The prevalence of menstrual disorders and premenstrual syndrome among adolescent girls living in North Borneo, Malaysia: a questionnaire-based study

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Abstract

\textbf{Background:} This study aimed to determine menstrual characteristics and related morbidities among adolescent girls living in Sabah, North Borneo, a less-developed state in Malaysia.

\textbf{Methods:} Data were obtained from a quantitative survey conducted in three government high schools located in Ranau, Sabah. The participants were adolescent girls who had attained menarche between the ages of 14 and 19.

\textbf{Results:} Based on the analysis of questionnaires completed by 757 adolescent girls, the mean age at the time of the survey was 17 ± 1.4 years, and the mean menarche age was 12.2 ± 1.1 years. Our data demonstrated that 85.7% of the participants experienced dysmenorrhoea, of which at least 42.1% (mean pain score ± SD: 4.81 ± 0.76, 95% confidence interval (CI) 4.72, 4.90) experienced moderate dysmenorrhoea, and 11.2% (mean pain score ± SD: 7.86 ± 0.94, 95% CI 7.64, 8.08) experienced severe dysmenorrhoea. Over 70% of these girls complained of tiredness, headache, and appetite changes during menses.

\textbf{Conclusions:} The prevalence of menstrual disorders and related morbidities was high among the girls residing in Sabah. Reproductive health issues in rural and socioeconomically deprived areas remains poorly addressed. The main consequence of neglecting menstrual disorders and their related morbidities is impaired future sexual reproductive health in adults. Thus, addressing adolescent reproductive health issues is crucial, especially for girls living in areas where access to healthcare is difficult. The information gathered from this study can be used to strategize effective interventions to improve adolescents’ reproductive health status in rural areas.

\textbf{Keywords:} Adolescents, Dysmenorrhoea, Premenstrual syndrome, Reproductive health, Rural population

Background

According to the World Health Organization (WHO), adolescents are individuals aged between 10 and 19 years [1]. Secondary sexual characteristics, sexual maturation, and reproductive capacity are usually attained in this age range. In girls, ovulation and menstruation begin during this period [2–5] and are often accompanied by menstrual disorders and related morbidities [4–6].

Inequality in a country’s socioeconomic status can lead to progressive health issues [7]. In Malaysia, lower socioeconomic status is often more prevalent in rural areas [8]. The socioeconomic status of a population influences the prevalence of menstrual disorders and their associated...
morbidities [9–11]. Malaysia provides a unique setting for studying menstrual cycle characteristics. Malaysia is divided into two halves: the South China Sea peninsula and North Borneo states (Sabah and Sarawak). The gap in socioeconomic status between these two regions is huge [12, 13]. The peninsula is more populated and more socioeconomically developed than Sabah and Sarawak [13]. The poverty rates in Sabah and Sarawak were 8.1% and 2.4% in 2012, respectively, higher than most states in the peninsula [14]. Although Malaysia is relatively free from natural disasters, Sabah, the most impoverished state in Malaysia, was affected by a series of earthquakes in 2015, which further complicated its socioeconomic status.

Adolescent girls from urban areas and higher socioeconomic populations have a higher prevalence of menstrual disorders such as premenstrual syndrome and dysmenorrhoea [15–19]. Girls with menstrual disorders frequently report other concurrent somatic symptoms such as headaches, fatigue, and vomiting [20, 21]. This inevitably leads to increased over-the-counter drug usage, school absenteeism, and a poorer quality of life. Data retrieved from the Peninsula of Malaysia revealed that the prevalence of premenstrual syndrome and dysmenorrhoea exceeded 60% and 70%, respectively [15, 20, 23–28]. Compared to the rural states in the peninsula, girls from the metropolitan city of Kuala Lumpur had a higher prevalence of dysmenorrhoea and increased school absenteeism [20]. These findings are attributed to the fact that girls from rural areas are more accepting of their condition and more tolerant of pain than girls from urban areas [15, 16].

