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The Prevalence and Risk Factors of Dysmenorrhea

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Dysmenorrhea is a common menstrual complaint with a major impact on women's quality of life, work productivity, and health-care utilization. A comprehensive review was performed on longitudinal or case-control or cross-sectional studies with large community-based samples to accurately determine the prevalence and/or incidence and risk factors of dysmenorrhea. Fifteen primary studies, published between 2002 and 2011, met the inclusion criteria. The prevalence of dysmenorrhea varies between 16% and 91% in women of reproductive age, with severe pain in 2%–29% of the women studied. Women's age, parity, and use of oral contraceptives were inversely associated with dysmenorrhea, and high stress increased the risk of dysmenorrhea. The effect sizes were generally modest to moderate, with odds ratios varying between 1 and 4. Family history of dysmenorrhea strongly increased its risk, with odds ratios between 3.8 and 20.7. Inconclusive evidence was found for modifiable factors such as cigarette smoking, diet, obesity, depression, and abuse. Dysmenorrhea is a significant symptom for a large proportion of women of reproductive age; however, severe pain limiting daily activities is less common. This review confirms that dysmenorrhea improves with increased age, parity, and use of oral contraceptives and is positively associated with stress and family history of dysmenorrhea.

dysmenorrhea; incidence; menstrual pain; natural history; painful menstruation; prevalence; risk factors

Abbreviations: CI, confidence interval; OCP, oral contraceptive pill.

INTRODUCTION

Dysmenorrhea or painful menstruation is defined as a severe, painful, cramping sensation in the lower abdomen that is often accompanied by other symptoms, such as sweating, headaches, nausea, vomiting, diarrhea, and tremulousness, all occurring just before or during the menses (1). There are 2 types of dysmenorrhea: Primary dysmenorrhea refers to pain with no obvious pathological pelvic disease and almost always first occurs in women 20 years or younger after their ovulatory cycles become established (1). Secondary dysmenorrhea is caused by underlying pelvic conditions or pathology and is more common in women older than 20 years (1, 2). Dysmenorrhea is considered the most common symptom of all menstrual complaints and poses a greater burden of disease than any other gynecological complaint in developing countries (3). Among women of reproductive age worldwide, dysmenorrhea is more prevalent than the other 2 common types of chronic pelvic pain, namely, dyspareunia and noncyclical chronic pelvic pain (4). Being a debilitating condition for many women, it has a major impact on health-related quality of life, work productivity, and health-care utilization (5–9). As a result, dysmenorrhea is responsible for considerable economic losses due to the costs of medications, medical care, and decreased productivity (1).

The prevalence of dysmenorrhea reported in the literature varies substantially. A greater prevalence was generally observed in young women, with estimates ranging from 67% to 90% for those aged 17–24 years (10, 11). A recent large Australian study of senior high school girls found that a higher proportion, 93%, of teenagers reported menstrual pain (12). The studies in adult women are less consistent in reporting prevalence of dysmenorrhea and often focus on a specific group, with rates varying from 15% to 75% (10). Severe pain sufficient to limit daily activities is considerably less common, affecting approximately 7%–15% of women (10), although a study of adolescents and young adults aged 26 years or less reported that 41% of the participants had limitations in their daily activities due to dysmenorrhea (7).

A range of risk factors for dysmenorrhea have been identified in the literature, although mixed results have been observed for many of these factors. In general, increased severity of

dysmenorrhea has been suggested to relate to age (13–15), smoking (14, 16, 17), higher body mass index (18), earlier age at menarche (15, 18), nulliparity (15, 19), longer and heavier menstrual flow (15, 18), and family history of dysmenorrhea (20). Women using oral contraceptives generally report less severe dysmenorrhea (14, 15, 21). Depression and stress have also been shown to increase the risk of dysmenorrhea (9, 22). Other common factors, such as education (23), marital status (14), employment (19), alcohol consumption (17, 18), and physical activity (15, 18), show largely negative or inconclusive results.

Currently there is a large body of literature on dysmenorrhea, the majority of which provides only a snapshot view of the disorder from cross-sectional studies and suffers from selection bias as they are based on convenience samples of mainly young college students. To our knowledge, there is no current review that has taken these design factors into account. Therefore, this review aims to ascertain more accurate estimates of the prevalence and incidence of dysmenorrhea in the community and to determine its risk factors by examining evidence from recent longitudinal and population-based studies. The additional aim of this review is to identify gaps in the literature to inform further research focus.

MATERIALS AND METHODS

This review is part of a wider literature review on the epidemiology, impact, and health services use related to dysmenorrhea and premenstrual syndrome/premenstrual dysphoric disorder, focusing on the prevalence and/or incidence and risk factors of dysmenorrhea. Published studies in English providing relevant information on dysmenorrhea were identified by searching PubMed and Embase, restricting the population to adult women (aged 18 years or more) and the year of publishing from 2002 to August 2012. The PubMed search field terms used related to this review were "dysmenorrhea"[MeSH] OR "dysmenorrhea"[tiab] OR ("painful"[tiab] AND "menstruation"[tiab]) OR "painful menstruation"[tiab] OR ("menstrual"[tiab] AND "pain"[tiab]) OR "menstrual pain"[tiab], where Medical Subject Headings (MeSH) and Title/Abstract (tiab) represented the tags.

