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Association of tea drinking and dysmenorrhoea among reproductive-age women in Shanghai, China (2013–2015): a cross-sectional study

Xiaoyu Zhang,[1] Rongrong Zhang,[2] Dan Chen,[1] Rong Huang,[1] Ying Tian,[3] Ping Zhang,[2] Jun Zhang,[1] For the Shanghai Birth Cohort

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[1]Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Ministry of Education-Shanghai Key Laboratory of Children's Environmental Health, Shanghai, China
[2]Xinhua Hospital, Shanghai Jiao Tong University School of Medicine, Department of Obstetrics and Gynecology, Shanghai, China
[3]Shanghai Jiao Tong University, School of Public Health, Shanghai, China

Correspondence to
Professor Ping Zhang; zjqzp@126.com and Professor Jun Zhang; junjimzhang@sina.com

ABSTRACT

Objectives To investigate the association between tea drinking and dysmenorrhoea among women of reproductive age.

Design A cross-sectional study based on Shanghai Birth Cohort Study.

Setting Two preconceptional care clinics in Shanghai, China.

Participants 1183 women of reproductive age who sought preconceptional care were recruited from August 2013 to April 2015.

Primary and secondary outcome measures Participants were asked if they had pelvic pain associated with menstrual bleeding during the past 12 months and to further grade the intensity of menstrual cramp as mild, moderate and severe. Multinomial logistic regression was performed to assess the association of tea drinking and dysmenorrhoea. Other information, such as demographic and lifestyle factors, was also collected and assessed in relation to dysmenorrhoea.

Results The prevalence of dysmenorrhoea was 57.8%, among whom 10.4% and 3.5% had moderate and severe dysmenorrhoea, respectively. Tea drinking was associated with a lower prevalence of dysmenorrhoea (adjusted OR [aOR]=0.68, 95% CI 0.50 to 0.93 for mild dysmenorrhoea; aOR=0.59 (95% CI 0.32 to 1.04) for moderate-to-severe dysmenorrhoea). Green tea and oolong tea appeared to have most reduction in the prevalence of dysmenorrhoea (for mild dysmenorrhoea: green tea: aOR=0.63 (95% CI 0.44 to 0.90) and oolong tea: aOR=0.60 (95% CI 0.35 to 1.03); for moderate-to-severe dysmenorrhoea: green tea: aOR=0.42 (95% CI 0.20 to 0.85) and oolong tea: aOR=0.34 (95% CI 0.11 to 1.09)).

Conclusions Consumptions of green tea and possibly oolong tea were associated with a lower prevalence of dysmenorrhoea.

Strengths and limitations of this study

- This was a large, population-based study, involving extensive potential confounders in the analyses.
- This was a cross-sectional study, and therefore cannot establish a causal relationship.
- The information on dysmenorrhoea was based on participants' self-report.

INTRODUCTION

Dysmenorrhoea refers to pelvic pain during menstruation and can be classified as primary and secondary. Primary dysmenorrhoea begins at or shortly after menarche without any evidence of pathology. Pain usually occurs just before or during menstrual period, lasting for 2–3 days.[1] Secondary dysmenorrhoea is caused by specific pathological conditions, such as adenomyosis and fibroids, endometriosis, and pelvic inflammatory disease. The onset of secondary dysmenorrhoea begins later than the primary dysmenorrhoea, usually more than 2 years after menarche.[2] Due to the lack of a standard method grading dysmenorrhoea-related pain, the estimated prevalence of dysmenorrhoea varied widely, ranging from 16.8% to 81%.[3 4] A study from China reported that 56.4% of female university students had dysmenorrhoea, and among them, 6.5% had very severe (unbearable) symptoms.[5] Dysmenorrhoea limits women's daily activity and is associated with absenteeism from school or work.[6] Furthermore, women with primary or secondary dysmenorrhoea have higher total healthcare costs than those without syndromes.[7]

