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ORIGINAL RESEARCH

Thyme Tea and Primary Dysmenorrhea Among Young Female Students

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Background: Thyme tea, locally known as "tossign tea", is one of the most popular herbal-tea in Ethiopia used for the medicinal attribute, besides adding aroma and flavor to the tea. Therefore, this study aimed to assess the effect of thyme tea-drinking and other dietary factors of school girls on primary dysmenorrhea.

Methods: An institutional case–control study was conducted from December 2019 to March 2020 in the suburbs of Debre Berhan town, Ethiopia. Data were collected through a face-to-face interview using a pre-tested semi-structured questionnaire on 252 (86 cases and 166 controls) study participants. Data were entered to Epi Data version 3.1 and then exported to IBM SPSS version 24 for analysis. Bivariable and multivariable logistic regressions were carried out to identify factors significantly associated with primary dysmenorrhea.

Results: The mean (±SD) age of cases was 15.98 (±1.60) years and controls was 15.73 (±1.35) years. Thyme tea drinking was reported by 19 (22.1%) of cases and 56 (33.7%) of controls. Thyme tea-drinking decreased the risk of primary dysmenorrhea by 63.2% (AOR: 0.368, 95% CI: 0.145–0.934). Coffee drinking tends to increase the odds of severe dysmenorrhea on young female students. Besides, age, age at menarche, meal frequency, and residence were significantly associated with primary dysmenorrhea.

Conclusion: Thyme tea-drinking, consumption of vegetables and fruits had primary dysmenorrhea related pain-relieving tendency. Delayed onset of menarche decreased the risk of primary dysmenorrhea. Coffee drinking was positively associated with primary dysmenorrhea. Further studies on the effect of thyme tea on primary dysmenorrhea are required.

Keywords: primary dysmenorrhea, thyme tea, tossign, Ethiopia

Introduction

Dysmenorrhea is defined as a recurrent lower abdominal pain during menstruation. It is categorized into primary and secondary. Primary dysmenorrhea is lower abdominal pain associated with the normal ovulatory cycle in the absence of pelvic disease or abnormality. The pain starts a few hours before or after the onset of menstruation and lasts for a few hours to 2–3 days. Secondary dysmenorrhea is also menstrual pain caused by underlying pelvic pathology which usually occurred on relatively older reproductive-age women.[1–4]

Primary dysmenorrhea has a wide range of severity with significant medical and psychosocial implications.[5–7] Due to the lack of a standard method to measure menstrual pain and the subjectivity nature of pain levels across individuals; studies across the world used various methods to measure the amount and severity of primary dysmenorrhea. As a result, the prevalence varies significantly from place to

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place. It ranges from 41.7% to 93.3% and the severe form of dysmenorrhea accounts for 10% to 20% in the world.[7–10] Studies from Ethiopia reported that about 70% of school girls experienced some form of primary dysmenorrhea and up to 12% had severe pain. The prevalence reaches up to 85.4% among university students.[5,11–15]

Though primary dysmenorrhea is one of the most common gynecologic complaints of adolescent and young females, it is poorly understood by many girls that they simply accept it as a normal part of their menstrual cycle. As a result, primary dysmenorrhea has a medical and psychosocial effect on adolescent girls. It is a cause for female students' school absenteeism and/or reduced class concentration and participation ability leading to poor school performance.[16–18]

Current evidence showed that the root cause of primary dysmenorrhea is mainly related to the level of prostaglandins (PGs) production in the uterus during menstruation. The drop in progesterone in the menstrual cycle after ovulation before the start of menses increases the formation of omega-6 fatty acid particularly arachidonic acid in the phospholipids of the cell membrane. PGs are synthesized from arachidonic acid through the cyclooxygenase (COX) pathway. Overproduction of PGs was observed in women with primary dysmenorrhea which is responsible for increased smooth muscle contraction of the uterus and causes painful menstruation.[3,19,20]

Though effective pharmacological drugs like non-steroid anti-inflammatory drugs (NSAIDs) and hormonal contraceptive pills are widely available,[16] most adolescents choose to use home remedies or non-pharmacological remedies for their pain. Non-pharmacologic nutritional measures called nutraceuticals,[21] used to control primary dysmenorrhea include: Dietary habit changes and consumption of foods (like fruits, vegetables, eggs, milk, and fish which are rich in vitamins, minerals, and omega-3 fatty acids),[4,22,23] and use of herbal products of cinnamon,[24] ginger root,[25] and *Foeniculum vulgare*[22] were reported effective in reducing the intensity of dysmenorrhea.