To date, no study has specifically evaluated menstrual patterns and related morbidities in girls living in Sabah. This study aimed to determine the menstrual characteristics and associated symptoms experienced by adolescent girls residing in Ranau, Sabah, a state below the poverty line and recently hit by multiple earthquakes. Achieving wholesome reproductive health in adolescents is crucial for ensuring a healthy reproductive system in adult women [27]. Therefore, addressing the menstrual challenges faced by rural girls should be prioritised, because healthcare facilities and their related resources may not be easily accessible.

Methods
Subjects and settings
This questionnaire-based study was conducted in Ranau, a district on the west coast of Sabah in North Borneo, Malaysia. After obtaining approval from the Department of Education in Sabah and Malaysia’s Ministry of Education, three schools were randomly selected using computer-generated randomisation. The sample size for this study was calculated using the Kish formula for prevalence objectives [29]. With an assumption of 75% prevalence of menstrual disorders among adolescents, the required sample size was approximately 750 [24, 25, 28]. We met with school principals to explain the purpose of this study. The names of each school and student were kept confidential by replacing them with their serial numbers. Student participation was voluntary, and the research activities did not disrupt the school activities or teaching sessions. Three schools agreed to participate and female students who had attained menarche were approached. Two research trips were conducted between January 4th and February 2nd, 2016. The schoolgirls were given an information sheet and a parental consent form. Those who returned the parental consent form were recruited and assembled in the school hall during two visits. The principal investigator provided a brief explanation of the study and described the contents of the questionnaire. When completing the questionnaires in the hall, the participants were encouraged to clarify any doubts pertaining to the questions by asking one of the six gynaecologically-trained, on-site research assistants. All completed questionnaires were collected from students before leaving the hall to obtain the highest possible response rate.

Questionnaire
The questionnaires used in this study were adapted from Parker et al. [30] and were prepared in two languages: English and Malay. The questionnaires were composed of five sections: Sect. 1 gathered general information, including date of birth, age at menarche, height, and weight. Sections 2 and 3 collected data regarding menstrual patterns and somatic symptoms related to menses, respectively. Section 4 collected the students’ perceptions towards their menses, and the final section identified allergies and intolerance to any food during menses. The validated English version of the questionnaire was translated into the Malay language. The Malay version of the questionnaire was verified via back-translation by an expert from the Faculty of Language and Linguistics at the University of Malaya. It was pre-tested with 20 students prior to the actual study.

Ethical oversight
Ethical insights were provided by the University of Malaya Medical Research Ethical Committee (MREC no. 20157-1601) on September 7th, 2015.

Statistical analysis
The data were analysed using SPSS Statistics for Windows, version 17.0 (SPSS Inc., Chicago, Ill., USA). The mean value was used for normally distributed continuous variables. The standard deviation (SD), a summary measure of the differences between each observation and the
mean, was also calculated. The 95% confidence interval (CI) was calculated for each independent variable.

**Results**
At the time of the study, 1814 female students attended the three participant schools in the Ranau District of Sabah. A total of 781 questionnaires were distributed to students who volunteered to participate. Of the distributed questionnaires, 24 were incomplete or were blank. Therefore, this cross-sectional study gathered data from 757 students with a response rate of 96.9%. The mean age of the participants was $17 \pm 1.4$ years, whereas $12.2 \pm 1.1$ years was the mean age of menarche. Demographic characteristics of the participants are presented in Table 1.

**Typical menstrual bleeding characteristics**
Figure 1 illustrates the number of bleeding days in each cycle (Fig. 1a), cycle length (Fig. 1b), and heaviest menstrual flow based on the menstrual day (Fig. 1c). The majority of participants experienced a normal number of bleeding days per cycle, with a mean of $6.32 \pm 1.56$ days. Approximately 7.0% ($n = 53/757$) of the students experienced bleeding for $\geq 10$ days (Fig. 1a). 39.4% ($n = 299/757$) of students were able to report their menstrual cycle length. From this number, 190 students reported having a regular menstrual cycle of between 27 and 30 days. Meanwhile, 61 students reported that their menstrual cycles exceeded 30 days, as illustrated in Fig. 1b. The heaviest menstrual bleeding was reported between day two and three of their menses (Fig. 1c).