In order to better infer the temporal relationship and to avoid selection bias, only studies adopting longitudinal study design, case-control studies, or cross-sectional studies with large community-based samples were included in this review. Data from included studies were extracted into a standard form including the key characteristics of the studies, main findings, limitations, and conclusions. The definition of dysmenorrhea varied from abdominal or low back pain or cramps of any severity during menstrual bleeding in the previous month to the past 12 months gathered through self-reporting, interview, or daily diary recording. The majority of studies did not limit the severity of pain or distinguish between the types of dysmenorrhea, such as primary or secondary dysmenorrhea. The severity and the type of dysmenorrhea were noted if the study clearly stated these. The reference lists of the studies included in this review were scanned to check for any additional studies not captured by the electronic database search.

Quality assessment was performed for the primary studies by using a checklist for appraising medical literature for cohort/case-control/cross-sectional studies; it is attached as Web Appendix 1 (available at http://aje.oxfordjournals.org/) (24). The checklist addresses potential biases introduced by study design, sample representativeness, comparability of groups (if applicable), quality of measurements, completeness of data, and confounding. A study was rated as good quality if no problem or only minor problems were identified and as poor quality if 4 or more major problems were identified, for the above-mentioned domains. An overall judgment on the quality was made on the basis of the appraisal of each domain, taking into account its expected effect on the results. Review articles providing relevant information on dysmenorrhea were included as supplementary information as they do not apply the same inclusion criteria.

In summary, this review used a comprehensive approach to identify and select relevant literature to provide a qualitative synthesis of the most up-to-date, better-designed, and relevant literature on the rate and risk factors for dysmenorrhea.

RESULTS

A total of 2,276 articles were retrieved through the search. After applying the selection criteria described above and scanning the reference lists of included studies, we included 15 primary studies: 3 longitudinal studies and 12 population-based, cross-sectional studies. Three systematic reviews were included as supplementary information, 2 providing information on prevalence and 1 providing information on risk factors of dysmenorrhea. Data from countries not included in the previous systematic review, particularly developing countries, were identified and thus enhance our overall knowledge base on dysmenorrhea that has been based mainly on literature from developed countries. Most studies were rated as moderate-quality only (quality rating included in Table 1), mainly related to potential biases introduced by the design or conduct of the study. The main concerns with most studies were as follows: 1) study design, as cross-sectional studies were often used to identify risk factors; 2) questionable validity of measurement, as retrospective self-reporting of symptom was used by most studies; 3) representativeness of the sample, as insufficient information on the characteristics of nonresponders or drop-outs was provided; 4) no justification of power of the study provided, given the sample size; and/or 5) no quality control method reported for the data collection. In addition, 6 studies omitted key exposure variables such as parity or oral contraceptive pill (OCP) use from the analysis, which may cause potential biases due to possible confounding. Because of the substantial heterogeneity among the studies, in terms of the study population, definition of dysmenorrhea, symptom reporting methods, length of recall or investigation, and various measurements used for the risk factors studied, a meta-analysis was not performed. Instead, a narrative review and qualitative summation on the associations of the risk factors and dysmenorrhea were undertaken.

Prevalence and/or incidence

A total of 14 individual studies (3, 25–37) and 2 systematic reviews (4, 38) reported on the prevalence and/or incidence rates of dysmenorrhea.

Table 1. Characteristics of Primary Studies (Published Between 2002 and 2011) and Reported Rates for Dysmenorrhea

First Author, Year (Reference No.)	Study Quality	Country	No. of Participants	Age Group, Years	Reporting Method	Length of Investigation/ Recall	Hormonal Contraception	Type of Dysmenorrhea	Definition of Dysmenorrhea	Rate (Prevalence/Incidence) of Dysmenorrhea, %			
										Overall[a]	Mild	Moderate	Severe
Longitudinal Study													
Ohde, 2008 (30)	Moderate	Japan	823	18–51	Daily diary	1 month	Not specified	Not specified	Any pain	15.8			
Wang, 2004 (36)	Moderate-good	China	388	20–34	Daily diary	12 months or until pregnancy	No	Not specified	Any pain	Incidence, 28.0; prevalence, 44.4			
Weissman, 2004 (37)	Moderate-good	United States	404	19–46	Self-reporting	Past 12 months	Yes	Primary	Any pain	76.0	53.0	21.0	2.0
Cross-sectional Study													
Abenhaim, 2006 (25)	Moderate	United States	904	36–44	Self-reporting	Not specified	No	Not specified	Moderate-severe	36.7			
Burnett, 2005 (26)	Moderate	Canada	1,546	≥18	Interview	Not specified	Yes	Primary	Any pain Limiting activity	60.4 20.6	24.0	36.4	
Harlow, 2002 (39)	Moderate	United States	976	36–44	Interview	Varied (up to 5 years after menarche)	Yes	Not specified	Any pain	Not reported			
Laszlo, 2008 (27)	Moderate	Hungary	2,722	<55	Interview	Not specified	Not specified	Not specified	Limiting activity	15.5			
Laszlo, 2009 (28)	Moderate	Hungary	821	37.16 (9.37)[b]	Interview	Not specified	Not specified	Not specified	Limiting activity	20.1			
Nohara, 2011 (29)	Poor-moderate[c]	Japan	2,166	Not reported	Self-reporting	Not specified	Not specified	Not specified	Severe	76.5	Tolerable	47.9	28.6
Patel, 2006 (3)	Moderate-good	India	2,262	18–45	Interview	Last 12 months	Yes	Not specified	Any pain Limiting activity	54.6 28.7	21.3	15.0	18.3
Pawlowski, 2004 (31)	Moderate	Mexico	177	18–45	Interview	Not specified	No	Not specified	Any pain	28.0			
Pitts, 2008 (32)	Poor[d]	Australia	1,983	16–49	Interview	Last 12 months	Yes	Not specified	Any pain	71.7			15.0
Santer, 2005 (33)	Moderate-good	United Kingdom	2,833	25–44	Self-reporting	Last 6 months	Yes	Not specified	Severe	15.0			15.0
Tavallaee, 2011 (34)	Poor-moderate[e]	Iran	276	16–56	Self-reporting	Last 12 months	Yes	Primary	Any pain	91.0	41.0	28.0	22.0
Unsal, 2010 (35)	Moderate	Turkey	729	15–49	Interview	Not specified	Yes	Not specified	Any pain	63.6			