Thyme tea is locally known as "tossign tea" is one of the most popular herbal-tea in Ethiopia. *Thyme* is wild endemic dietary herbs used as spices to flavor various food products and herbal medicine. Though, fresh or dried leaves of *Thyme* species are used locally as a tea for the medicinal attribute, mostly it is marinated for adding aroma and flavor to the tea. *T. schimperi* and *T. serrulatus* are common thymus species found in

Ethiopia. However, *T. schimperi* is a more prevalent highland area of North Shewa, a central part of Ethiopia.[26–28]

Even though thyme tea is locally used as herbal medicine to treat various health problems like abdominal pain, diarrhea, parasite, cough, asthma, hypertension, and general pain syndrome, it is not used to treat menstrual pain related to primary dysmenorrhea in Ethiopia.[26,27] But studies in other countries revealed that *thyme* is effective herbal medicine in alleviating menstrual pains and treating dysmenorrhea.[29,30] According to a study in Iran, oil extracted from *T. Vulgaris* was as effective as Ibuprofen in reducing the severity of dysmenorrheal pain.[31] The extracts of the *thyme* have anti-oxidant, anti-inflammatory, analgesic, and anti-spasmodic effects.[32]

Hence, it is hypothesized that thyme tea drinking may probably decrease the risk of severe dysmenorrhea. However, there is no study tried to investigate the association between thyme tea habit and dysmenorrhea. Therefore, this study aimed to assess the effect of thyme tea drinking and other dietary factors of school girls on severe primary dysmenorrhea in the suburbs of Debre Berhan town.

Methods and Materials
Study Design, Period and Setting
This study was conducted from December 2019 to March 2020 in the suburbs of Debre Berhan town. Debre Berhan is a zonal administrative town of North Shewa, Amhara national regional state. It is about 582.44km south east of Bahir Dar and 130km northeast of the capital city Addis Ababa of driving distance. Debre Berhan town is located at a latitude and longitude of 9°41′N 39°32′E and has an elevation of 2840m. It has a cold agro-climate as part of the highland plateau of North Shewa, central Ethiopia with average maximum and minimum temperature of 20.1°C and 6.5°C respectively.

Study Design and Participants
A case-control study was conducted on post-menarche young female students aged 13 to 19 years old. The participants were recruited from a large study involving 1328 public school adolescent girls that investigated menstruation and menstrual hygiene management practice in Debre Berhan town and surrounding area.

First, each post-menarche students were asked if they experienced one or more menstrual cramp or abdominal pain during the last three consecutive menstrual cycles and asked

to rate the intensity of pain using Verbal Multidimensional Scoring System (VMS). VMS considers the impacts of pain on daily activities, systemic symptoms and analgesic requirements to level dysmenorrhea as mild dysmenorrhea (do not limit normal daily activities, and little or no systemic symptoms and analgesic need), moderate (slightly limit normal daily activities, and moderate systemic symptoms and analgesic need) and severe (severely limit normal daily activities such as school absenteeism, and noticeable symptoms and analgesic need).

For this study, primary dysmenorrhea was defined as abdominal crampy menstrual pain which starts immediately before or after the onset of menses and lasts for 12 hours to 3 days. Absence from school by young female students due to dysmenorrhea was used to classify severe primary dysmenorrhea. Accordingly, those who had severe dysmenorrhea and associated school absenteeism were recruited as "cases" and those who did not have experience of any menstrual cramp were taken as comparison group "controls". The eligibility criteria: being age ≤19 years was used for inclusion and students who had lower abdominal pain in non-menses days, history of abdominal surgery, history of modern family planning use, and history of pregnancy were excluded from the study.

