2011;65:434–
31. Huerta MC, Borgonovi F. Education, alcohol use and abuse among young adults in Britain. *Soc Sci Med*. 2010;71:143–51.
32. Rosenquist JN, Murabito J, Fowler JH, Christakis NA. The spread of alcohol consumption behavior in a large social network. *Ann Intern Med*. 2010;152:426–
33. Glymour MM, Avendano M, Kawachi I. Socioeconomic status and health. In: Berkman LF, Kawachi I, Glymour MM, editors. *Social epidemiology*. New York, NY: Oxford University Press; 2014. p.17–62.
34. Grittner U, Kuntsche S, Gmel G, Bloomfield K. Alcohol consumption and social inequality at the individual and country levels – results from an international study. *Eur J Public Health*. 2013;23:332–
35. Organisation for Economic Co-operation and Development. *Tackling Harmful Alcohol Use: Economics and Public Health Policy*. Paris, France: OECD Publishing; 2015.

36. Stade BC, Bailey C, Dzendoletas D, Sgro M, Dowswell T, Bennett D. Psychological and/or educational interventions for reducing alcohol consumption in pregnant women and women planning pregnancy. Cochrane Database Syst Rev 2009; (2): CD004228.
37. Cutler DM, Lleras-Muney A. Understanding differences in health behaviors by education. J Health Econ. 2010;29:1–28.
38. Nykjaer C, Alwan NA, Greenwood DC, Simpson NA, Hay AW, White KL, et al. Maternal alcohol intake prior to and during pregnancy and risk of adverse birth outcomes: evidence from a British cohort. J Epidemiol Community Health. 2014;68:542–9.
39. Sedgh G, Singh S, Hussain R. Intended and unintended pregnancies worldwide in 2012 and recent trends. Stud Fam Plann. 2014;45:301–
40. Osawa E, Ojima T, Akiyama Y, Yamagata Z. National campaign to promote maternal and child health in 21st-century Japan: Healthy Parents and Children 21. J Natl Inst Public Health. 2019;68:2–7.
41. O'Keeffe LM, Kearney PM, McCarthy FP, Khashan AS, Greene RA, North RA, et al. Prevalence and predictors of alcohol use during pregnancy: findings from international multicentre cohort studies. BMJ Open. 2015;5:e006323.

Tables

Table 1. Characteristics of the pregnant women: the Tohoku Medical Megabank Project Birth and Three-Generation Cohort Study (n=11592).

	n	(%)
Age in early pregnancy		
-29 years	3785	(32.6)
30-34 years	4424	(38.2)
35- years	3383	(29.2)
Educational attainment		
High school or lower	3657	(31.6)
College	4512	(38.9)
University or higher	3423	(29.5)
Equivalent household income (/year)		
0-2 million Japanese yen	2641	(22.8)
2-3 million Japanese yen	3669	(31.6)
3-4 million Japanese yen	2163	(18.7)
4- million Japanese yen	3119	(26.9)
Work status in early pregnancy		
Not working	3935	(34.0)
Working	7657	(66.0)
Work status in middle pregnancy		
Not working	4475	(38.6)
Working	7117	(61.4)
Psychological distress in early pregnancy		
No	7695	(66.4)
Yes	3897	(33.6)
Psychological distress in middle pregnancy		
No	8373	(72.2)
Yes	3219	(27.8)
Alcohol use in early pregnancy		
No	9171	(79.1)
Yes	2421	(20.9)
Alcohol use in middle pregnancy		
No	10849	(93.6)
Yes	743	(6.4)

Table 2. Prevalence, odds ratio (OR) and 95% confidence interval (CI) for alcohol use in early pregnancy (n=11592).

	Alcohol use in early pregnancy /participants	(%)	Age-adjusted	Multivariate-adjusted ^a
			OR (95% CI)	OR (95% CI)
Total	2421/11592	(20.9)		
Age in early pregnancy				
-29 years	726/3785	(19.2)	1.00	1.00
30-34 years	948/4424	(21.4)	1.15 (1.03-1.28)	1.08 (0.96-1.20)
35- years	747/3383	(22.1)	1.19 (1.07-1.34)	1.11 (0.99-1.25)
Educational attainment				
High school or lower	588/3657	(16.1)	1.00	1.00
College	986/4512	(21.9)	1.44 (1.29-1.61)	1.33 (1.18-1.49)
University or higher	847/3423	(24.7)	1.69 (1.50-1.91)	1.47 (1.30-1.66)
Equivalent household income (/year)				
0-2 million Japanese yen	409/2641	(15.5)	1.00	1.00
2-3 million Japanese yen	715/3669	(19.5)	1.32 (1.15-1.50)	1.22 (1.06-1.39)
3-4 million Japanese yen	534/2163	(24.7)	1.78 (1.54-2.05)	1.50 (1.30-1.74)
4- million Japanese yen	763/3119	(24.5)	1.74 (1.52-1.99)	1.37 (1.19-1.58)
Work status in early pregnancy				
Not working	616/3935	(15.7)	1.00	1.00
Working	1805/7657	(23.6)	1.67 (1.51-1.84)	1.53 (1.38-1.70)
Psychological distress in early pregnancy				
No	1647/7695	(21.4)	1.00	1.00
Yes	774/3897	(19.9)	0.92 (0.84-1.02)	0.95 (0.86-1.04)