**Dysmenorrhoea**
Dysmenorrhoea was reported by 85.7% ($n = 648/756$) of students, causing 16.9% ($n = 110/648$) to skip school. Severity of dysmenorrhoea was categorised according to a rating scale from 0 to 10; no/mild pain (0–3), moderate (4–7), and severe (8–10). Seventy-three students (11.2%) experienced severe dysmenorrhoea with a mean pain score of $7.86 \pm 0.94$ (95% CI 7.64, 8.08). Meanwhile, 273 students stated that they experienced moderate dysmenorrhoea with a mean pain score of $4.81 \pm 0.76$ (95% CI 4.72, 4.90), as illustrated in Table 2. However, only 8.3% ($n = 54/648$) of students who experienced menstrual-related pain consumed oral analgesia or regular hormonal pills to control pain. Among those who required analgesia, the preferred choices were paracetamol (85.2%) and nonsteroidal anti-inflammatory drugs (7.4%) (Fig. 2). Apart from pain, the top three reasons for not attending school were heavy menstrual bleeding (0.03%), nausea, and vomiting (0.01%).

**Menstrual-related symptoms**
The top ten symptoms related to menstruation documented by the students were tiredness, change in appetite, headache, depression, frequent urination, bloating, pelvic pain, farting pain, vomiting, and anal bleeding, as described in Table 3. In particular, 82.5% ($n = 623/755$) of the girls complained of tiredness during menses, 75.7% ($n = 569/751$) observed a change in their appetite, and 69.2% ($n = 522/754$) experienced headaches during their bleeding days. Over half of the participants reported feeling depressed and/or experiencing increased urination (Table 3).

**Diagnosis and discussion of dysmenorrhoea**
Regarding the diagnosis and investigation of dysmenorrhoea, 62 (8.2%) students consulted their general practitioner, 15 (1.9%) girls visited a gynaecologist, and 25 (3.3%) sought aid from traditional healers in their villages. Eighteen students reported menstrual pain. Blood tests and ultrasonography were performed in nine and three students, respectively, and six students had undergone surgery for pain. Additionally, majority of the students discussed menstrual issues with their friends (72.5%, $n = 549/757$) and family (60.8%, $n = 460/757$), instead of consulting their teachers or counsellors (4.6%, $n = 35/756$).

**Discussion**
Our data showed a dysmenorrhoea prevalence of 85.7% among our participants, with more than half reporting moderate-to-severe pain. Additionally,
Fig. 1 Typical menstrual characteristics: a) Number of bleeding days per cycle, b) Length of menstrual cycle and c) Heaviest menstrual flow based on menstrual day

Table 2 Prevalence and the severity of dysmenorrhea

| Prevalence of dysmenorrhea, n = 756 |
|------------------------------------|
| No, n (%)                         | 108 | 14.3 |
| Yes, n (%)                        | 648 | 85.7 |

| Severity of dysmenorrhea breakdown, n = 648 |
|--------------------------------------------|
| n (%)       | Mean | SD     | 95%CI     |
| Severe       | 73 (11.2)| 7.86   | 0.94 | 7.64 | 8.08 |
| Moderate     | 273 (42.1)| 4.81   | 0.76 | 4.72 | 4.90 |
| Mild         | 302 (46.6)| 2.00   | 0.79 | 1.91 | 2.09 |
menstruation-related somatic symptoms, such as tiredness, changes in appetite, and headache, were common complaints.

The prevalence of dysmenorrhoea among adolescents worldwide varies between 16 and 93% [31, 32] and is greatly influenced by geographic location. For example, the prevalence of dysmenorrhoea is 94% in Oman, 59.8% in Bangladesh, 34% in Egypt, and 0.9% in Korea [32]. In the present study, 85.7% of participants experienced dysmenorrhoea. The study participants had a higher prevalence of dysmenorrhoea than their counterparts living in the Malaysian Peninsula. For example, the prevalence in Negeri Sembilan was 67.7% [23], 76.6% in Kelantan [24], and between 63.9 and 74.5% in the metropolitan city of Kuala Lumpur [25, 28] (Table 4).