The sample size was computed using Epi Info version 7.1.5.0 software. We considered 95% confidence level, 80% power, and 2:1 control-to-case ratio for an unmatched case-control study. By taking 63.0% and 43.4% prevalence of coffee drinking among dysmenorrheic and non-dysmenorrheic women respectively from a study in Shanghai china[33] we get a sample size of 248. Adding a 10% non-response rate gave the final sample size of 273 (cases 91, controls 182).

Data Collection Procedures and Tools

Data were collected by trained female nurses using a semi-structured questionnaire through a face-to-face interview. The interview was conducted at school during free class time and it took on average 25–30 minutes. The questionnaire was developed by reviewing different pieces of literature and contextually adapted to socio-cultural norms and agro-climatic conditions of the area. The questionnaire was divided into four parts: socio-demographic characteristics, menstrual conditions, dietary practices (diet diversity and meal frequency including thyme tea consumption), and anthropometric measurements.

Socio-demographic characteristics include age, residence, religion, family size, and parental education status,

and occupation. Menstrual conditions addressed age at menarche, menstrual regularity, menstrual cycle length, and bleeding duration. Menstrual regularity was by asking the question: "Is your menstrual cycle length is regular in the last six menstrual cycles?" If yes, participants were asked the average length of the menstrual cycle in days. If no, participants were asked to recall the shortest and the longest length of the menstrual cycle in days, and menstrual irregularity was considered if the difference between the shortest and longest menstrual length was greater or equal to 8 days. The intensity of dysmenorrhea was again measured by Verbal Multidimensional Scoring System (VMS) both on cases and controls. From the controls, one participant who failed to fulfill the control definitions was excluded from the analysis.

Dietary factors such as; meal frequency, diet diversity, frequency of vegetables, fruits, and dairy consumption per week were assessed. The 24 hours recall diet diversity score (DDS) was measured by adapting the called Minimum Diet Diversity for Women (MDD-W) tool which was developed by the FANTA project. The tool was developed to reflect the micronutrient adequacy of women's diet. The minimum food groups required to get adequate micronutrient was five out of ten defined food groups. Therefore, DDS of ≥5 was considered adequate.[34]

Information about thyme tea and other caffeinated drinks like; tea and coffee consumptions were collected. Participants were asked whether they drink thyme tea, normal tea, and coffee in their everyday life or not. If yes, they were asked to quantify the amount and frequency of consumption using the number of cups per day per week.

Anthropometric measurements: Height was measured to the nearest 0.1cm with barefoot, and weight was measured to the nearest 0.1kg with light clothing and barefoot. Nutritional status was assessed by Body Mass Index (BMI), which was calculated by dividing weight in kilograms by height in meters square. Study participants with BMI <18.5kg/m2, 18.5–25kg/m2 and >25kg/m2 were classified as underweight, normal and overweight respectively.

Data Quality Assurance

The English version of the questionnaire was translated into the local language (Amharic), the consistency was check by re-translated back to English and compared with the original version. The Amharic version of the questionnaire was pre-tested on 25 post-menarche female

students to check its understandability by study participant, response rate to each question, and determine the time required per questionnaire. One-day training was given for three female data collectors and one supervisor. Daily monitoring and supervision of the data collection, checking for completeness and consistency of collected data was carried out by supervisors. The principal investigator also examined the collected data for completeness and consistency before data entry.

Data Analysis Procedures

Collected data were entered into Epi Data version 3.1 software and exported to IBM SPSS Statistics for Windows, Version 24 (Corp Armonk, New York, USA) for analysis. Both bi-variable and multivariable binary logistic regression analyses were carried out to see the association between severe dysmenorrhea and thyme tea consumption and other dietary habits of young female students. Odds ratios with 95% confidence intervals were computed as a measure of association and a p-value of <0.05 was used to declare the presence of a statistically significant association between the dependent variable and covariates.

Ethical Considerations

Ethical clearance was obtained from the Ethical Review Committee of Debre Berhan University. Permission to proceed with the study was obtained from school directors. Study participants were adequately informed about the importance of the study and participate in the study was based on volunteerism. Based on the Ethical Review Committee's approval, oral consent was obtained by ≥15years old study participants during data collection. A day prior to the interview, <15years aged participants were informed to get verbal consent from their parents besides their oral assent to participate in the study. School teachers also consented for their students' participation in the study. For confidentiality purpose, the names of participants and other personal identifiers related questions were excluded in the questionnaire.

