Progressing towards Adolescents' Ovulatory-menstrual Health Literacy:

A Systematic Literature Review of School-based Interventions

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Abstract

This study was designed to evaluate the extent to which school-based ovulatory-menstrual (OM) health interventions facilitate the Health Outcome Model's domains of health literacy. Electronic databases and grey literature sources were searched from 1980 to 2019. Findings from 16 studies of school-based OM health interventions (n=>8,800 adolescents aged 13 to 16 years) were collated. The results indicate that OM health education addresses the domains of health literacy to various degrees; critical health literacy skills are least often addressed. Future programs would benefit from positive teaching about the cycle as a health monitor and from engaging parents, and healthcare providers.

Key words: Education, Ovulation, Menstruation, Health Literacy, Dysmenorrhea, Premenstrual Syndrome

Introduction

The World Health Organization defined health literacy as "the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health" (World Health Organization [WHO], 2009 Track 2). The most noticeable event during the ovulatory-menstrual (OM) cycle is menstruation. However, it is ovulation preceding each menstruation which is the OM cycle's main event and its occurrence indicates good health (Vigil, 2019). Through these events, the OM cycle reflects a woman's personal health (Barron, 2013) because it shows how biofeedback mechanisms in anatomical, hormonal, and psychological systems auto regulate (Hillard, 2014). Women have OM cycles for many years, and OM-specific health literacy could enable them to obtain, understand, and apply information and skills to benefit their personal health.

OM health interventions are important for adolescent girls at the start of their reproductive lives because the slow maturation of their reproductive system (Hillard, 2008; Quint & Smith, 2003) can manifest common OM disturbances, such as dysmenorrhea, abnormal uterine bleeding, cycle irregularities, and premenstrual syndrome (PMS). Despite the association of OM disturbances with school absenteeism (Agarwal & Venkat, 2009; Armour, Parry, Manohar, et al., 2019; Pitangui et al., 2013; Tadakawa, Takeda, Monma, Koga, & Yaegashi, 2016; Zannoni et al., 2014), body image concerns (Ambresin, Belanger, Chamay, Berchtold, & Narring, 2012), eating disorders (Abraham, Boyd, Lal, Luscombe, & Taylor, 2009; Drosdzol-Cop et al., 2017), mental health difficulties (Liu, Liu, Fan, & Jia, 2018; van Iersel, Kiesner, Pastore, & Scholte, 2016; Yu, Han, & Nam, 2017), and poor quality of life (Gallagher et al., 2018; Jones, Hall, Lashen, Balen, & Ledger, 2011; Knox, Nur Azurah, & Grover, 2015; Nur Azurah, Sanci, Moore, & Grover, 2013; Rapkin & Winer, 2009; Sveinsdóttir, 2018), only 5-34% of affected adolescents seek medical advice (Agarwal

& Venkat, 2009; Armour, Parry, Al-Dabbas, et al., 2019; Farquhar, Roberts, Okonkwo, & Stewart, 2009; Hillen, Grbavac, Johnston, Straton, & Keogh, 1999; Ortiz, Rangel-Flores, Carrillo-Alarcón, & Veras-Godoy, 2009; Parker, Sneddon, & Arbon, 2010; Pitangui et al., 2013; Subasinghe, Happo, Jayasinghe, Garland, & Wark, 2016; Yücel, Kendirci, & Gül, 2018). Variations in help-seeking behavior are likely to be a result of cultural differences and access to services in some settings. Furthermore, lack of knowledge about OM normality reduces the likelihood that adolescents will voice concerns (McShane et al., 2018). Without diagnosis and treatment, OM disorders worsen over time, as does any underlying pathology (Vigil, Ceric, Cortés, & Klaus, 2006), and the cycle itself can exacerbate existing diseases and disorders, such as acne, asthma, diabetes, irritable bowel syndrome and migraines (Pinkerton, Guico-Pabia, & Taylor, 2010).

Existing reviews of adolescents' OM cycle include menarche (Chang, Hayter, & Wu, 2010), menstrual disorders (Peacock, Alvi, & Mushtaq, 2012), anovulation (Rosenfield, 2013), and menstrual patterns (Gunn, Tsai, McRae, & Steinbeck, 2018). Reviews of adolescents' menstrual cycle-related knowledge include fertility awareness (Pedro, Brandão, Schmidt, Costa, & Martins, 2018) and self-care strategies (Armour, Parry, Al-Dabbas, et al., 2019). Two reviews of interventions focused on menstrual hygiene management (Hennegan & Montgomery, 2016; Sumpter & Torondel, 2013) but not on recognizing ovulation or on the management of OM disturbances. Furthermore, reviews indicate that adolescents' health literacy is an emerging field (Guo et al., 2018; Ormshaw, Paakkari, & Kannas, 2013; Sanders, Federico, Klass, Abrams, & Dreyer, 2009; Sansom-Daly et al., 2016).

We used the Health Outcome Model as a framework (Nutbeam, 2000) because it lends itself to health literacy as an outcome of education. This model describes how health literacy is realized after individuals sequentially and progressively acquire knowledge and skills in a hierarchy of three core domains: the functional health literacy domain (e.g., ability to find and understand information), the interactive health literacy domain (e.g., personal application of health knowledge and engagement with healthcare providers), and the critical health literacy domain (e.g., information appraisal, social awareness, understanding civic responsibilities) (Nutbeam, 2008, 2015; Ormshaw et al., 2013; Palumbo, 2017). The model's progression from the functional to the critical health literacy domains aligns with the trajectory of adolescent cognitive and social development (Sansom-Daly et al., 2016), which may explain its use in studies of young people (Fairbrother, Curtis, & Goyder, 2016; Wu et al., 2010). In addition, the model has been used as a foundation to construct several health literacy scales (Abel, Hofmann, Ackermann, Bucher, & Sakarya, 2015; Chinn & McCarthy, 2013; Guo et al., 2018; Ishikawa, Takeuchi & Yano, 2008; McDonald, Patterson, Costa, & Shepherd, 2016), including some to help school teachers plan students' learning objectives and then assess their students' achievement of health literacy (Paakkari & Paakkari, 2012). For example, Western Australian schools base the assessment, standards, and reporting of their Health and Physical Education curricula on this model (School Curriculum and Standards Authority [SCSA], 2017).