Overproduction of uterine prostaglandins from arachidonic acid through cyclooxygenase (COX) pathway has been commonly accepted as the aetiology of primary dysmenorrhoea.[8] The intensity of painful cramps and dysmenorrhoea-related symptoms are proportional to the level of prostaglandin released.[1] Non-steroidal anti-inflammatory drugs (NSAIDs) are commonly prescribed as the first line of treatment for dysmenorrhoea, due to its suppression of COX activity. However, the inhibitory effect of NSAIDs on COX-1 brings about several physiological

concerns.[2 9] A total of 10%–20% of women with primary dysmenorrhoea fail to respond to or are intolerable to NSAIDs.[2] More and more women with dysmenorrhoea resort to complementary and complementary medicine.

Tea has been considered as a medicinal staple for hundreds of years in China, thanks to the potential health benefits of tea flavonoids as antioxidants, anticarcinogenic and antiarteriosclerotic agent. Recently, green tea catechins have been demonstrated their inhibitory effect on COX-2 activity.[10 11] Hence, it is hypothesised that green tea may possibly decrease prostaglandin level and thereby relieve the severity of dysmenorrhoea. However, there is a huge paucity of epidemiological evidence of the association of tea drinking with dysmenorrhoea, especially green tea consumption, and the results of association are still inconsistent. A cross-sectional study of 729 Turkish women of reproductive age showed no association between tea drinking and dysmenorrhoea,[12] while another small study with 440 female university students suggested that students consuming >4 glasses of tea per day had a higher risk of primary dysmenorrhoea than those who did not drink tea.[13] To fill in the knowledge gap, the present study aims to examine the relationship between tea drinking and dysmenorrhoea in Chinese women of reproductive age.

MATERIALS AND METHODS

This study is based on the Shanghai Birth Cohort Study (SBC), which is a hospital-based, multicentre cohort study. It aims to assess the impacts of genetic, environmental and behavioural factors on reproductive health, pregnancy outcomes, child growth, development and risks of diseases. The reader is referred to cohort profile for more details about SBC.[14]

Patient and participant involvement

In SBC, couples of reproductive age were recruited at either preconception or first trimester of pregnancy. Potential participants who agreed to participate in the study would sign an informed consent during recruitment. Women were followed at several time points, including preconception (if they were recruited before pregnancy), first, second, third trimesters and birth, and husbands were interviewed at preconception or at birth. Information on demographic characteristics, health behaviours, social support, reproductive and medical history, and family history of diseases was collected. Biological specimens were collected at each round of follow-up for further analyses.

This study used data from the preconception women who sought preconceptional care at two preconceptional care clinics in Shanghai, China, with the following inclusion criteria: (1) married women with age ≥20 years (legal marriage age in China); (2) plan to be pregnant in the following year; (3) registered residents of Shanghai who do not plan to move out in the next 2 years and (4) plan to give birth in collaborating hospitals. Women who had tried to conceive for 12 months or longer were excluded from this study.

Sociodemographic characteristics

Participants provided information on demographic characteristics and lifestyle factors. Demographic characteristics include age, ethnicity, education level, income by herself, household income, as well as height and weight. Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared. Lifestyle factors included smoking history, alcohol intake, consumption of fruits and vegetables, use of dietary supplements and physical activity which was assessed by International Physical Activity Questionnaire short version.[15]

In addition, the consumptions of caffeinated beverages, such as coffee, soda (Coca-Cola, Pepsi) and energy drink (eg, Red Bull), were queried. Specifically, the consumption of tea was assessed by a structured questionnaire. Participants were asked whether they drank tea in their daily life. If yes, what type of tea they usually drank, including green, oolong and black tea, which are commonly consumed in China. They could choose one or multiple categories depending on their tea drinking habits. Participants were also asked about the number of years of tea drinking and the choices were '<1 year', '1–5 years', '6–10 years' and '>10 years', and the number of cups per day.