The findings reported in this study contradict the notion highlighted in other studies that rural girls suffer fewer menstrual disorders than urban girls [16–18, 20]. There are several possible explanations for this discrepancy in the results. First, the studies conducted on the Peninsula of Malaysia involved younger adolescents (mean age 15 years), whereas the mean age of the participants in the present study was 17 years. Interestingly, the prevalence of dysmenorrhoea increases with increasing gynaecological age (age after menarche) [33, 34].

### Table 3: Top ten symptoms reported

| Symptoms            | Frequency, n (%) | Number of respondents, n | Missing data, n | 95% CI       |
|---------------------|------------------|--------------------------|-----------------|-------------|
| Tiredness           | 623 (82.5)       | 755                      | 2               | 0.80, 0.85  |
| Change of appetite  | 569 (75.7)       | 751                      | 6               | 0.73, 0.71  |
| Headache            | 522 (69.2)       | 754                      | 3               | 0.66, 0.71  |
| Depression          | 426 (56.4)       | 755                      | 2               | 0.53, 0.58  |
| Frequent urination  | 412 (54.7)       | 752                      | 5               | 0.52, 0.57  |
| Bloating            | 198 (26.5)       | 747                      | 10              | 0.23, 0.28  |
| Pelvic pain         | 178 (24.1)       | 719                      | 38              | 0.22, 0.26  |
| Farting pain        | 101 (13.9)       | 726                      | 31              | 0.12, 0.15  |
| Vomiting            | 53 (7.0)         | 755                      | 2               | 0.05, 0.07  |
| Anal bleeding       | 47 (6.3)         | 747                      | 10              | 0.04, 0.07  |

The over-the-counter drugs used among participants who required medication for dysmenorrhoea are shown in Fig. 2. The top ten symptoms reported are listed in Table 3.
Additionally, our study also noted that the girls living in Kuala Lumpur was lower (75.4% and 38.4%, respectively) [20].

Fatigue and headache, among girls residing in Kuala Lumpur, contributed to the prevalence of such somatic symptoms, particularly change in appetite (75.7%) during menstruation. In contrast, girls living in Sabah consumed oral analgesia. In addition to relieving menstrual pain [20], whereas only 8.3% of young girls in Sabah consumed oral analgesia. In addition to dysmenorrhoea, the prevalence of somatic symptoms during menstruation was equally high among our study participants. In the present study, 82.5% of participants felt tired, suffered from headaches (69.2%), and noted a change in appetite (75.7%) during menses. In contrast, the prevalence of such somatic symptoms, particularly tiredness and headache, among girls residing in Kuala Lumpur was lower (75.4% and 38.4%, respectively) [20]. Additionally, our study also noted that the girls living in Sabah were also less likely to utilise health care services with only 10.1% of these girls receiving healthcare consultation or intervention.

There are several explanations for these health-seeking behaviours. First, the vast differences in pain self-management could be attributed to girls from rural areas being more resilient and having higher endurance of menstrual disorders [15, 16]. Additionally, these girls may perceive menstrual pain as a normal part of their menstrual cycle [24]. Adolescent girls may not be aware of the existence of dedicated adolescent healthcare services available to them [24, 40]. Those who were aware of such health care services described embarrassment and lack of confidentiality as some of the major barriers to the utilisation of health care services for their sexual reproductive health [39–41]. Many find it difficult or uncomfortable to discuss menstruation-related issues, suggesting that sexually related topics are sensitive to Malaysian culture [40].

