The Association Between Alcohol Consumption and Dysmenorrhea in University Students in North China

Zhuo Yang  
Liaoning Cancer Institute and Hospital

Jia Guo  
China Medical University

Ming-li Sun  
China Medical University

Qin-cheng He  
China Medical University

Ya-Nan Ma (ynma@cmu.edu.cn)  
China Medical University  https://orcid.org/0000-0003-0385-8929

Research article

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Abstract

Background: Dysmenorrhea is common gynecological disease in the whole world. Unfortunately, only a few studies have estimated the relationship between alcohol consumption and dysmenorrhea among women. In particular, there are fewer studies to explore the association between alcohol consumption, dysmenorrhea, and age at menarche.

Objective: This study aimed to evaluate whether and what extent alcohol consumption is related to dysmenorrhea and age at menarche.

Methods: This is a cross-sectional, observational study conducted among college students. A total of 3,837 participants (age ≥ 18 years) volunteered to participate in the study and completed the questionnaire. Moreover, 145 were excluded from the study owing to exclusion criteria. Finally, a total of 3692 female college students were enrolled in this study using the following criteria. We divided female college students into two groups stratified by age at menarche 13 years. The logical regression model was performed to evaluate the association between alcohol use and primary dysmenorrhea. The model adjusted for confounding factors and estimated the odds ratio and 95% confidence interval.

Results: A total of 3692 female college students completed the survey, including 409(11.08%) students with alcohol use and 3283 (88.92%) participants without alcohol use. We founded that alcohol use and alcohol consumption were not related to dysmenorrhea. However, stratified by age at menarche, we found that there was a negative association between alcohol consumption and dysmenorrhea among participants with AAM ≥ 13 years (OR, 1.41; 95% CI, 1.06, 1.88). Compared with participants without alcohol consumption, participants with alcohol consumption at least once a month (OR, 1.29; 95% CI, 0.94, 1.78) and alcohol consumption at least once a week (OR, 1.92; 95% CI, 1.07, 3.45) were more likely to have dysmenorrhea adjusted for other confounding factors.

Conclusion: Our findings showed there was a negative association between alcohol consumption and dysmenorrhea stratified by age at menarche (13 years).

Background

Dysmenorrhea is common gynecological disease in the whole world, which is characterized by cramping pain in the lower abdomen [1]. Over the last few decades, the incidence of dysmenorrhea among women increases year by year around the world. Also, the prevalence of primary dysmenorrhea was 41.7% among Chinese female university students[2]. Compared with their pain-free follicular phase, women with primary dysmenorrhea have a significantly reduced quality of life, poorer mood, and poorer sleep quality during menstruation[3]. The reasons for the increased prevalence of dysmenorrhea in women are not fully understood. Identification of risk factors, particularly those that are modifiable is urgently needed.

There are many potential factors driving dysmenorrhea, including a family history of dysmenorrhea, BMI, annual household income, and environmental tobacco smoke[2, 4]. However, it is necessary to pay more
attention to alcohol consumption. A 36% increase in per capita alcohol consumption in liters of pure alcohol in China according to the World Health Organization[5, 6]. Also, we should concern about the harm of dysmenorrhea. A study found that dysmenorrhea increased with drinking level and was strongly associated with reported consumption of 6 or more drinks a day at least once a week[7]. However, there is no a significant relationship between alcohol use and dysmenorrhea[8, 9]. Hence, the association between alcohol and dysmenorrhea remains a controversial issue. Moreover, it has been reported that the age of menarche was significantly associated with dysmenorrhea among high-school students in Kuwait[10]. Also, age at menarche (AAM) younger than 12 years was associated with risk factors of primary dysmenorrhea[2]. Unfortunately, only a few studies have estimated the relationship between alcohol consumption, dysmenorrhea, and age at menarche.

Thus, the purpose of our research is to investigate the association between alcohol use and dysmenorrhea in female college students. Also, we further evaluated whether and what extent of alcohol assumption related to dysmenorrhea is stratified by AAM.

**Methods**

**Study population**

This study was based on a large-scale epidemiological study conducted in North China from May 2016 to Aug 2016.

The inclusion criteria for the study were: (1) full-time female university student, and (2) nulliparous. Exclusion criteria were: (1) diagnosis of gynecological or endocrine disease, (2) current active smokers or active smoker history, because of only 19 (0.50%) smoker in our study (3) oral contraceptive user, (4) participants without complete data, especially incomplete data regarding dysmenorrhea.

A total of 3,837 participants (age ≥18 years) volunteered to participate in the study and completed the questionnaire and examination. Moreover, 145 were excluded from the study owing to exclusion criteria. Finally, a total of 3692 female college students were enrolled in this study using the following criteria.