Menstrual characteristics

Women were asked about menstrual characteristics including the onset of menarche, menstrual cycle length, bleeding duration, volume of menstrual flow and dysmenorrhoea. If participants stated that they had pelvic pain associated with menstrual bleeding during the past 12 months, they were further asked to grade the intensity of menstrual cramp as mild, moderate and severe. Mild pain was defined as one could feel the pain but did not need further treatment. Moderate pain was defined as one needed to use therapy or treatment to relieve dysmenorrhoea, and severe pain was referred as taking absence of work or bed rest besides treatment. The method grading pain intensity in this study was modified based on verbal rating scale—a validated pain scale to evaluate dysmenorrhoea.[16] Although verbal rating scale is not as sensitive as the visual scale or numerical rating scale, which offers a broader spectrum of differentiating pain intensity, it is easier for participants to fill out and thereby limits missing data. The regularity of menstrual cycle length was assessed with the question: 'Is your menstrual cycle length regular?'. Length variation of 8 days or more was considered as irregular. If irregular, the durations of the shortest and longest menstrual cycles were asked. If regular, participants stated the average length of their menstrual cycle. Participants were asked to state their volume of menstrual flow with four choices: 'light', 'normal' and 'heavy'.

Statistical analysis

All the analyses were performed using R studio (V.1.0.136). We described the distribution of continuous variables (including mean and SE) according to the severity of dysmenorrhoea, and described the relationship of categorical variables with severity of dysmenorrhoea using contingency tables. In addition, the differences in demographic characteristics and lifestyle factors according to the severity of dysmenorrhoea were analysed by Kruskal-Wallis test for categorical variables and one-way analysis of variance for continuous variables. The primary result was the relationship between tea drinking and dysmenorrhoea, which was performed by multinomial logistic regression model. Variables with $p<0.05$ of the significance test for the difference were selected in the final logistic model. Other confounders were selected if they could change the coefficient by more than 10% compared with unadjusted coefficient. $P<0.05$ (two sided) was considered statistically significant.

Patient and public involvement statement

Patients or the public were not involved in the design or conduct of the study. Participants will be able to view the study results once the study is published.

RESULTS

A total of 1183 participants were recruited, of whom 23 did not finish the interview and 8 participants did not provide information on severity of dysmenorrhoea, leaving 1152 women for the final analysis. The prevalence of dysmenorrhoea was 57.8% (666/1152). Among them, 86.2% (574) had mild, 10.4% (69) moderate and 3.5% (23) severe dysmenorrhoea. Since the total number of moderate and severe dysmenorrhoea was only 99, we combined them together for further analyses.

Table 1 presents the demographic and menstrual characteristics of the study population according to the severity of dysmenorrhoea. The average age of all the 1152 participants was 29.4±3.2 years, ranging from 21 to 44 years. Five per cent of women were 35 years or older. Women with moderate-to-severe dysmenorrhoea had a mean age of 28.4±2.4 years, in comparison to 29.9±3.5 years in women without dysmenorrhoea. The average BMI was 21.0±2.7 kg/m^2, with 7.2% being overweight or obese (BMI ≥25 kg/m^2). Non-dysmenorrhoea group had a higher BMI than mild-dysmenorrhoea group, followed by moderate-to-severe group. There was no difference in education, women's income and household income among the three groups.

The average age of the onset of menarche was 13.4±1.3 years. The average length of menstrual cycle and bleeding was 29.8±3.5 days and 5.7±1.3 days, respectively, among all the women of reproductive age. The prevalence of moderate-to-severe dysmenorrhoea was higher in women with heavy menstrual flow, compared with women with light and normal menses. Multiparous women were less likely to have dysmenorrhoea.

Table 2 presents the distribution of lifestyle factors according to the intensity of dysmenorrhoea. Very few women smoked. There was no association between smoking and dysmenorrhoea. However, women who were exposed to secondhand smoke from her husband, roommates or colleagues were more likely to have dysmenorrhoea.