Second, due to their remoteness and diversity in language, ethnicity, and cultural background, people in Sabah face healthcare challenges [39, 42] including poor access to healthcare [43] and poor awareness of many non-communicable and communicable diseases [44]. A recent study has demonstrated that the utilisation of healthcare services in rural areas of Sabah was 48% as compared to 67.7% in peninsular Malaysia, which is attributed to the longer travel time and distance to assess healthcare [45]. When coupled with the lack of knowledge and awareness of health problems related to menstruation among these girls, they experience further reduction in the utilisation of health care services [40, 46]. Finally, the Ministry of Health, Malaysia has reported that current adolescent health services in Malaysia are not adolescent-friendly [47] and are therefore underutilized [40, 47]. Negative attitudes of healthcare providers and lack of privacy [41] were identified as some of the major barriers to the utilisation of adolescent health services. When dealing with adolescents, highly trained, knowledgeable, and competent professionals

### Table 4 Prevalence reported of dysmenorrhoea in adolescents living in the peninsula of Malaysia

| Authors            | Year of publication | Location of study       | Poverty rate in study area (%)(approximately) | Subject age (mean ± SD and/or range) | Sample size | Prevalence of dysmenorrhoea (%) |
|--------------------|---------------------|-------------------------|---------------------------------------------|-------------------------------------|-------------|----------------------------------|
| Wong et al. [20]   | 2010                | Kuala Lumpur            | 1.1                                         | 15.19 ± 1.39 (13–19)                 | 1092        | 46.9                             |
| Lee et al. [23]    | 2003                | 7 districts in Negeri sembilan | 0.7                                         | 15.4 ± 1.8                          | 2411        | 67.7                             |
| Wong et al. [24]   | 2011                | 2 districts in Kelantan | 2.7                                         | 15.28 ± 1.45 (13–19)                | 1295        | 76.1                             |
| Wong et al. [25]   | 2009                | Kuala Lumpur            | 1.1                                         | 15.19 ± 1.39                        | 1075        | 74.5                             |
| Liliwati et al. [26] | 2007            | Hulu Langat, Selangor  | 0.8                                         | 12–17                               | 300         | 62.3                             |
| Mariappan y [28]  | 2022                | Kuala Lumpur            | 1.1                                         | 12.14 ± 1.11                        | 729         | 63.9                             |
are significantly better at relating to adolescents. Engaging with adolescents in managing their health problems requires training of various levels of healthcare personnel [47]. Unfortunately, only 4.62% of the Ministry of Health’s budget was dedicated to healthcare personnel training programs in adolescent health [48].

During a focus group discussion among girls residing in rural and urban areas across the Malaysian Peninsula, urban girls commonly cited their mothers, sisters, peers, and teachers as sources of information about menstruation-related matters [15]. However, the participants preferred discussing menstrual-related matters with their peers. Similarly, those from rural areas admitted feeling embarrassed to discuss menstrual-related issues with their mothers and sisters, and thus prefer to talk about it with a friend [20]. A similar outcome was observed in the present study. It is clear that between sophomore (15–16 years old) to senior year (17–18 years old) communication and support transitions from mothers to friends [49].

To the best of our knowledge, this study is the first to describe menstrual characteristics and related morbidities in adolescent girls living in North Borneo, Malaysia. This study provides evidence that there is an urgent need to effectively address and develop interventions to improve the reproductive-related health status among rural girls in Sabah. However, the results of this study should be interpreted with caution because of the small number of participants. Therefore, it does not represent the entire state of Sabah, which has 219 government high schools covering an area of 73,631 km². Additionally, in this study, primary and secondary dysmenorrhoea and participants’ socioeconomic status were not differentiated or recorded.

Despite the governments’ best efforts, healthcare facilities, healthcare provider training, and other associated resources are still lacking [42, 43]. WHO recommends improving the quality of health service provision to adolescents by developing an adolescent-friendly national quality standard of care [50]. However, implementing such programs requires a deeper understanding of the issue [51]. This study provides insights into reproductive health challenges faced by adolescent girls in Sabah.

Conclusion
In conclusion, girls residing in Sabah reported a higher prevalence of dysmenorrhoea with several menstruation-related somatic symptoms than their peninsular counterparts. Girls living in the Peninsula of Malaysia have better accessibility to essential sexual reproductive health information and specialist healthcare, and girls from Sabah lack these privileges. Information gathered from this study is required to strategize an effective intervention to improve adolescents’ reproductive health status in rural areas, where reproductive health care, education, and essential information are sparse.