**Questionnaire design**

Each participant was asked to learn detailed information about the questionnaire before completing it. The information included the objective of the study and instructions on filling out the questionnaire. A standard anonymous questionnaire was used for this study. The questionnaire was designed to obtain information about participant-reported outcomes for dysmenorrhea, demographic characteristics, and environmental exposures. Dysmenorrhea is defined as the occurrence of a lower abdomen pain during menstruation[11]. Passive smoking and alcohol consumption were assessed through self-reporting. Passive smoking was defined as the inhalation of second-hand smoke, which was queried as “Were you exposed to someone smoking indoors in your presence?” Alcohol use was queried as “Did you drink beer,
white wine, or red wine?”, and was scored as “Yes” or “No”. Alcohol consumption was queried on three levels and scored as follows: “No”, “At least once a month”, or “At least once a week”.

**Statistical analysis**

The distribution of BMI, age, and menarche age follows a normal distribution by Kolmogorov–Smirnov test. Continuous variables are reported as mean ± standard deviation (SD), whereas categorical variables are reported as percentages. The chi-square test or t-test was used to test for differences between the two dysmenorrheal groups. We divided female college students into two groups stratified by AAM 13 based on a priori hypotheses[12]. The logistic regression model to estimate odds ratios (ORs) and 95% confidence intervals (CIs) was adjusted for confounding factors including age, body mass index, household income, mother's education, mother's history of dysmenorrhea, passive smoking, area of residence, and AAM. All statistical analyses were performed using Empower (www.empowerstats.com; X&Y Solutions, Inc., Boston, MA) and R (http://www.R-project.org). *P* values less than 0.05 were considered statistically significant.

**Results**

**Data description**

A total of 3692 female college students completed the survey. The average age of menarche in our study was 13.42 ± 1.30 years. Participants with dysmenorrhea tended to have lower menarche age (Table 1). There are 409 (11.08%) students with alcohol use and 3283 (88.92%) participants without alcohol assumption. Alcohol use (“Yes” or “No”) and alcohol consumption (“No”, “At least once a month”, or “At least once a week”) were significantly associated with dysmenorrhea (Table 2).

**Logistic regression models**

We founded that alcohol use and alcohol consumption were not related to dysmenorrhea (Table 3). However, stratified by AAM we found that there was a negative association between alcohol consumption and dysmenorrhea among participants with AAM ≥13 years (OR,1.41; 95% CI, 1.06, 1.88). Compared with participants without alcohol use, participants with alcohol consumption at least once a month (OR,1.29; 95% CI, 0.94, 1.78) and alcohol use at least once a week (OR,1.92; 95% CI, 1.07, 3.45) were more likely to have dysmenorrhea adjusted for other confounding factors (Table 4).

**Discussion**

The results of this study can be divided into two levels. Firstly, without stratification, we founded that there was no association between alcohol consumption and dysmenorrhea among university students in North China. However, our findings showed there was a negative association between alcohol consumption and dysmenorrhea stratified by AAM (13 years).
In our study, alcohol consumption is not related to dysmenorrhea without stratification. It has been reported that alcohol use was not associated with any type of gynecological pain[9], which is lined with our findings. Another research identified that dysmenorrhea is not significantly associated with consumption of salt, tea, coffee, or alcohol use among 488 health school students[8]. Alcohol consumption did not influence the prevalence of dysmenorrhea[13]. However, the findings of relationship between alcohol consumption and dysmenorrhea among students were inconsistent. Dysmenorrhea, heavy menstrual flow, and premenstrual discomfort increased with drinking level and were particularly strongly associated with reported consumption of 6 or more drinks a day at least once a week[7].

The average age of menarche is 12.27 years (95% CI, 12.16-12.39) in China[14], and the average age of menarche in this study is 13.42 ±1.30 years, so we divided female college students into two groups stratified by AAM 13 based on a priori hypotheses[12]. Interestingly, we founded that there is a significant relationship between alcohol consumption and dysmenorrhea among participants with AAM ≥13 years. There is a study that may explain the association between alcohol consumption among participants with AAM ≥13 years. Firstly, a dose of alcohol affected the serum concentrations of allopregnanolone throughout the menstrual cycle, which might affect the occurrence of severe premenstrual syndrome and dysmenorrhea[15]. Secondly, for participants older than 13 years of AAM, the function of the adrenal and hypothalamic pituitary-gonadal axis (HPG) may mature later. In this condition, alcohol consumption might disrupt the unstable maturation process, which may lead to many of the physical and hormonal changes and even dysmenorrhea. We observed that alcohol use was not related to the prevalence of dysmenorrhea among participants with AAM before age 13. Several studies can explain the possible mechanisms responsible for this phenomenon. Among female university students with AAM before age 13, dysmenorrhea may be due to higher levels of estrogen caused by hormone patterns in the early stages of sexual maturity[16]. Furthermore, a longitudinal study reported that women with an earlier age at menarche were more likely to have longer and more painful episodes. Also, frequent alcohol consumption increased duration and severity among women with menstrual pain[17]. Thus, participants with AAM before age 13 might reduce alcohol use and alcohol consumption.