Consumptions of vegetables, fruits, dietary supplements of Vitamin E and fish oil were not associated with the severity of menstrual pain (table 2). However, the prevalence of moderate-to-severe dysmenorrhoea was slightly higher in women who did not take vitamin E, compared with vitamin E consumers (8.8% vs 4.0%). Physical activity (vigorous, moderate or walking) was not associated with the severity of dysmenorrhoea.

The prevalence of tea drinking was 34.5% (398 of 1152) among women with reproductive age, and the number of tea drinkers according to the severity of dysmenorrhoea was shown in table 3. Table 4 shows the association between tea drinking and dysmenorrhoea. After adjusting for age, BMI, personal income, ever pregnant, consumption of caffeinated beverages (coffee, soda or energy drink), alcohol drinking during last 12 months, secondhand smoke, supplementation of fish oil, consumption of leaf vegetable, moderate physical activity and walking, tea drinking was associated with a 32% lower prevalence of mild dysmenorrhoea. The adjusted OR (aOR) of mild dysmenorrhoea was attenuated by half in women who drank tea for 3–5 cups per day compared with women who did not drink tea, whereas we did not find such relationship in higher tea consumers (≥6 cups/day). We did not find a relationship between number of years of tea drinking and severity of dysmenorrhoea among tea drinkers. Consumption of green tea was associated with a lower prevalence of dysmenorrhoea, and the relationship was stronger in moderate-to-severe dysmenorrhoea than in mild dysmenorrhoea, which is shown in table 5. Consumption of oolong tea was associated with a lower prevalence of dysmenorrhoea but the association did not reach statistical significance.

As for the relationship between each caffeine-contained beverage (coffee, soda and energy drink) and severity of dysmenorrhoea (table 5), women with moderate-to-severe dysmenorrhoea were twice more likely to be coffee drinkers than women without dysmenorrhoea. However, after adjusting for potential confounders, consumption of neither soda nor energy beverages was associated with prevalence of moderate-to-severe dysmenorrhoea.

DISCUSSION

The present study found that more than half of Chinese reproductive age women (57.8%) had some degree of dysmenorrhoea. Exposure to secondhand smoke or consumption of coffee was positively associated with moderate-to-severe dysmenorrhoea. After adjustment for the potential confounders, consumptions of green tea

and possibly oolong tea were associated with lower prevalence of dysmenorrhoea.

The prevalence of dysmenorrhoea in our population was consistent with previous studies. It was reported that at least 50% of women around the world[17] and 56.4% of university students in China suffered from dysmenorrhoea.[5] However, the prevalence of severe dysmenorrhoea in this study was slightly lower than the previous study (3.5% vs 6.5%, respectively),[5] which may be explained by the age difference between the study populations (29.4±3.2 years in the current study vs 20.3±1.3 in Zhou *et al*'s study[5]). Previous literature indicated that menstrual pain was alleviated to some degree with advancing age.[12 18 19]

The relationships between dysmenorrhoea and menstrual characteristics (such as onset of menarche, regular menses, bleeding duration) are still uncertain.[20] Some studies reported that older age at menarche was associated with a decreased risk of dysmenorrhoea,[18 21] while others showed no association.[12 22] Unsal *et al* found that menstrual irregularity was one of risk factors for dysmenorrhoea (OR=1.90 (95% CI 1.22 to 32.95)).[12] As for blood flow, some studies showed that reduced menstrual flow may be a sign of uterine constriction and it was associated

Table 1 Demographic and menstrual characteristics according to the severity of dysmenorrhoea