Results
Socio-Demographic and Menstrual Characteristics of Participants

Data collected from 252 (cases 86, controls 166) study participants, and the response rate was 92.3%. Table 1 describes the socio-demographic and menstrual characteristics as well as the nutritional status of cases and controls.

Almost all 247 (98.0%) and 230 (91.3%) of study participants had a habit of tea and coffee drinking, respectively. Thyme tea drinking was reported by 75 (29.8%) study participants, and it was 19 (22.1%) among cases and 56 (33.7%) among controls (Table 2).

Meal frequency of >3 meals per day was higher 75 (45.2%) among controls compared to 27 (31.4%) among cases. The mean (±SD) 24hours DDS of cases and controls was 4.27 (±1.87) and 4.44 (±1.69), respectively. Those who consumed at least 5 food groups (the minimum required food groups) in the last 24 hours were 30 (34.9%) of cases and 77 (46.4%) of controls (Table 3).

Risk Factors of Dysmenorrhea

Table 2 described the bi-variable analysis of thyme tea drinking and the frequency of thyme tea drinking on primary dysmenorrhea. Even if, the association was not significant at p-value <0.05, thyme tea-drinking tended to decrease the risk of primary dysmenorrhea. Concerning the frequency of thyme tea consumption, those who drank thyme tea at least once per day had a lesser risk of primary dysmenorrhea by over 70% (COR: 0.286 and 95% CI: 0.095–0.862).

As shown in Table 3 below, the adjusted effect of thyme tea drinking on primary dysmenorrhea was computed by involving dietary, menstrual, and socio-demographic related variables in the final model. Variables found to have significant association on bi-variable analysis: meal frequency, frequency of dairy consumption, frequency of vegetable and fruit consumption, age at menarche and post-menarche duration, and other clinically important variables such as; age, BMI, menstrual regularity, DDS, and frequency of coffee drinking were included in the multivariable analysis.

Accordingly, thyme tea drinking was significantly associated with primary dysmenorrhea. Thyme tea decreased the risk of primary dysmenorrhea by 63.2% (AOR: 0.368 and 95% CI: 0.145–0.934). In this study, coffee drinking tends to increase the odds of primary dysmenorrhea on young female students. Compared to those who drink coffee once per day, those who drink coffee less than once per day (or rarely per week) and coffee non-drinkers had 0.14 and 0.12 times less likely to experience primary dysmenorrhea respectively (Table 3).

Besides, age, age at menarche, meal frequency, and residence were significantly associated with primary dysmenorrhea. As the age of young female students' increases, the probability of experiencing primary