Our study still has several limitations. The main limitation of our study is a cross-sectional design so that statistical associations can be determined, but no causal inferences can be made. In the future, it is necessary to conduct a longitudinal study. Also, we collect the questionnaire information from a large government-owned and operated public university located in North China. We can't generalize the results to the whole college students because of selection bias. Our research only showed that the association between alcohol use and the prevalence of dysmenorrhea was consistently stronger among participants with AAM ≥13 years than among participants with AAM <13 years. However, it does not explain the underlying mechanism. Further research was needed to confirm our findings and clarify the potential specific mechanisms. In our study, alcohol consumption and dysmenorrhea were evaluated through a retrospective questionnaire, which might be subject to recall bias. Accurate responses from the study participants were crucial for the study validity. Several underlying factors that could affect the magnitude of dysmenorrhea were not sufficiently investigated, including age at first alcohol use, the disease which could cause dysmenorrhea, lifestyle, drug abuse, exercise, and genotypic variation. Future studies
including these additional factors are needed. One additional limitation that should be noted is that non-standard questions were used for assessing passive smoke exposure and alcohol use and consumption, which may make the results not comparable to those of prior studies that have used standardized instruments. Finally, the questionnaire did not query about the occurrence of dysmenorrhea before the start of alcohol use, which may have a confounding effect on the association of alcohol consumption with dysmenorrhea, due to the participants with dysmenorrhea may tend to avoid using alcohol or reduce alcohol consumption. It is important to use standard questions and reduce information bias in further research.

Conclusion

Our findings showed there was a negative association between alcohol consumption and dysmenorrhea stratified by AAM. Future research is needed to confirm our findings and to elucidate the underlying mechanisms.

Declarations

Ethics approval and consent to participate

The procedures of this survey were conducted under the World Medical Association Declaration of Helsinki-Ethical Principles for Medical Research involving Human Subjects. This study was approved by the Responsible Committee on Human Experimentation of China Medical University. Written informed consent was obtained from each participant before data collection. No children enrolled in this study.

Consent to publish

We have obtained consent to publish from the participant to report individual patient data.

Availability of data and material

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Author Contributions:

Conceptualization: YM, ZY
Data curation: YM, QH
Formal analysis: YM, ZY
Investigation: YM, ZY
Methodology: YM
Project administration: YM
Resources: YM, ZY, QH
Supervision: YM
Validation: ZY
Writing-original draft: ZY
Writing-review and editing: YM, ZY, JG, MS
All authors read and approved the final manuscript.

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Abbreviations

SD: standard deviation
ORs: odds ratios
95%CIs: 95% confidence intervals
AAM: age at menarche

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Tables

Table 1. Characteristics of study participants with respect to dysmenorrhea.
|                                | No       | Yes      | P value |
|--------------------------------|----------|----------|---------|
| Dysmenorrhea status            |          |          |         |
| N                              | 1425     | 2267     |         |
| BMI (kg/m$^2$)                 | 20.41 ± 2.72 | 20.30 ± 2.56 | 0.244   |
| Age (years)                    | 20.13 ± 1.36 | 20.14 ± 1.40 | 0.752   |
| Menarche age (years)           | 13.53 ± 1.33 | 13.35 ± 1.27 | <0.001  |
| Current household income       |          |          | 0.326   |
| (per capita monthly RMB)       |          |          |         |
| <1,000                         | 390 (27.50%) | 620 (27.60%) |         |
| 1,000-2,000                    | 600 (42.30%) | 903 (40.20%) |         |
| >2,000                         | 427 (30.10%) | 725 (32.30%) |         |
| Mother’s history of dysmenorrhea|          |          | <0.001  |
| No                             | 754 (52.90%) | 713 (31.50%) |         |
| Yes                            | 193 (13.50%) | 717 (31.60%) |         |
| Unknown                        | 478 (33.50%) | 837 (36.90%) |         |
| Mother’s education             |          |          | 0.115   |
| Primary school or lower        | 274 (19.30%) | 502 (22.20%) |         |
| Middle school                  | 614 (43.20%) | 983 (43.50%) |         |
| High school                    | 382 (26.90%) | 558 (24.70%) |         |
| College or above               | 150 (10.60%) | 218 (9.60%)  |         |
| Passive smoking                |          |          | <0.001  |
| No                             | 972 (68.20%) | 1235 (54.50%) |         |
| Yes                            | 453 (31.80%) | 1032 (45.50%) |         |
| Area of residence              |          |          | 0.550   |
| Rural                          | 603 (42.30%) | 982 (43.30%)  |         |
All values are percent of total subjects; other values are mean ± SD