	Dysmenorrhoea (n (%) or (mean±SD))			
Variables	**No (486)**	**Mild (574)**	**Moderate-to-severe (92)**	**P value**
Age (years)	29.9±3.5	29.2±3.0	28.4±2.4	<0.001
BMI (kg/m^2)	21.2±2.9	20.9±2.5	20.3±3.0	0.021
Race				0.733
Han	474 (42.2)	559 (49.8)	89 (7.9)	
Others	12 (40.0)	15 (50.0)	3 (10.0)	
Education				0.533
Junior college	96 (42.7)	113 (50.2)	16 (7.1)	
Undergraduate	302 (43.0)	346 (49.2)	55 (7.8)	
Graduate	88 (39.3)	115 (51.3)	21 (9.4)	
Home income				0.646
<¥100K	31 (36.9)	48 (57.1)	5 (6.0)	
¥100K–¥150K	77 (41.4)	96 (51.6)	13 (7.0)	
≥¥150K	357 (43.9)	392 (48.2)	65 (8.0)	
Personal income				0.622
<¥100K	241 (40.3)	315 (52.7)	42 (7.0)	
¥100K–¥150K	159 (45.2)	161 (45.7)	32 (9.1)	
≥¥150K	62 (43.7)	68 (47.9)	12 (8.5)	
Onset of menarche (years)	13.4±1.4	13.4±1.3	13.4±1.3	0.763
Length of menstrual cycle (days)	29.8±2.9	29.7±2.9	30.3±7.7	0.308
Bleeding duration (days/month)	5.6±1.4	5.7±1.2	5.7±1.3	0.268
Volume of menstrual flow				<0.001
Light	48 (48.0)	44 (44.0)	8 (8.0)	
Normal	419 (43.2)	487 (50.2)	65 (6.7)	
Heavy	18 (23.1)	41 (52.6)	19 (24.4)	
Regularity of menstrual cycle				0.773
Regular	393 (41.7)	479 (50.8)	71 (7.5)	
Irregular	93 (44.5)	95 (45.5)	21 (10.0)	
Having had a pregnancy				<0.001
No	244 (37.2)	344 (52.4)	68 (10.4)	
Yes	241 (48.7)	230 (46.5)	24 (4.8)	

P value was obtained by Kruskal-Wallis test for categorical variables and one-way analysis of variance for continuous variables.
BMI, body mass index.

Table 2 Lifestyle factors according to the severity of dysmenorrhoea

Variables	Dysmenorrhoea (n (%))			P value
	No (486)	Mild (574)	Moderate-to-severe (92)	
Smoking now				0.193
No	481 (42.3)	569 (50.0)	88 (7.7)	
Yes	5 (35.7)	5 (35.7)	4 (28.6)	
Used to smoke				0.604
No	471 (42.2)	557 (50.0)	87 (7.8)	
Yes	9 (47.4)	9 (47.4)	1 (5.3)	
Secondhand smoke				<0.001
No	365 (46.5)	363 (46.2)	57 (7.3)	
Yes	121 (33.2)	209 (57.3)	35 (9.6)	
Alcohol drinking within 1 year				0.110
No	325 (43.6)	366 (49.1)	54 (7.2)	
Yes	160 (39.4)	208 (51.2)	38 (9.4)	
Current alcohol drinking				0.676
No	469 (42.3)	551 (49.7)	88 (7.9)	
Yes	17 (39.5)	22 (51.2)	4 (9.3)	
Vitamin E				0.065
No	392 (41.3)	474 (49.9)	84 (8.8)	
Yes	81 (46.8)	85 (49.1)	7 (4.0)	
Supplementation of fish oil				0.874
No	438 (42.0)	519 (49.8)	85 (8.2)	
Yes	33 (42.9)	38 (49.4)	6 (7.8)	
Leaf vegetables				0.359
<1 per week	8 (57.1)	6 (42.9)	0 (0)	
1–3 per week	73 (42.4)	81 (47.1)	18 (10.5)	
4–7 per week	264 (40.7)	330 (50.9)	54 (8.3)	
≥2 per day	137 (44.1)	154 (49.5)	20 (6.4)	
Fruits				0.262
>1 per week	8 (32.0)	15 (60.0)	2 (8.0)	
1–3 per week	90 (39.1)	113 (49.1)	27 (11.7)	
4–7 per week	286 (43.4)	331 (50.2)	42 (6.4)	
≥2 per day	99 (43.2)	109 (47.6)	21 (9.2)	
Vigorous physical activity				0.460
No	393 (41.6)	475 (50.3)	77 (8.1)	
Yes	85 (44.7)	90 (47.4)	15 (7.9)	
Moderate physical activity				0.456
No	300 (41.3)	366 (50.3)	61 (8.4)	
Yes	171 (43.4)	193 (49.0)	30 (7.6)	
Walk				0.195
No	24 (57.1)	12 (28.6)	6 (14.3)	
Yes	409 (41.6)	495 (50.4)	78 (7.9)	

P value was obtained by Kruskal-Wallis test.