[a] Reported as prevalence unless otherwise specified. Note that, although Nohara (29) defines dysmenorrhea as severe pain, the overall prevalence was reported for any pain.
[b] Age as mean (standard deviation) for women with pain-limiting activity.
[c] A cross-sectional study, with a high nonrespondent rate (73%) but no information on their characteristics, and analyses were not controlled for oral contraceptive pill use.
[d] A cross-sectional study, with a moderate survey response rate of 57%, no information on nonresponders, the final models adjusted only for age, and important confounders such as both parity and oral contraceptive pill use not controlled for.
[e] A cross-sectional study, with a small sample size, and the analyses were not adjusted for important risk factors such as parity.

Primary studies. The results from the 15 primary studies, 14 of which reported on the prevalence and/or incidence, are summarized in Table 1. The reported prevalence of dysmenorrhea of any severity varies between 16% and 91% in women of reproductive age. The lowest prevalence of 16% was reported in a random sample of Japanese women aged 17–51 years through daily diary recording for 1 month (30). Although an incidence of 16% (defined as the proportion of participants who developed dysmenorrhea during the study period) was reported in the study, no baseline dysmenorrheal status was determined for the participating women. Therefore, the reported rate was more appropriately interpreted as the 1-month prevalence rate. The highest prevalence of 91% was reported in a random sample of Iranian women aged 16–56 years, with most less than 30 years of age without children, through self-reporting (34). Primary dysmenorrhea was specified in 3 studies, occurring in 60%–91% of the women.

Most studies relied on subjective level of pain reported by the participants (generally mild, moderate, or severe), with only 3 studies using some type of criteria to define severe pain. Although Weissman et al. (37) and Tavallaee et al. (34) used similar definitions as pain requiring bed rest and missing work or cutting back on activities, the other study defined it as having a score of 8–10 on a 10-point visual analog scale (35). According to these criteria, severe pain was reported in 2%–29% of women. In addition, dysmenorrhea-limiting activities were reported in 4 studies varying from 16% to 29% of women.

The incidence of dysmenorrhea was reported in a prospective cohort study using daily diary recording, occurring in 28% of women during a follow-up of 12 months (36). The study ascertained the past history of dysmenorrhea according to whether the women experienced dysmenorrhea during the past 12 months at baseline; however, it did not provide explicit definition of incidence. Weissman et al. (37), in another prospective longitudinal study of 404 women with primary dysmenorrhea, studied the change of the symptom over 6 years of follow-up. Although 88% of women with primary dysmenorrhea at baseline still reported the symptom at follow-up, it was not consistent over time. Among women with the symptom at baseline, 26% of these women experienced improvement, and 27% experienced worsening of the symptom over 6 years.

Systematic reviews. A systematic review conducted by the World Health Organization (4) assessed the worldwide prevalence of 3 different types of chronic pelvic pain, including dysmenorrhea. It included 106 cross-sectional studies on 124,259 nonpregnant women with or without endometriosis, published mainly from 1980 onward. The prevalence of dysmenorrhea varied from 8.8% in hospitalized women aged 19–41 years to 94% in girls aged 10–20 years. Studies from the United Kingdom reported a prevalence range between 45% and 97% for any dysmenorrhea in community-based studies and between 41% and 62% in hospital-based studies. In 20 high-quality studies with representative samples, the prevalence of dysmenorrhea was reported between 17% and 81%. Severe dysmenorrhea, however, was reported in 12%–14% of women in community-based studies in the United Kingdom. The review explored the source of variation in prevalence estimates and found the validated measurement tool to be a significant factor in explaining the heterogeneity.

Another systematic review (38), which included 25 studies from developing countries between 1970 and mid-2002, reported on the prevalence of a range of menstrual disorders for women of reproductive age. The number of studies reporting on the prevalence of dysmenorrhea was not clear. Despite a limited evidence base and the imprecise definition of menstrual disorders, the review summarized that between 25% and 50% of adult women reported menstrual pain. Severe pain or pain that prevents a woman from work or daily activities ranged from 5% to 20%. The review authors concluded that the findings were comparable to those reported in studies from developed countries and that menstrual disorders constituted an important area of unmet need for reproductive health services for women in developing countries.