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Author contributions
JMKA, LKL, NR, SS, and JH conceived and designed the study. JMKA, LKL, NR, SS, AVAW, ASAA, and JH distributed the questionnaires and collected data. JMKA and LKL analysed the data. JMKA, LKL and JH wrote the manuscript. All authors have read and approved the final manuscript.

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Availability of data and materials
The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

Declarations
Ethical approval and consent to participate
This study was conducted in accordance with the Declaration of Helsinki (2000) for human studies. Informed consent was obtained from all female students or from parents and/or legal guardians of those under the age of 16. This study was registered and approved by the Medical Research Ethics Committee of the University Malaya Medical Centre (MREC no. 20157-1601. Date: 7/09/2015). Prior to the study, written informed consent while providing treatment was obtained from all participants or from a parent and/or legal guardian for those under the age of 16 years.

Consent for publication
Not applicable.

Competing interests
All authors declare no competing interests.

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References
1. World Health Organization. WHO factsheets on women’s health. http://www.who.int/mediacentre/factsheets/fs334/en/ (2009). Accessed 1 Jan 2021.
2. Talbert LM, Hammond MG, Groff T, Udny JR. Relationship of age and pubertal development to ovulation in adolescent girls. Obstet Gynecol. 1985;66:542–4.
3. Carlson LJ, Shaw ND. Development of ovulatory menstrual cycles in adolescent girls. J Pediatr Adolesc Gynec. 2019;32:249–53.
4. Williams CE, Creighton SM. Menstrual disorders in adolescents: review of current practice. Horm Res Paediatr. 2012;78:135–43.
5. American Academy of Pediatrics Committee on Adolescence, American College of Obstetricians and Gynecologists Committee on
Adolescent Health Care, Diaz A, Lauffer MR, Breech LL. Menstruation in girls and adolescents: using the menstrual cycle as a vital sign. Pediatrics. 2006;118:2245–50.
6. Rigon F, Sanctis VD, Bernasconi S, Bianchini L, Bona G, Bozzola M, et al. Menstrual pattern and menstrual disorders among adolescents: an update of the Italian data. Ital J Pediatr. 2012;38:38.
7. Robertson T, Batty GD, Der G, Fenton C, Shiels PG, Benzeval M. Is socio-economic status associated with biological aging as measured by telomere length? Epidemiol Rev. 2012;35:98–111.
8. Shahar S, Vanoh D, Mat Ludin AF, Singh DKA, Hamid TA. Factors associated with poor socio-economic status among Malaysian older adults: an analysis according to urban and rural settings. BMC Public Health. 2019;19(Suppl 4):549.
9. Latthe P, Latthe M, Say L, Gülmezoglu M, Khan KS. WHO systematic review of prevalence of chronic pelvic pain: a neglected reproductive health morbidity. BMC Public Health. 2006;6:177.
10. Ju H, Jones M, Mishra G. The prevalence and risk factors of dysmenorrhea. Epidemiol Rev. 2014;36:104–13.
11. Sanjay S, Ray S. Variation in the menstrual characteristics in adolescents of West Bengal. Singap Med J. 2008;49:542–50.
12. Islam R, Ghani ABHA, Abidin ISZ, Rayaiappan JM. Impact on poverty and income inequality in Malaysia’s economic growth. Probl Perspect Manag. 2017;15:53–62.
13. Mariapun J, Hairi NN, Ng CW. Are the poor dying younger in Malaysia? An examination of the socio-economic gradient in mortality. PLoS ONE. 2016;11:e0158685.