Table 3 Caffeinated beverages according to the severity of dysmenorrhoea

Variables	Dysmenorrhoea (n (%))			P value
	No (486)	Mild (574)	Moderate-to-severe (92)	
Tea				0.216
No	308 (40.8)	384 (50.9)	62 (8.2)	
Yes	178 (44.7)	190 (47.7)	30 (7.5)	
Green tea				0.012
No	347 (40.2)	443 (51.3)	74 (8.6)	
Yes	139 (48.3)	131 (45.5)	18 (6.3)	
Black tea				0.337
No	413 (42.7)	481 (49.7)	74 (7.6)	
Yes	73 (39.7)	93 (50.5)	18 (9.8)	
Oolong tea				0.033
No	434 (41.3)	528 (50.3)	88 (8.4)	
Yes	52 (51.0)	46 (45.1)	4 (3.9)	
Coffee				0.027
No	275 (43.9)	317 (50.6)	34 (5.4)	
Yes	211 (40.1)	257 (48.9)	58 (11.0)	
Soda (Coca-Cola, Pepsi)				0.047
No	335 (43.7)	381 (49.7)	51 (6.6)	
Yes	151 (39.2)	193 (50.1)	41 (10.6)	
Energy beverages				0.050
No	462 (42.7)	539 (49.8)	81 (7.5)	
Yes	24 (34.3)	35 (50.0)	11 (15.7)	

P value was obtained by Kruskal-Wallis test.

Table 4 Relationship of tea drinking and dysmenorrhoea

Variables	Crude OR model*			Adjusted OR model†	
	No (486)	Mild (574)	Moderate-to-severe (92)	Mild (574)	Moderate-to-severe (92)
Tea					
No	1	1	1	1	1
Yes	1	0.86 (0.66 to 1.10)	0.84 (0.52 to 1.34)	0.68 (0.50 to 0.93)	0.59 (0.32 to 1.04)
No of cups/day					
0 per day	1	1	1	1	1
1–2 cups/day	1	0.97 (0.71 to 1.33)	1.06 (0.61 to 1.84)	0.80 (0.55 to 1.17)	0.71 (0.36 to 1.41)
3–5 cups/day	1	0.66 (0.44 to 0.98)	0.57 (0.25 to 1.31)	0.49 (0.31 to 0.79)	0.39 (0.15 to 1.00)
≥6 cups/day	1	0.80 (0.43 to 1.50)	0.71 (0.21 to 2.45)	0.75 (0.37 to 1.53)	0.77 (0.21 to 2.86)
No of years of tea drinking					
1 year	1	1	1	1	1
1–5 years	1	0.64 (0.36 to 1.13)	1.41 (0.44 to 4.50)	0.53 (0.26 to 1.07)	2.13 (0.40 to 11.2)
≥6 years	1	0.61 (0.33 to 1.14)	0.71 (0.18 to 2.73)	0.54 (0.24 to 1.25)	1.67 (0.25 to 11.2)

*Model 1 was a crude multinomial logistic regression which was used for each outcome.
†Model 2 was an adjusted multinomial logistic regression model for each outcome, and was adjusted for age, body mass index, personal income, ever pregnant, caffeinated beverages drinking, alcohol drinking now and during last 1 year, secondhand smoke, supplementation of fish oil, consumption of leaf vegetables, moderate-intensity and walk-intensity physical activity.