Risk factors

Fifteen individual studies (3, 25–37, 39) and a systematic review (40) reported on the associations between at least 1 risk factor and dysmenorrhea. Tables 2–4 present qualitative summation on the associations between dysmenorrhea and the main risk factors reported in the studies. All the associations reported in the tables were based on multivariable analyses, although the extent of adjustment made varies among the studies with 1 study adjusting for only age in the analyses (32). Three studies did not control for the important effect of parity when examining the association between age and dysmenorrhea. In addition, 6 studies (27–30, 32, 39) did not collect the information on OCP use and, thus, its effect was not accounted for in their analyses. Only 1 study (39) is duplicated in the current review and the earlier systematic review identified (40). More detailed information including the effect size reported for significant risk factors can be found in Web Appendix 2.

Demographic and lifestyle factors. The association of age and dysmenorrhea was reported in 9 studies, with 2 longitudinal (30, 37) and 5 cross-sectional (3, 26, 29, 32, 34) studies consistently demonstrating a significant inverse relationship between age and the risk of dysmenorrhea (Table 2). Among the 7 studies reporting an inverse association, 4 conducted the analyses adjusted for parity/livebirth, whereas the other 3 failed to do so (30, 32, 34). In the study by Weissman et al. (37), the univariate analysis revealed that women younger than 25 years were at more than twice the risk (odds ratio = 2.24, 95% confidence interval (CI): 1.24, 4.05) of reporting moderate to severe pain compared with those aged 25–34 years. In their multivariable analysis model, including livebirth, a 1-year increase in age was associated with an odds ratio of 0.92 (95% CI: 0.86, 0.98) for developing moderate to severe dysmenorrhea. The other 2 cross-sectional studies (31, 33) did not detect a significant association in the adjusted analysis, although the large study from Scotland showed a reduced risk of severe pain with every 5-year increment in age (odds ratio = 0.93, 95% CI: 0.82, 1.05). The reported odds ratios were between 1 and 3 for younger women to have more severe dysmenorrhea. The pooled effect size (odds ratio = 1.89) from 3 studies in the systematic review for women younger than 30 years of age is in line with these estimates (40).

Family history of dysmenorrhea demonstrated a strong association with reporting of menstrual pain by the women in 2

Table 2. Adjusted Association[a] Between Dysmenorrhea and Reported Main Demographic and Lifestyle Factors in the Included Studies[b]

First Author, Year (Reference No.)	Age (Younger)	Education	Employed	Married	Body Mass Index (Higher)	Residence	Income/ SES (Lower)	Smoking	Alcohol Use	Fruit and Vegetable Intake (Higher)	Family History of Dysmenorrhea
Longitudinal Study											
Ohde, 2008 (30)	↑	↔	↑		↔	↔	↔				
Weissman, 2004 (37)	↑							↔			
Cross-sectional Study											
Burnett, 2005 (26)	↑	↔					↔	↑			
Nohara, 2011 (29)	↑				↑			↔	↔		
Patel, 2006 (3)	↑	↔	↔	↔			↔				
Pawlowski, 2004 (31)	↔				↔						
Pitts, 2008 (32)	↑	↔	↔	↔							
Santer, 2005 (33)	↔						↑				
Tavallaee, 2011 (34)	↑				↔		↑			↓	↑
Unsal, 2010 (35)			↔				↔	↔	↔		↑
Systematic Review											
Latthe, 2006 (40)	↑	↔	↔	↔	↔		↑	↑	↔		

Abbreviation: SES, socioeconomic status.

[a] Associations based on multivariable analyses, although the extent of adjustment made varies among the studies: Pitts (32) adjusted only for age; parity was not adjusted for in 3 studies (Ohde (30), Pitts (32), Tavallaee (34)); and oral contraceptive pill use was not adjusted for in 3 studies (Ohde (30), Nohara (29), Pitts (32)).

[b] ↑, significant risk factors for dysmenorrhea; ↓, significant protective factors against dysmenorrhea; ↔, no significant association detected.

cross-sectional studies. An odds ratio of 3.8 (95% CI: 2.2, 6.9) was reported in a sample of 276 Iranian women with primary dysmenorrhea (34), and an even stronger association with an odds ratio of 20.7 (95% CI: 11.5, 37.4) was observed in a study of 729 Turkish women (35).

Fruit and vegetable intake, on the other hand, was shown to reduce the risk of dysmenorrhea in a cross-sectional study with odds ratios of 0.4 (95% CI: 0.2, 0.6) and 0.2 (95% CI: 0.08, 0.50) for high and very high fruit and vegetable intakes, respectively, for risk of dysmenorrhea (34).

No significant associations were detected between years of education (3, 26, 30, 32), marital status (3, 32), area of residence (30), and dysmenorrhea. Similarly, alcohol consumption was not associated with dysmenorrhea (29, 35).

The association between cigarette smoking and dysmenorrhea was reported in 4 studies, and mixed results were seen. One longitudinal (37) and 2 cross-sectional (29, 35) studies did not detect any significant association, whereas another cross-sectional study reported an increased risk of dysmenorrhea for smokers (26). Similarly, conflicting results were observed among the studies for a range of other sociodemographic and lifestyle factors, such as employment, socioeconomic status, and body mass index. However, there are only a limited number of studies, and no longitudinal studies have reported on these associations.