14. Department of Statistics Malaysia. Higher Household Income, Lower Poverty Rates. https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=1&VbJbuxzIWo6k3FfEaw22m1Uv42FQ2zZo9 (2012). Accessed 1 Jan 2021.
15. Wong LP. Premenstrual syndrome and dysmenorrhea: urban-rural and multiethnic differences in perception, impacts, and treatment seeking. J Pediatr Adolesc Gynecol. 2011;24:272–7.
16. Avasarala AK, Panchangam S. Dysmenorrhea in different settings: are the rural and urban adolescent girls perceiving and managing the dysmenorrhea problem differently? Indian J Community Med. 2008;33:246–9.
17. El-Gilany AH, Badawi K, El-Fedawy S. Epidemiology of dysmenorrhea among adolescent students in Mansoura, Egypt. East Mediterr Health J. 2005;11:155–63.
18. Zegeye DT, Megabiaw B, Mulu A. Age at menarche and the menstrual pattern of secondary school adolescents in northwest Ethiopia. BMC Womens Health. 2009;9:29.
19. Rani A, Sharma MK, Singh A. Practices and perceptions of adolescent girls regarding the impact of dysmenorrhea on their routine life: a comparative study in the urban, rural, and slum areas of Chandigarh. Int J Adolesc Med Health. 2016;28:3–9.
20. Wong LP, Khoo EM. Menstrual-related attitudes and symptoms among multi-racial Asian adolescent females. Int J Behav Med. 2011;18:246–53.
21. Bianchini L, Bozzola M, Pier AB, Bernasconi S, Bona G, Buzzi F, et al. Menstrual cycle and headache in teenagers. Indian J Pediatr. 2019;86(Suppl 1):25–33.
22. Sodeman L, Edlund M, Marions L. Prevalence and impact of dysmenorrhea in Swedish adolescents. Acta Obstet Gynecol Scand. 2019;98:215–21.
23. Lee UK, Chen PC, Lee KK. Kaur J. Menstruation among adolescent girls in Malaysia: a cross-sectional school survey. Singap Med J. 2006;47:869–74.
24. Wong LP. Attitudes towards dysmenorrhea, impact and treatment seeking among adolescent girls: a rural school-based survey. Aust J Rural Health. 2011;19:218–23.
25. Wong LP, Khoo EM. Dysmenorrhea in a multiethnic population of adolescent Asian girls. Int J Gynaecol Obstet. 2010;108:139–42.
26. Lilliwar J, Verna L, Khariani O. Dysmenorrhea and its effects on school activities among adolescent girls in a rural school in Selangor. Malays Med Health. 2007;2:42–7.
27. Azurah AGN, Sanci L, Moore E, Grover S. The quality of life of adolescents with menstrual problems. J Pediatr Adolesc Gynecol. 2013;26:102–8.
28. Mariappan U, Chew KT, Zainuddin AA, Mahdy ZA, Abdul Ghani NA, Grover S. Quality of life of adolescents with menstrual problems in Klang Valley, Malaysia: a school population-based cross-sectional study. BMJ Open. 2020;12(1):e051896.
29. Kish L. Survey sampling. New York: Wiley; 1965. p. 78–94.
30. Parker MA, Sneddon AE, Arbon P. The menstrual disorder of teenagers (MDOT) study: determining typical menstrual patterns and menstrual disturbance in a large population-based study of Australian teenagers. BJOG. 2010;117:185–92.
31. Ravi R, Shah P, Palani G, Edward S, Sathyasekaran BW. Prevalence of menstrual problems among adolescent school girls in rural Tamil Nadu. J Pediatr Adolesc Gynecol. 2016;29:571–6.
32. Sanctis VD, Sollman A, Bernasconi S, Bianchini L, Bona G, Bozzola M, et al. Primary dysmenorrhea in adolescents: prevalence, impact and recent knowledge. Pediatr Endocrinol Rev. 2015;13:512–20.
33. Kazama M, Maruyama K, Nakamura K. Prevalence of dysmenorrhea and its correlating lifestyle factors in Japanese female junior high school students. Tohoku J Exp Med. 2015;236:107–13.
34. Agarwal A, Venkat A. Questionnaire study on menstrual disorders in adolescent girls in Singapore. J Pediatr Adolesc Gynecol. 2009;22:365–71.