^aAdjusted for all other variables in the table.

Table 3. Prevalence, odds ratio (OR) and 95% confidence interval (CI) for alcohol use in middle pregnancy (n=11592).

	Alcohol use in middle pregnancy /participants	(%)	Age-adjusted	Multivariate-adjusted ^a
			OR (95% CI)	OR (95% CI)
Total	743/11592	(6.4)		
Age in early pregnancy				
-29 years	217/3785	(5.7)	1.00	1.00
30-34 years	281/4424	(6.4)	1.12 (0.93-1.34)	1.12 (0.93-1.35)
35- years	245/3383	(7.2)	1.28 (1.06-1.55)	1.30 (1.07-1.57)
Educational attainment				
High school or lower	227/3657	(6.2)	1.00	1.00
College	303/4512	(6.7)	1.06 (0.89-1.27)	1.06 (0.88-1.27)
University or higher	213/3423	(6.2)	0.98 (0.81-1.19)	0.95 (0.77-1.17)
Equivalent household income (/year)				
0-2 million Japanese yen	172/2641	(6.5)	1.00	1.00
2-3 million Japanese yen	229/3669	(6.2)	0.95 (0.77-1.16)	0.94 (0.77-1.16)
3-4 million Japanese yen	121/2163	(5.6)	0.84 (0.66-1.07)	0.80 (0.63-1.02)
4- million Japanese yen	221/3119	(7.1)	1.05 (0.86-1.30)	1.00 (0.80-1.26)
Work status in middle pregnancy				
Not working	237/4475	(5.3)	1.00	1.00
Working	506/7117	(7.1)	1.37 (1.17-1.60)	1.38 (1.18-1.63)
Psychological distress in middle pregnancy				
No	518/8373	(6.2)	1.00	1.00
Yes	225/3219	(7.0)	1.16 (0.99-1.37)	1.18 (1.00-1.39)

^aAdjusted for all other variables in the table.

Table 4. Prevalence, odds ratio (OR) and 95% confidence interval (CI) for alcohol cessation between early and middle pregnancy among women who consumed alcohol in early pregnancy (n=2421).

	Alcohol cessation /drinkers in early pregnancy	(%)	Age-adjusted		Multivariate-adjusted ^a	
			OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Total	1881/2421	(77.7)				
Age in early pregnancy						
-29 years	566/726	(78.0)	1.00		1.00	
30-34 years	753/948	(79.4)	1.09 (0.86-1.38)	1.08 (0.85-1.38)		
35- years	562/747	(75.2)	0.86 (0.67-1.09)	0.86 (0.67-1.10)		
Educational attainment						
High school or lower	435/588	(74.0)	1.00		1.00	
College	769/986	(78.0)	1.26 (0.99-1.60)	1.16 (0.91-1.49)		
University or higher	677/847	(79.9)	1.40 (1.09-1.80)	1.31 (1.00-1.71)		
Equivalent household income (/year)						
0-2 million Japanese yen	290/409	(70.9)	1.00		1.00	
2-3 million Japanese yen	557/715	(77.9)	1.45 (1.10-1.92)	1.39 (1.05-1.84)		
3-4 million Japanese yen	443/534	(83.0)	2.01 (1.47-2.74)	1.87 (1.35-2.57)		
4- million Japanese yen	591/763	(77.5)	1.44 (1.10-1.90)	1.31 (0.97-1.76)		
Work status in early and middle pregnancy						
Not working in early and middle pregnancy	465/616	(75.5)	1.00		1.00	
Working only in early pregnancy	110/130	(84.6)	1.76 (1.06-2.94)	1.72 (1.03-2.88)		
Working in early and middle pregnancy	1306/1675	(78.0)	1.14 (0.92-1.42)	1.09 (0.87-1.36)		
Psychological distress in early and middle pregnancy						
None in early and middle pregnancy	1130/1453	(77.8)	1.00		1.00	
Only in early pregnancy	250/319	(78.4)	1.03 (0.76-1.38)	1.03 (0.77-1.39)		
Only in middle pregnancy	143/194	(73.7)	0.80 (0.57-1.13)	0.80 (0.57-1.13)		
Both in early and middle pregnancy	358/455	(78.7)	1.04 (0.81-1.35)	1.07 (0.83-1.39)		

^aAdjusted for all other variables in the table.