Reproductive factors. The association between parity or number of livebirths and dysmenorrhea was reported in 9 studies (Table 3). Despite different categorizations used for parity, results were consistent from 1 longitudinal study (37) and 6 cross-sectional studies (3, 25, 29, 32, 33, 35), demonstrating a significant negative association between increased parity or number of livebirths and the risk of dysmenorrhea. Weissman et al. (37), in their multivariable analysis model including age, demonstrated a significant cross-sectional association between parity and moderate to severe dysmenorrhea (for an increment of 1 birth, odds ratio = 0.70, 95% CI: 0.54, 0.91) at baseline. Furthermore, the authors examined the effect of livebirth after baseline on the severity of dysmenorrhea at follow-up and showed that livebirth was associated with an odds ratio of 0.20 (95% CI: 0.08, 0.53) for reporting moderate to severe dysmenorrhea. The remaining 2 cross-sectional studies failed to find a significant relationship between dysmenorrhea and parity (26, 31). The observed odds ratios ranged from 0.3 to 0.74 for parity of 1 or more compared with nulliparity, whereas an odds ratio of 7.83 (95% CI: 4.21, 14.57) for dysmenorrhea was observed for never giving birth (compared with 3 or more births) in a cross-sectional study with 729 Turkish women (35).

The association of OCP or hormonal contraception use with dysmenorrhea was reported in only 3 cross-sectional studies, 2 of which observed a protective effect of OCP or hormonal contraception use (26, 33). The third study failed to show a significant association between moderate to severe pain and different type of contraceptives, including OCP use, in a large sample of Indian women (3). In the 2 studies reporting a protective association, a relative effect size of 2–4 was detected. The use of an intrauterine contraceptive device (type not specified) was reported in 2 cross-sectional studies that found no relation with dysmenorrhea (3, 26). Similarly, no significant association between tubal ligation and dysmenorrhea was found in 2 cross-sectional studies (3, 39).

Table 3. Adjusted Association[a] Between Dysmenorrhea and Reported Main Reproductive Factors in the Included Studies[b]

First Author, Year (Reference No.)	Age at Menarche (Later)	Parity/ Livebirth (Higher)	Age at First Birth (Later)	OCP/Hormonal Contraception	IUCD	Tubal Ligation	Cesarean Section	Heavy Menses	Irregular Menses
Longitudinal Study									
Weissman, 2004 (37)		↓							
Cross-sectional Study									
Abenhaim, 2006 (25)		↓					↔		
Burnett, 2005 (26)	↔	↔		↓	↔				
Harlow, 2002 (39)						↔			
Nohara, 2011 (29)		↓							
Patel, 2006 (3)	↓	↓		↔	↔	↔		↑	
Pawlowski, 2004 (31)	↔	↔	↑						
Pitts, 2008 (32)		↓							
Santer, 2005 (33)		↓		↓					
Unsal, 2010 (35)	↔	↓							↑
Systematic Review									
Latthe, 2006 (40)	↓	↓	↑	↓	↔	↑		↑	↑

Abbreviations: IUCD, intrauterine contraceptive device; OCP, oral contraceptive pill.

[a] Associations based on multivariable analyses, although the extent of adjustment made varies among the studies: Pitts (32) adjusted only for age, whereas parity was not adjusted for; OCP use was not adjusted for in 2 studies (Nohara (29) and Pitts (32)).

[b] ↑, significant risk factors for dysmenorrhea; ↓, significant protective factors against dysmenorrhea; ↔, no significant association detected.

The presence of heavy menses or irregular menses was associated with increased risk for dysmenorrhea in 2 cross-sectional studies, with odds ratios of 1.9 (95% CI: 1.4, 2.6) (3) and 1.9 (95% CI: 1.22, 32.95) (35), respectively. In addition, an earlier age of giving birth to the first child was related to a reduced risk of dysmenorrhea in a cross-sectional study of 177 women from a traditional Mayan society not using hormonal contraceptives (31).

Inconsistent results for the association between age at menarche and menstrual pain were found in 4 cross-sectional studies. Three studies did not observe any significant effect for age at menarche (26, 31, 35), whereas the other study (3) reported a significantly reduced risk of dysmenorrhea in women with age at menarche later than 12 years (odds ratio = 0.75, 95% CI: 0.6, 0.9). No significant association was observed for the number of cesarean sections and dysmenorrhea after adjusting for a

Table 4. Adjusted Association[a] Between Dysmenorrhea and Reported Main Psychological and Other Factors in the Included Studies[b]

First Author, Year (Reference No.)	Psychological Factors				Others	
	Depressed	Stress (Higher)	Somatoform Symptom Score (Higher)	Violence From Others	Long-standing Illness	Lower Abdominal Pain
Longitudinal Study						
Wang, 2004 (36)		↑				
Cross-sectional Study						
Laszlo, 2008 (27)		↑				
Laszlo, 2009 (28)		↑				
Nohara, 2011 (29)		↑				
Patel, 2006 (3)			↑	↑		↑
Santer, 2005 (33)					↑	
Tavallaee, 2011 (34)	↑	↔				
Systematic Review						
Latthe, 2006 (40)	↔		↑			

[a] Associations based on multivariable analyses, although the extent of adjustment made varies among the studies: Parity was not adjusted for in Tavallaee (34), and oral contraceptive pill use was not adjusted for in 3 studies (Laszlo (27, 28), Nohara (29)).