Table 1 Socio-Demographic and Menstrual Characteristics of Study Participants

Variables		Dysmenorrhea			p-value
		Cases No. (%)	Controls No. (%)	Total No. (%)	
Age	<15 years	18 (20.9)	26 (15.7)	44 (17.5)	0.233
	≥15 years	68 (79.1)	140 (84.3)	208 (82.5)	
Residence	Rural	42 (48.8)	68 (41.0)	110 (43.7)	0.237
	Urban	44 (51.2)	98 (59.0)	142 (56.3)	
Educational status of the mother	Illiterate	27 (31.4)	74 (44.6)	101 (40.1)	0.082
	Primary	46 (53.5)	79 (47.6)	125 (49.6)	
	Secondary	7 (8.1)	9 (5.4)	16 (6.3)	
	College and above	6 (7.0)	4 (2.4)	10 (4.0)	
Educational status of the father	Illiterate	9 (10.5)	23 (13.9)	32 (12.7)	0.038
	Primary	58 (67.4)	122 (73.5)	180 (71.4)	
	Secondary	13 (15.1)	8 (4.8)	21 (8.3)	
	College and above	6 (7.0)	13 (7.8)	19 (7.5)	
Occupation of the mother	Housewife	38 (44.2)	112 (67.5)	150 (59.5)	0.003
	Farmer	26 (30.2)	33 (19.9)	59 (23.4)	
	Merchant	8 (9.3)	13 (7.8)	21 (8.3)	
	Gov't employee	4 (4.7)	2 (1.2)	6 (2.4)	
	Private employee	6 (7.0)	4 (2.4)	10 (4.0)	
	Others	4 (4.7)	2 (1.2)	6 (2.4)	
Occupation of the father	Farmer	62 (72.1)	128 (77.1)	190 (75.4)	0.381
	Merchant	4 (4.7)	13 (7.8)	17 (6.7)	
	Gov't employee	16 (18.6)	17 (10.2)	33 (13.1)	
	Private employee	2 (2.3)	4 (2.4)	6 (2.4)	
	Others	2 (2.3)	4 (2.4)	6 (2.4)	
Family size	<5	32 (37.2)	53 (31.9)	85 (33.7)	0.411
	≥5	54 (62.8)	113 (68.1)	167 (66.7)	
Age at menarche	≤12 years	10 (11.6)	12 (7.2)	22 (8.7)	<0.001
	13–14 years	64 (74.4)	90 (54.2)	154 (61.1)	
	≥15 years	12 (14.0)	64 (38.6)	76 (30.2)	
Post-menarche duration	≤2 years	44 (51.2)	134 (80.7)	178 (70.6)	<0.001
	>2 years	42 (48.8)	32 (19.3)	74 (29.4)	
Menstrual cycle duration	<21 days	2 (2.3)	4 (2.4)	6 (2.4)	0.592
	21–35 days	84 (97.7)	160 (96.4)	244 (96.8)	
	>35 days	0	2 (1.2)	2 (0.8)	
Menstrual bleeding duration	<4 days	26 (30.2)	56 (33.7)	82 (32.5)	0.459
	4–7 days	54 (62.8)	104 (62.7)	158 (62.7)	
	>7 days	6 (7.0)	6 (3.6)	12 (4.8)	
Menstrual regularity	Regular	54 (62.8)	100 (60.2)	154 (61.1)	0.694
	Irregular	32 (37.2)	66 (39.8)	98 (38.9)	
BMI	Underweight	24 (27.9)	58 (34.9)	80 (32.5)	0.259
	Normal	62 (72.1)	108 (65.1)	170 (67.5)	

Abbreviation: BMI, body mass index.

Table 2 Bivariable Analysis of Thyme Tea Drinking and Its Frequency on Primary Dysmenorrhea

Variables		Dysmenorrhea		COR (95% CI)	p-value
		Cases (%)	Controls (%)		
Thyme tea	Yes	19 (22.1)	56 (33.7)	0.557 (0.305–1.018)	0.055
	No	67 (77.9)	110 (66.3)	1	
Frequency of thyme tea drinking	≥once/day	4 (4.7)	23 (13.9)	0.286 (0.095–0.862)	0.019
	<once/days or (rarely/week)	15 (17.4)	33 (19.9)	0.746 (0.377–1.476)	0.399
	Never	67 (77.9)	110 (66.3)	1	

dysmenorrhea increase by 66.5%. Late menarche (at or after 15 years of age) girls were 0.09 times less likely to have primary dysmenorrhea as compared to girls who experience menarche at 13–14 years of age. Having ≥4meals/day decreased the odds of primary dysmenorrhea by 67.3% than having 3meals/day. Primary dysmenorrhea was 3.5 times more common among rural residents than urban (Table 3).

Discussion

In this study, thyme tea-drinking showed the tendency of alleviating severe form of dysmenorrhea among young female students. Thyme tea consumers were 63% less likely to experience primary dysmenorrhea than their counterparts. The dysmenorrhea risk reduction effect of thyme tea might be due to the antioxidant and analgesic capacities of bioactive phytochemicals of thyme leaves used in the tea. According to Dagne et al, the essential oil of *T. schimperi* leaves, thyme species found in this study area is rich in phenolic compounds that have significant antioxidant activities.[28] Thyme tea drinking could have a role in reducing PGs production by suppressing the COX-2 pathway and prevent oxidative stress by scavenging lipid peroxide radicals (index of oxidative stress) in dysmenorrhea women. Several studies[35–37] showed the presence of increased lipid peroxide in dysmenorrheic women compared to normal women. Overproduction and release of PGs especially PGF2α in the secretary endometrium[20,38,39] lead to myometrium over activation and subsequent uterine hypoxic-ischemia. This tissue damage in the uterus activates phospholipase A2 that hydrolysis cell membrane phospholipids, which further propagate the lipid peroxide radicals and arachidonic acid (precursor of prostaglandin syntheses) production, and exacerbate the severity of primary dysmenorrhea.[40,41] Phenolic compounds of the thyme leaves in the tea might inhibit the activity of phospholipase A2 enzyme and subsequence arachidonic acid production. A randomized and triple-blind clinical trial in