Table 5 ORs for dysmenorrhoea according to consumption of type of tea beverage/caffeinated beverage

	Crude OR model			Adjusted OR model	
Variables	No (486)	Mild (574)	Moderate-to-severe (92)	Mild (574)	Moderate-to-severe (92)
Model 1*					
Green tea	1	0.74 (0.56 to 0.97)	0.61 (0.35 to 1.05)	0.63 (0.44 to 0.90)	0.42 (0.20 to 0.85)
Black tea	1	1.09 (0.78 to 1.53)	1.38 (0.78 to 2.44)	1.27 (0.81 to 2.00)	1.96 (0.94 to 4.10)
Oolong tea	1	0.73 (0.48 to 1.10)	0.38 (0.13 to 1.08)	0.60 (0.35 to 1.03)	0.34 (0.11 to 1.09)
Model 2†					
Coffee	1	1.06 (0.83 to 1.35)	2.22 (1.40 to3.52)	1.08 (0.80 to 1.44)	2.11 (1.22 to 3.62)
Soda	1	1.12 (0.87 to1.45)	1.78 (1.13 to 2.81)	1.05 (0.76 to 1.44)	1.20 (0.69 to 2.10)
Energy beverages	1	1.25 (0.73 to 2.13)	2.61 (1.23 to 5.54)	0.91 (0.50 to 1.69)	1.65 (0.66 to 4.15)

*Model 1 was a multinomial logistic regression model which was used for each type of tea beverage separately, and was further adjusted for other types of tea beverages, age, body mass index (BMI), personal income, ever pregnant, caffeinated beverages drinking, alcohol drinking now and during last 1 year, secondhand smoke, supplementation of fish oil, consumption of leaf vegetables, moderate-intensity and walk-intensity physical activity.
†Model 2 was a multinomial logistic regression model which was used for each caffeinated beverage separately, and was further adjusted for other caffeinated beverages, age, BMI, personal income, ever pregnant, secondhand smoke, walk-intensity physical activity and tea drinking.

with cramp pain[1 23] while others showed that the severity of dysmenorrhoea increased with increasing volume of blood flow.[5 24] Our study was consistent with the latter finding, that is, women with heavy blood flow were more likely to have dysmenorrhoea. However, we did not find any other relationship between menstrual health and dysmenorrhoea. Interestingly, our result showed that pregnancy history was inversely associated with dysmenorrhoea, in line with previous studies.[12 18]

Our results showed a tendency towards dysmenorrhoea relief when women drank tea in daily life. Those who consumed 3–5 cups/day of tea were 51% less likely to report having mild dysmenorrhoea than non-drinkers. The observation of no relationship between high tea drinking (≥6 cups/day) and dysmenorrhoea may be true or due to chance; only 45 participants stated tea consumption of ≥6 cups/day. In contrast, a small cross-sectional study with randomly selected 440 female university students in Ethiopia suggested that people drinking tea for more than 4 glasses/day had 19 times higher prevalence of dysmenorrhoea than non-drinkers, the corresponding aOR was 18.94 (95% CI 2.19 to 163.73).[13] However, the very wide CI indicates that the conclusion is uncertain.

Among three types of tea, our study showed that consumption of green tea may be beneficial for relief of dysmenorrhoea while consumption of black tea was not. The latter finding is consistent with the results from a Turkey study—a cross-sectional study with 729 reproductive-age women, which found no association between tea consumption and dysmenorrhoea,[12] as the traditional tea in Turkey is black tea. Consumption of oolong tea had a boardline association with a lower prevalence of dysmenorrhoea, which may be ascribed to a small sample size. Our study may be underpowered to detect the desired difference between oolong tea drinkers and non-drinkers.