[b] ↑, significant risk factors for dysmenorrhea; ↔, no significant association detected.

range of sociodemographic and lifestyle factors in a substudy of the Harvard Study of Moods and Cycles (25).

Psychological factors. Stress has been reported in 5 studies (Table 4). The results are consistent among 1 prospective longitudinal study of nulliparous Chinese women (36) and 3 cross-sectional studies (27–29). All 4 studies reported a positive association between stress and risk of dysmenorrhea among female workers, whereas the other cross-sectional study did not reveal a significant relationship after adjustment for age, socioeconomic status, body mass index, fruit and vegetable intakes, smoking, alcohol consumption, and family history of dysmenorrhea in a random sample of Iranian women. The study did, however, show an increased odds ratio of having severe pain in women who were extremely stressed in the unadjusted analysis (34). Among the studies reporting a significant association, various methods were used to measure different types of stress. In the longitudinal study (36), self-perceived stress, either work related or generated from other sources, in the subsequent menstrual cycle was recorded in a daily diary. Work-related stress, measured by a range of variables including control at the workplace, coworker support, job security, effort-reward imbalance, and overcommitment, was obtained through interview (27, 28), whereas self-reported stress was used in a group of Japanese workers (29). In general, a modest effect (odds ratios of 1–2.5) was observed for the reported high level of stress and increased risk of dysmenorrhea. However, Wang et al. (36) detected a combined effect of more than 10-fold (odds ratio = 10.4, 95% CI: 4.9, 22.3) risk of reporting dysmenorrhea in the subsequent cycle among women with both high stress and a history of dysmenorrhea compared with women with low stress and no history of dysmenorrhea.

One cross-sectional study observed a strong effect of being depressed most of time and the risk of menstrual pain with an odds ratio of 13.3 (95% CI: 2.0, 86.0) in a random sample of Iranian women with primary dysmenorrhea (34). A higher somatoform symptom score (>7), indicating poor mental health, was also significantly associated with moderate to severe menstrual pain in a random sample of 2,262 Indian women, with an odds ratio of 3.67 (95% CI: 2.7, 4.9) (3). The same study also observed a significant association between violence from others and the risk of moderate to severe dysmenorrhea (odds ratio = 2.23, 95% CI: 1.5, 3.4) (3). These associations, however, are shown only in a very limited number of cross-sectional studies, and no longitudinal data have yet demonstrated their support for these.

Other factors. Several other general health problems have been studied in a limited number of cross-sectional studies (Table 4), showing significant association between longstanding illness and an increased risk of severe menstrual pain (odds ratio = 1.73, 95% CI: 1.33, 2.23) (33) and lower abdominal pain (not related to menstrual periods) and an increased risk of moderate to severe pain (odds ratio = 1.8, 95% CI: 1.3, 2.3) (3).

In addition, a systematic review evaluated factors predisposing women to chronic and recurrent pelvic pain of 3 different types, including dysmenorrhea, dyspareunia, and noncyclical pelvic pain (40). A total of 63, mainly case-control, studies were included for dysmenorrhea. Twenty-nine of these studies satisfied 3 or more of the quality criteria used. Detailed characteristics for the patients in the included studies were not reported. The review conducted a series of meta-analyses across the studies. Among the range of risk factors evaluated in at least 2 of the included studies, presence of dysmenorrhea was found to be associated with age <30 years (odds ratio = 1.89, 99% CI: 1.36, 2.63), body mass index <20 kg/m^2 (odds ratio = 1.42, 99% CI: 1.26, 1.59), smoking (odds ratio = 1.37, 99% CI: 1.19, 1.57), high socioeconomic status (odds ratio = 1.25, 99% CI: 1.04, 1.50), age at menarche <12 years (odds ratio = 1.54, 99% CI: 1.17, 2.04), longer cycles (odds ratio = 1.46, 99% CI: 1.01, 2.11), irregular cycles (odds ratio = 2.02, 99% CI: 1.19, 3.44), heavy menstrual flow (odds ratio = 4.73, 99% CI: 2.95, 7.58), presence of premenstrual symptoms (odds ratio = 2.42, 99% CI: 1.84, 3.18), clinically suspected pelvic inflammatory disease (odds ratio = 1.58, 99% CI: 1.09, 2.30), sterilization (odds ratio = 1.35, 99% CI: 1.04, 1.75), history of sexual abuse (odds ratio = 1.60, 99% CI: 1.29, 2.00), and somatization (odds ratio = 3.04, 99% CI: 1.42, 6.53). On the other hand, use of oral contraceptives (odds ratio = 0.65, 99% CI: 0.60, 0.71) and higher parity (odds ratio = 0.64, 99% CI: 0.57, 0.72) were associated with reduced risk of dysmenorrhea. Heterogeneity was present in all analyses with multiple studies.