35. Valvaikas KS, Shah HK. An urban–rural comparison of menstrual pattern and menstrual problems among school-going girls. Int J Med Sci Public Health. 2016;5:2086–90.
36. Takeda T, Tadakawa M, Koga S, Nagase S, Yaegashi N. Relationship between dysmenorrhea and post-traumatic stress disorder in Japanese high school students 9 months after the Great East Japan Earthquake. J Pediatr Adolesc Gynecol. 2013;26:355–7.
37. von Känel R, Hepp U, Kraemer B, Traber R, Keel M, Mica L, Schnyder U. Evidence for low-grade systemic proinflammatory activity in patients with posttraumatic stress disorder. J Psychiatr Res. 2007;41:744–52.
38. Wu MH, Lu CW, Chiang PC, Tsai SJ. Prostaglandin E2: the master of endometriosis? Exp Biol Med (Maywood). 2010;235:668–77.
39. Bahari F, Alim AC, Malek MDA, Madian L, Mutang JA, Sulaiman WAW. Effect of trauma distress, trauma dissociative experience, and satisfaction among earthquake victims in Sabah, Malaysia. Soc Sci. 2017;12:897–901.
40. Othman S, Kong S, Mydin FM, Ng C. Knowledge, utilization and barriers to primary care services for sexual and reproductive health among adolescent girls in secondary schools in Selangor, Malaysia. Malays Fam Physician. 2019;14:10–7.
41. Aida J, Azimah M, Radziwi Am, Iryan Yi, Ramli M, Khariarion O. Barriers to the utilization of primary care services for mental health problems among adolescents in a secondary school in Malaysia. Malays Fam Physician. 2010;3:31–5.
42. Dahluí M, Azzeri A, Zain MA, Mohd Noor Mi, Jaafar H, Then AYH, et al. Health status, healthcare utilization, and quality of life among the coastal communities in Sabah: protocol of a population-based survey. Medicine (Baltimore). 2020;99:22067.
43. Children Out of School. Malaysia, The Sabah Context—UNICEF. https://www.unicef.org/malaysia/media/921/file/Out%20of%20School%20in%20Kota%20Lidder%20%20OCS%20Accessible%20version.pdf (2015). Accessed 30 Mar 2021.
44. Harris H, Ooi YBH, Lee JS, Matanpur J. Non-communicable diseases among low income adults in rural coastal communities in Eastern Sabah, Malaysia. BMC Public Health. 2019;19(Suppl 4):554.
45. Tha NO, Shoesmith WD, Tan CBY, Ibrahim MY, Hussefn SS. Geographic accessibility of healthcare services and health seeking behaviours of rural communities in Kudat and Pitas areas of Sabah. BEJ. 2020;1:1.
46. Gundi M, Subramanya MA. Menstrual health communication among Indian adolescents: a mixed-methods study. PLoS ONE. 2019;14(10):e023923.
47. Awang H, Ab Rahman A, Sukeri S, Hashim N, Nik Abdul Rashid NR. Making health services adolescent-friendly in Northeastern Peninsular Malaysia: a mixed-methods study. Int J Environ Res Public Health. 2020;17(4):1323.
48. Ministry of Health National Adolescent Health Plan of Action. http://fh.moh.gov.my/v3/index.php/component/downloads/send/21-sektor-kesehatan-remaja/345-nahpoa-2015-2020. Accessed 11 Nov 2019.
49. Jones RM, Vaterlaus JM, Jackson MA, Morrill TB. (2014). Friendship characteristics, psychosocial development, and adolescent identity formation. Pers Relat. 2014;21:51–67.
50. Making health services adolescent friendly: developing national quality standards for adolescent friendly health services. https://apps.who.int/iris/bitstream/handle/10665/75217/9789241503594_eng.pdf. Accessed 30 Mar 2021.

51. Agampodi SB, Agampodi TC, Lkfd P. Adolescents perception of reproductive health care services in Sri Lanka. BMC Health Serv Res. 2008;8:98.

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