Figures

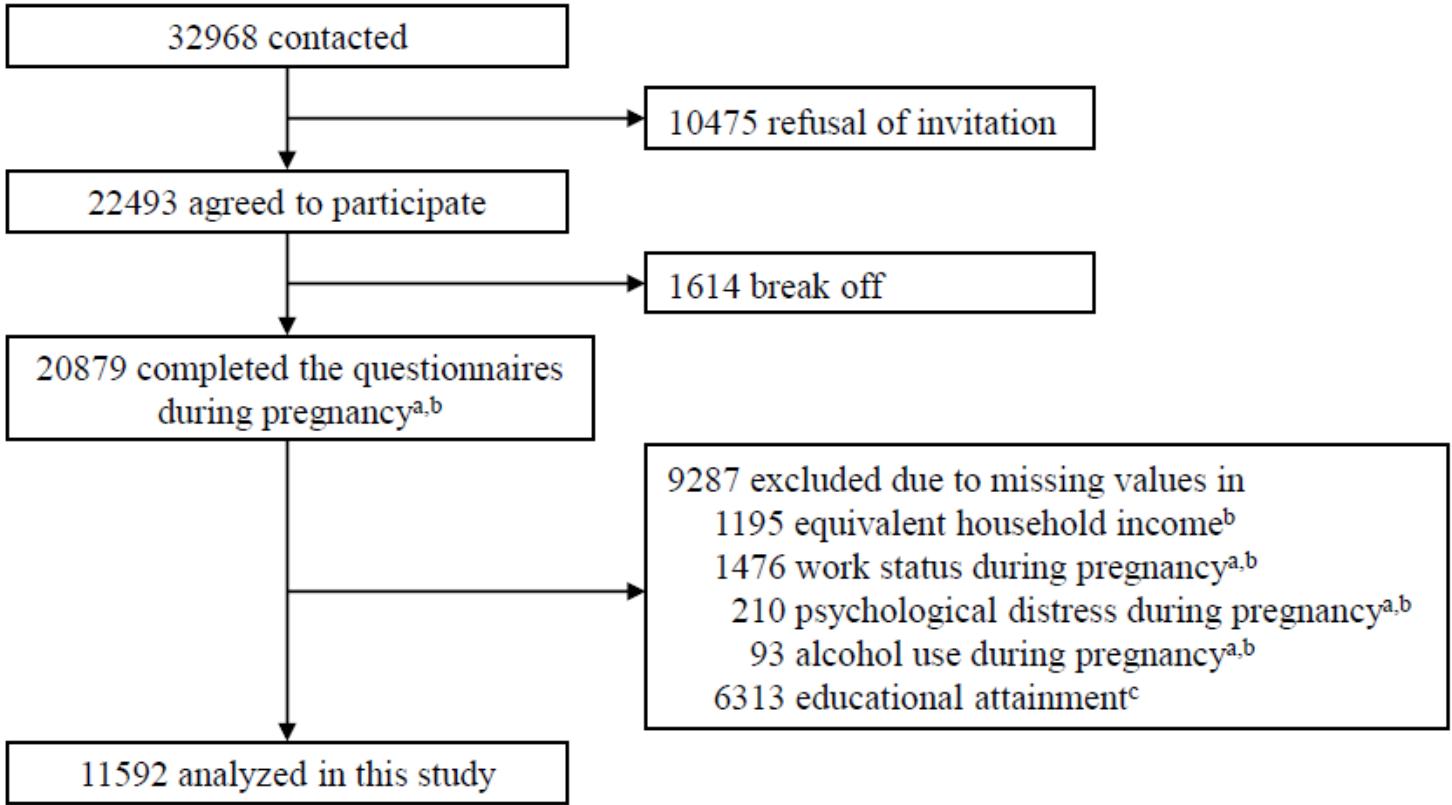


Figure 1

Figure 1. Flow diagram of participants in the present analysis of the TMM BirThree Cohort Study a Data on work status, psychological distress, and alcohol use were obtained using a questionnaire administered in early pregnancy. b Data on equivalent household income, work status, psychological distress, and alcohol use were obtained using a questionnaire administered in middle pregnancy. c Data on educational attainment were obtained using a questionnaire administered one year postpartum.

Supplementary Files

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