DISCUSSION

This review has highlighted that recent data on the rates and risk factors for dysmenorrhea in women of reproductive age from longitudinal studies or community-based samples are sparse. Among the limited studies identified, the prevalence of dysmenorrhea varies substantially from 16% to 91%. The lowest prevalence of 16% reported in a random sample of Japanese women aged 17–51 years was attributed to the short study period (1 month) and potential underreporting of mild menstrual pain (30). In addition, the prospective daily diary recording may also be a reason for the reported lower rate. Disregarding this lowest rate and that of 28% reported in women with a mean age of giving birth at 19.9 years from a traditional society in Mexico, the prevalence of 37%–91% reported in other studies is very similar to the range of 45%–97% reported from community-based studies in the World Health Organization review (4) and the range of 43%–90% reported in earlier literature (11). The variation in prevalence rates may be attributed to the lack of standard methods for assessing the severity of dysmenorrhea and the use of different definitions, ranging from the occurrence of occasional menstrual cramps to pain severe enough to interfere with daily activities and/or to require prescribed medication. In addition, the difference in the study populations, medication use including OCPs, various reporting methods, and length of symptom recall may also partially explain the variation in the prevalence reported.

Most studies show that dysmenorrhea is a common problem affecting the majority of women in the community. Severe pain or pain limiting women's daily activities, however, occurred only in 2%–28% of adult women. The lowest rate of 2% reported in a longitudinal study was possibly due to potential underreporting as 74% of the included women were employed and thus less likely to stay in bed and miss work, which is used to define severe pain in the study (37). The

prevalence of severe pain reported in this review appears to be higher than the 12%–14% reported in community-based studies in the World Health Organization review (4) but comparable with 5%–20% reported in another review of the condition in developing countries (38). Weissman et al. (37) found that dysmenorrhea persisted over the 6-year follow-up among the majority of women reporting it at baseline, and improvement or worsening of the symptom was equally likely. In their multivariable analysis, the presence of dysmenorrhea at baseline (excluding women with severe dysmenorrhea) was a strong predictor of reporting moderate or severe dysmenorrhea at follow-up (odds ratio = 7.48, 95% CI: 3.09, 18.15). More studies are needed to explore the natural history of the symptom.

Despite some disagreement, the majority of the previous literature generally demonstrates an inverse association between both age and parity and dysmenorrhea (10, 13–15, 41). This association was confirmed by the vast majority of studies included in this review, consistent across different types of study, although 3 studies failed to adjust for parity in their analysis on the association between age and dysmenorrhea (30, 32, 34). The systematic review (40) also supported the association. Interestingly, Burnett et al. (26) found that the effect of age remained in the adjusted model including nulliparity, whereas the association between nulliparity and primary dysmenorrhea was no longer significant when controlled for age and smoking ($\beta = 0.93$; $P = 0.582$). It is unclear though what the proportion of nulliparous women was in the study. Furthermore, the study did find that the women most debilitated by pain were significantly more likely to be nulliparous. Nevertheless, the longitudinal study by Weissman et al. (37) provides stronger support for the inverse association between both age (odds ratio = 0.92, 95% CI: 0.86, 0.98) and livebirth (odds ratio = 0.20, 95% CI: 0.08, 0.53) and the severity of dysmenorrhea after controlling for each other; however, parity clearly had a much stronger effect in their analysis. In addition, the study also found that gravidity was less influential than livebirth, consistent with other studies showing no effect from pregnancies ending in miscarriage or abortion (15, 41).

Different mechanisms have been proposed for the relation between livebirth and dysmenorrhea. One is related to the pathogenesis of primary dysmenorrhea of the close association with elevated prostaglandin levels in the secretory endometrium that triggers pain (1, 42). After a term delivery, the endometrium may release a lower level of prostaglandins, resulting in decreased pain (41). Another hypothesis is that neuronal degeneration in the uterus following term pregnancy, due to disappearance of uterine adrenergic nerves and a decrease in uterine noradrenaline in the third trimester of pregnancy, may explain the disappearance or reduction of menstrual pain after childbirth (15).

A strong effect of family history of dysmenorrhea and risk of dysmenorrhea was shown in 2 studies, which is in line with some previous studies reporting a similar association, suggesting genetic susceptibility to dysmenorrhea among women with variant genotypes in a number of metabolic gene polymorphisms (20, 43). However, other possible explanations are that the association could be related to conditioned behavior that is learned from mother or sisters for the possibility of societal reward or that control for pain exists (1). Alternatively, it could be simply due to similar living patterns and lifestyles in the families (34).

Among the range of lifestyle and other demographic factors studied such as smoking, body mass index, and socioeconomic status, conflicting results were shown. Previous studies on the association between smoking and dysmenorrhea are mixed. Although most cross-sectional studies show an increased risk among smokers (13, 14, 16), a negative effect was also seen (44). Inconsistent results have also been observed for smoking and the incidence or the severity of dysmenorrhea in longitudinal studies (15, 18). Sundell et al. (15) found that the prevalence and severity of dysmenorrhea were increased in smokers and that the severity increased with the number of cigarettes smoked per day. On the other hand, Harlow and Park (18) found that smoking was not associated with the probability of having pain or severe cramps but, among those with pain, smokers were more likely to have pain lasting longer than 2 days. Similarly, being overweight was found to be an important risk factor for the probability of experiencing pain and for increasing duration of pain in 1 longitudinal study (18), and severity of dysmenorrhea was not associated with either height or weight in another (15). The systematic review also failed to detect a significant association between obesity and dysmenorrhea in the pooled analysis of 5 studies (40). No association was shown among women's education, marital status, alcohol use, and the risk of dysmenorrhea in the current review, which is supported by the recent systematic review identified (40) and previous studies (14, 17, 18). However, caution should apply when interpreting the systematic review results, as heterogeneity was present in all analyses with multiple studies, and the review is based largely on case-control studies that are subject to recall bias.