Iran,[31] revealed that taking Thyme Vulgaris essential oil was as effective as Ibuprofen in reducing the severity of dysmenorrheal pain.

To rule out whether the protective effect of thyme tea was related to the caffeine constituent of thyme tea, we examined the effect of caffeinated beverages such as coffee drinking on dysmenorrhea. Also, by including into the final model we observed that coffee drinking had an independent direct association with primary dysmenorrhea. Coffee non-drinkers and those who drink rarely per week had 88% and 86% lesser odds of primary dysmenorrhea, respectively compared to daily coffee drinkers. Drinking coffee more than once per day was not significantly associated with primary dysmenorrhea. Similarly, previous studies in Ethiopia,[14] Turkey,[42] and Kuwait[43] showed that caffeinated beverages exacerbate the risk of primary dysmenorrhea. Though the mechanism of how coffee aggravates dysmenorrhea is not clearly understood, one possible mechanism is the caffeine vasoconstriction effect which decreases the blood flow to the uterus exacerbating the severity of dysmenorrhea.

Concerning dietary habits, young female students who had had four or more meals per day were 67.3% less likely to experience primary dysmenorrhea than those who had three meals per day. Meal frequency of twice per day or less had no association with primary dysmenorrhea, maybe this is due to the small number of this study population who had had ≤2 meals/day.

The frequency of fruit or vegetable intake was inversely associated with primary dysmenorrhea. Those who had frequent fruits or vegetable consumption (≥4times/week) had around 68% lesser odds of dysmenorrhea compared to those who never had one. This is consistent with previous studies report of increased consumption of fruits and vegetables as the sources of vitamins and minerals are associated with decreased menstrual pain.[44–46] Micronutrients such as vitamins (vitamin C, vitamin E, and β-carotene) and mineral (zinc) are non-enzymatic dietary antioxidants. Hence,