To explore whether caffeine in tea was responsible to the relief of dysmenorrhoea, we examined the association between consumption of caffeinated beverages, especially coffee, and dysmenorrhoea. Unlike tea, consumption of coffee was positively related to the severity of dysmenorrhoea in this study after adjustment of potential confounders. Previous studies showed that the risk of dysmenorrhoea was twice as high in high caffeine consumers (≥300 mg/day) compared with low/moderate caffeine consumers (<300 mg/day) (OR=1.97 (95% CI 1.09 to 3.59))[25] and in coffee consumers (OR=2.08 (95% CI 1.34 to 3.24)).[12] The mechanism through which caffeine could aggravate cramp-like pain is uncertain and further studies are warranted. One possible mechanism is the vasoconstricting action of caffeine.[26] A study in pregnant women indicates that caffeine stimulates uterine muscle and, consequently, causes increased uterine contraction.[27] Uterine hypercontraction reduces blood flow and results in pain.[1]

Instead, catechins in green tea might partly explain the observed relationship with relieved severity of dysmenorrhoea. The extent of the oxidative processing (also called 'fermentation') differs among three types of tea—green tea is minimally processed, while black tea is completed fermented. Hence, catechins are rich in green tea followed by oolong tea, while much lower in black tea, as it is unstable and sensitive to oxidisation. A number of animal and in vitro studies suggest that green tea extract (catechins) is an effective inhibitor of COX-2 but not COX-1[10 11] thereby preventing overproduction of uterine prostaglandin levels, a major pathogenesis of primary dysmenorrhoea. In addition, catechins inhibit the activity of phospholipase A2, an enzyme involved in the production of arachidonic acid, and consequently decreases the production of additional prostaglandin from arachidonic acid.[28] Given the high catechins content in green tea, it

is convincingly expected green tea may be beneficial to relieve menstrual cramp by inhibiting prostaglandin level.

Further studies are needed to specify the role of catechins in dysmenorrhoea. Despite the promising effect of tea drinking in dysmenorrhoea, tea drinking during menstrual period may also have unwanted side effects. Catechins and tannic acid rich in tea can chelate iron, thus tend to interfere with iron absorption.[29–31] As menstruating women lose iron through bleeding, caution of drinking too much tea during menstruation may be warranted.

Several limitations of our study are worth mentioning. First, as our study collected data from the study population at a single point of time, it may be difficult to establish a causal relationship between tea drinking and dysmenorrhoea. Second, this study did not distinguish secondary dysmenorrhoea from primary dysmenorrhoea. However, secondary dysmenorrhoea may share some of the same pathways of pain as the primary dysmenorrhoea, with an evidence of an increased level of prostaglandin in endometriosis and adenomyosis.[32 33] On the other hand, an animal study has shown that green tea catechins inhibited the development of endometriosis through antiangiogenic effects.[34] Thus, it is possible that green tea may potentially be beneficial to both primary and secondary dysmenorrhoea. Third, we did not include information on oral contraceptive pills use, which may cause potential bias due to residual confounding. However, this study recruited women of reproductive age who were planning to become pregnant. Therefore, the number of participants using oral contraceptive pills was negligible. Fourth, the size of a tea serving and the biochemical quantity in a tea serving vary widely with different methods of preparing tea between individuals in China. We were unable to standardise the size of teacups. Finally, the information on dysmenorrhoea was based on participants' self-report and, as such, it was subject to information bias. However, it is difficult to explain why such a bias only occurred in certain types of tea but not all types.

The strengths of this study are also worth noting. The large sample size made the results more precise. In addition, this study was based on a large cohort, which enables us to involve more potential confounders in the analyses. The study population was women who were planning to be pregnant, so they were more likely to remember their health-related behaviours and characteristics, especially those related to reproduction, such as menstrual characteristics.

In conclusion, our study suggests that drinking green tea was associated with a lower prevalence of dysmenorrhoea among reproductive-age women in China. On the other hand, excessive tea drinking may not be advisable, either, as tea may inhibit iron absorption. Given the scarcity of epidemiological evidence of tea drinking and dysmenorrhoea, this study gives new insights in the possible role of green tea on the relief of dysmenorrhoea. Cohort studies and subsequent randomised controlled trials are needed to confirm this finding, which may have important clinical and public health significance.

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Competing interests None declared.

Patient consent for publication Not required.

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