A protective effect of OCPs or other forms of hormonal contraceptive for dysmenorrhea is evident in the majority of previous studies (10, 13–15, 21), consistent across different study types. This is largely confirmed by the current review, although 1 of the studies on a large sample of Indian women did not show any significant association between different methods of contraception, including OCPs, and moderate to severe dysmenorrhea (3). The reason for this discrepancy may be due to the small number of women using OCPs ($n = 43$) in the study. There is evidence suggesting an association between early age at menarche and increased risk of dysmenorrhea (15, 18, 19), which is supported by the systematic review (40). However, most of the studies reporting it in this review failed to show an association (26, 31, 35) with the exception of the Indian study (3). The reason for the discrepancy is not readily apparent, and the association may be confounded or mediated by other factors. Furthermore, although there is suggestion of some associations of other reproductive factors such as age at first birth, cesarean section, and heavy and irregular menses (14, 18, 41), this review is unable to reach any firm conclusion because of the limited number of studies reporting these effects.

Among the psychological factors studied, a positive association between perceived stress, related to work or general life events, and the risk of dysmenorrhea was shown in most included studies (1 longitudinal and 3 cross-sectional).

Similar results have been reported by previous studies (22, 45). The biological mechanism for association between work stress and dysmenorrhea is not well understood, although potentially through a cascade of neuroendocrine responses (36). Stress inhibits the release of follicle-stimulating hormone and luteinizing hormone, leading to impaired follicular development. This can alter progesterone synthesis and release, which may influence the activity of prostaglandin. Besides progesterone, stress-related hormones, including adrenaline and cortisol, also appear to influence prostaglandin synthesis and/or binding in the myometrium (36). Furthermore, mental health may act as a mediator in the relationship between stress and dysmenorrhea, with high job stress increasing the risk of mental health morbidity, which in turn is positively related to painful menses (28).

Of note is that these studies were generally conducted on groups of employed women, whereas another included cross-sectional study of a random sample of Iranian women did not observe a significant association between stress level and the severity of pain in the adjusted analysis (34). One possible explanation for the discrepancy is that this random sample of Iranian women, most of whom are younger than 30 years with no children, with college or higher education, and from a higher socioeconomic class, may be quite different from those employed women included in most other studies. The other explanation may be that this study has a relatively small sample size ($n = 276$), coupled with ordinal logistic regression analyses used to examine the association between multiple levels of stress and severity of pain; thus, the study may be underpowered to detect a difference. Consistent with other studies (9, 46), this review study suggested positive associations for depression and somatization with dysmenorrhea; however, no meaningful conclusion can be made because of the limited number of studies reporting them.

There are a number of limitations to this review. As it is not a systematic review, there is the potential to miss some relevant studies. By adopting a comprehensive approach through literature search and scan of reference lists, we hope to limit the impact of this. A narrative approach was used for this review instead of a meta-analysis, because of the profound heterogeneity in study populations, definition of dysmenorrhea, and measurements of risk factors among the included studies. Only a limited number of studies were included in this review because of restrictions on study design and year of publication, which may in turn limit the ability to detect a true association between the risk factors and dysmenorrhea. However, given that the 2006 systematic review by Latthe et al. (40) has covered studies published up to 2002, it is unlikely that any important study to address our research purpose has been missed. As the main objective of the study is to get a true picture of dysmenorrhea in the community, only representative community samples may give accurate estimates of the problem.

From conducting this review, we highlight a few issues that deserve further research effort: better quality population-based longitudinal studies on the natural history of dysmenorrhea and on the effect of its risk factors across the reproductive life course; epidemiologic studies of age-specific incidence and prevalence of dysmenorrhea; more standardized measurement of common risk factors useful for potential meta-analysis to estimate the true effect size; and more comprehensive reporting of study results (can be supplementary material due to space limitations).

In conclusion, this review shows that dysmenorrhea is a significant symptom for a large proportion of women throughout the reproductive years. Severe dysmenorrhea limiting daily activities is much less common. Improvement of the symptom over time has been observed, although many women also experience unchanged or worse symptoms. From longitudinal or population data, this review has confirmed the following:

- Dysmenorrhea is inversely related to age, parity or number of livebirths, and oral contraception use;
- Dysmenorrhea is positively associated with stress related to both work and general life, as well as with family history of dysmenorrhea.

However, uncertainty still remains for a number of lifestyle factors, such as smoking, obesity and diet, psychological factors, and environmental factors. Furthermore, there is a lack of longitudinal data to study the natural history of dysmenorrhea and the effects of a range of modifiable risk factors over time. More research on these from population-based, prospective, longitudinal studies to generate robust evidence will help to support targeted preventive interventions.

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