Table 3 Factors Associated with Primary Dysmenorrhea Among Young Female Students

Variables		Dysmenorrhea		Total	COR (95% CI)	AOR (95% CI)
		Cases No. (%)	Controls No. (%)			
Thyme tea	≥once/day	4 (4.7)	23 (13.8)	27 (10.7)	0.286 (0.095–0.862)	0.415 (0.087–1.972)
	<once/days (rarely/week)	15 (17.4)	33 (19.9)	48 (19.1)	0.746 (0.377–1.476)	0.291 (0.097–0.873)*
	Never	67 (77.9)	110 (66.3)	177 (70.2)	1	1
Coffee	>once/day	26 (30.2)	60 (36.1)	86 (34.1)	0.693 (0.378–1.272)	0.474 (0.195–1.152)
	Once/day	40 (46.5)	64 (38.6)	104 (41.3)	1	1
	<once/days (rarely/week)	12 (14.0)	28 (16.9)	40 (16.9)	0.686 (0.313–1.501)	0.136 (0.033–0.554)*
	Never	8 (9.3)	14 (8.4)	22 (8.7)	0.914 (0.352–2.374)	0.124 (0.021–0.727)*
DDS	<5 food groups	56 (65.1)	89 (53.6)	145 (57.5)	1.615 (0.943–2.767)	1.937 (0.879–4.269)
	≥5 food groups	30 (34.9)	77 (46.4)	107 (42.5)	1	1
Meal frequency	<3 meal/day	4 (4.6)	8 (4.8)	12 (4.8)	0.769 (0.220–2.685)	1.315 (0.625–6.532)
	3 meals/day	55 (64.0)	83 (50.0)	138 (54.8)	1	1
	>3meal/day	27 (31.4)	75 (45.2)	102 (40.4)	0.556 (0.315–0.981)	0.327 (0.140–0.766)*
Frequency of dairy consumption	≥once/day	4 (4.7)	10 (6.0)	14 (5.6)	0.631 (0.191–2.089)	1.195 (0.192–7.437)
	Rarely/week	11 (12.8)	44 (26.5)	55 (21.8)	0.394 (0.191–0.814)	0.518 (0.172–1.557)
	Never	71 (82.6)	112 (67.5)	183 (72.6)	1	1
Frequency of vegetable or fruit consumption	Rarely/week	42 (48.9)	77 (46.4)	119 (47.2)	0.739 (0.370–1.476)	0.918 (0.366–2.306)
	≥once/day	21 (24.4)	60 (36.1)	81 (32.1)	0.441 (0.211–0.924)	0.321 (0.105–0.981)*
	Never	23 (26.7)	29 (17.5)	52 (20.7)	1	1
BMI	Normal	62 (72.1)	108 (65.1)	170 (67.5)	1	1
	Underweight	24 (27.9)	58 (34.9)	80 (32.5)	0.721 (0.408–1.273)	1.158 (0.451–2.977)
Age		86 (34.1%)	166 (65.9%)	252 (100%)	1.124 (0.937–1.348)	1.665 (1.441–8.328)*
Age at menarche	13–14 years	64 (74.4)	90 (54.2)	154 (61.1)	1	1
	≤12 years	10 (11.6)	12 (7.2)	22 (8.7)	1.172 (0.477–2.878)	1.729 (0.431–6.931)
	≥15 years	12 (14.0)	64 (38.6)	76 (30.2)	0.264 (0.132–0.528)	0.091 (0.025–0.334)*
Post-menarche duration	≤2 years	44 (51.2)	134 (80.7)	178 (70.6)	1	1
	>2 years	42 (48.8)	32 (19.3)	74 (29.4)	3.997 (2.255–7.084)	1.892 (0.511–7.013)
Residence	Rural	42 (48.8)	68 (41.0)	110 (43.7)	1.376 (0.815–2.323)	3.464 (1.441–8.328)*
	Urban	44 (51.2)	98 (59.0)	142 (56.3)	1	1

Note: *Significantly associated variables.
Abbreviations: DDS, Diet Diversity Score; BMI, body mass index.

frequent consumption of fruits and vegetables is important to prevent the occurrence of oxidative stress secondary to increased lipid peroxide in primary dysmenorrhea.[47,48]

Other risk factors associated with primary dysmenorrhea were age and age at menarche of young female students. As the age of young female students approaches to late teens, the probability of experiencing primary dysmenorrhea also increased. Late menarche girls had a decreased risk of primary dysmenorrhea. Several previous studies[6,7,11,15,49] conducted on adolescent girls also revealed that the peak prevalence of primary dysmenorrhea occurs in late teens, and the onset of menarche at an early age is associated with increased risk of primary dysmenorrhea.

Limitations that could affect the finding of this study are: first, there could be recall bias since study variables were measured through participants' self-report. Second, in the study area thyme leaves sometimes used as food additives and spices to flavor a wide range of food products. The amount and frequency the thyme leaves consumed by the study participants in the form of food additive or spices were not measured in the study. This may dilute and lead to underestimating the magnitude of the association between thyme tea and primary dysmenorrhea. Third, other important variables that might affect the occurrence of primary dysmenorrhea including alcohol drinking, stress, and physical exercise were not considered in the study. However, this study gives new insight into the possible role of the local herbal tea, thyme tea, drinking in reducing dysmenorrhea.

Conclusion

Thyme tea drinking and consumption of vegetables and fruits had primary dysmenorrhea related pain-relieving tendency. Delayed onset of menarche decreased the risk of primary dysmenorrhea. Coffee drinking was positively associated with primary dysmenorrhea. Further investigations with a clinical trial on the effect of thyme tea drinking on dysmenorrhea are required to enrich epidemiological evidence and mechanism of action.

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