1$=6.83RMB

Table 2. prevalence of dysmenorrhea with respect to alcohol use and alcohol consumption.

| Dysmenorrhea status | Alcohol use | Alcohol consumption |
|---------------------|-------------|---------------------|
| No                  | No          | No                  |
| Yes                 | Yes         | Yes                 |

|                    |                  |                      |
|---------------------|------------------|----------------------|
| Alcohol use         | No (n=3283)      | No (n=3283)          |
|                     | 1294 (90.80%)    | 1294 (90.80%)        |
| Yes (n=409)         | 131 (9.20%)      | 131 (9.20%)          |

| Alcohol consumption|                  |                      |
|--------------------|------------------|----------------------|
| No                 | 1294 (90.80%)    | 1294 (90.80%)        |
| At least once a month | 102 (7.20%) | 102 (7.20%)          |
| At least once a week  | 29 (2.00%)     | 29 (2.00%)           |

| Yes (n=409)         | 1989 (87.70%)    | 1989 (87.70%)        |
| At least once a month | 205 (9.00%) | 205 (9.00%)          |
| At least once a week  | 73 (3.20%)      | 73 (3.20%)           |

\(a\) \(P\) values for physical characteristics were derived from \(t\)-test; all others were derived from chi-square test.

Table 3. Crude and adjusted odds ratio (OR) and 95% confidence interval (CI) of dysmenorrhea association with alcohol use and alcohol consumption.

|                    | Unadjusted model | Adjusted model\(a\) |
|--------------------|------------------|---------------------|
| Alcohol use        |                  |                     |
| No (n=3283)        | 1.0 (Reference)  | 1.0 (Reference)     |
| Yes (n=409)        | 1.38 (1.11, 1.72)\(0.004\) | 1.24 (0.97, 1.58) \(0.083\) |

| Alcohol consumption|                  |                     |
|--------------------|------------------|---------------------|
| No (n=3283)        | 1.0 (Reference)  | 1.0 (Reference)     |
| At least once a month | 1.31 (1.02, 1.67)\(0.034\) | 1.22 (0.93, 1.61) \(0.150\) |
| At least once a week  | 1.64 (1.06, 2.53)\(0.027\) | 1.29 (0.81, 2.07) \(0.288\) |
Logistic regression model was adjusted for age, body mass index, household income, mother’s education, mother’s history of dysmenorrhea, passive smoking, area of residence, and age at menarche.

**Table 4.** Crude and adjusted odds ratio (OR) and 95% confidence interval (CI) of dysmenorrhea association with alcohol use and alcohol consumption stratified by menarche age

| Menarche age (OR (95% CI) P value) | < 13  | ≥ 13 |
|-----------------------------------|-------|------|
| **Unadjusted model**              |       |      |
| Alcohol use                       |       |      |
| No (n=3283)                       | 1.0 (Reference) | 1.0 (Reference) |
| Yes (n=409)                       | 0.85 (0.56, 1.31) 0.472 | **1.48 (1.14, 1.93) 0.004** |
| Alcohol consumption               |       |      |
| No (n=3283)                       | 1.0 (Reference) | 1.0 (Reference) |
| At least once a month (n=307)     | 0.94 (0.57, 1.54) 0.798 | 1.31 (0.97, 1.76) 0.078 |
| At least once a week (n=102)      | 0.68 (0.32, 1.44) 0.311 | **2.26 (1.29, 3.97) 0.005** |
| **Adjusted model**                |       |      |
| Alcohol use                       |       |      |
| No (n=3283)                       | 1.0 (Reference) | 1.0 (Reference) |
| Yes (409)                         | 0.88 (0.55, 1.42) 0.607 | **1.41 (1.06, 1.88) 0.018** |
| *P value for interaction*         |       | 0.042 |
| Alcohol consumption               |       |      |
| No (n=3283)                       | 1.0 (Reference) | 1.0 (Reference) |
| At least once a month (n=307)     | 1.06 (0.61, 1.83) 0.836 | 1.29 (0.94, 1.78) 0.118 |
| At least once a week (n=102)      | 0.53 (0.23, 1.25) 0.150 | **1.92 (1.07, 3.45) 0.029** |
| *P value for interaction*         |       | 0.017 |

Logistic regression model was adjusted for age, body mass index, household income, mother’s education, mother’s history of dysmenorrhea, passive smoking, and area of residence.

Interaction effect analysis was adjusted for age, body mass index, household income, mother’s education, mother’s history of dysmenorrhea, passive smoking, and area of residence.
Supplementary Files

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