Our research question was the extent to which school-based OM health interventions enabled 13-16-year-old girls to gain OM health literacy. To our knowledge, this is the first systematic literature review on this topic.

Method

Search Strategy

We followed accepted methodologies for systematic literature reviews (Pati & Lorusso, 2018), and the study was conducted and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Moher, Liberati, Tetzlaff, & Altman, 2009).

The search strategy followed the PICO framework to list the keywords for Population and Problem, Interventions, Comparison or Control groups, and measured Outcomes (Schardt, Adams, Owens, Keitz, & Fontelo, 2007). These headings and their keywords are listed in Table 1, and they were combined with Boolean Operators and truncations. An iterative search was conducted of the CINAHL, Informit, OVID, Medline, ProQuest, ScienceDirect, Web of Science, and Scopus databases. The timeframe searched was from 1980 to April 2019. The selection of 1980 was based on the publication of a mainstream text (Billings & Westmore, 1980) that explained ovulation identification by cervical mucus without recourse to inconvenient, invasive, and expensive assays. This was important because cervical mucus observations meant women could learn to self-determine their likely day of ovulation (Ecochard, Duterque, Leiva, Bouchard, & Vigil, 2014; Fehring, 2002), which is the main event of the OM cycle (Vigil, 2019).

Articles were restricted to English language publications. Titles, keywords, abstracts, and full text were searched in each database. References of identified articles were searched for additional studies. Representatives of educational authorities (e.g., all-girls' school associations, providers of sexuality and relationship school programs) and reproductive health organizations (e.g., family planning associations, fertility awareness accreditation authorities) were approached via 120 websites and asked to identify grey literature on adolescent menstrual health programs.

Eligibility Criteria

The eligibility criteria were determined a priori in light of our aim to determine the extent to which OM health literacy had been acquired. Studies were considered for inclusion if the reports provided evidence of the impact of a school-based intervention that gave either detailed instruction on how to determine ovulation or how to manage at least one OM disturbance, such as dysmenorrhea, abnormal uterine bleeding, cycle irregularities, or PMS.

We focused on school-based programs because they have explicit learning objectives and expected learning outcomes (Paakkari & Paakkari, 2012). The population for inclusion was girls aged 13-16 years. Although menarche typically occurs around 12 years of age (Chrisler & Gorman, 2016), the immaturity of the hypothalamic-pituitary-ovarian axis means that adolescents' OM parameters are variable (Gunn et al., 2018). Therefore, early post-menarche cycles are mostly anovulatory (Carlson & Shaw, 2019), and cyclical regularity establishes about 1 year after menarche (Rosenfield, 2013). Therefore, the earliest age to discern possible ovulatory cycles is 13 years. Ovulatory cycles have been noted to coincide with the common OM disturbances of dysmenorrhea (French, 2008; Jamieson, 2015; Rigon et al., 2012) and PMS (Rapkin & Mikacich, 2013).

Studies were excluded if there was no evidence of impact or insufficient information to determine content, or if they focused on menstrual hygiene management. Settings outside of schools (e.g., religious groups, sports clubs) were excluded because they are unlikely to deliver formal health and science curricula that are overseen by professionals trained in pedagogy. Studies with only premenarcheal girls were excluded because the absence of OM cycles limits progression past functional health literacy: it is not possible to gather evidence of personal application of OM knowledge (for interactive health literacy) when OM cycles are not experienced.

Data Extraction

The titles identified by the search were screened for their adherence to the inclusion criteria, and duplicates and irrelevant articles were removed by the first author. Each author independently screened abstracts and then full texts for articles of probable inclusion. Consensus was reached through discussion. We used the PRISMA 2009 Checklist as a guide (Moher et al., 2009) to create a data extraction spreadsheet which included: authors; year; country; research design; participants' demographics; sample size and selection; educational program content; mode of teaching delivery; data collection instruments; statistical measures; and outcomes.

Data Synthesis

A data extraction spreadsheet based on the Health Outcome Model (Nutbeam, 2000) was developed to tabularize the articles for synthesis. Each article was assessed on outcomes measured for improved knowledge (functional health literacy), personal application of knowledge, improved attitudes, and increased help-seeking behaviors (interactive health literacy), and assessment of information appraisal (critical health literacy).

Results

The initial search produced 19,178 articles from the CINAHL, Informit, OVID, Medline, ProQuest, ScienceDirect, Web of Science, and Scopus databases; 14 from grey literature; and 19 from searching the references of the identified articles (n=19,211 total). After we removed duplicates (n=9,084), the articles were screened by title for relevance, which left 173 articles. Each author independently screened the abstracts for inclusion, which left 36 articles for full-text review (see Figure 1). Twenty articles were subsequently excluded because of inadequate data or methods; participants who were outside the eligible age range; they did not describe an educational intervention; or the intervention was menstrual hygiene management. This left 16 articles for analysis.

Study Characteristics

Table 2 describes the study characteristics and intervention aims and summarizes the outcome measures of the health literacy domains for each article. Studies from three middle-high income countries and six low-income countries from four continents are represented. One article reported randomized control trial registration (Akbarzadeh et al., 2018). The median sample size of students who participated in the interventions was 158 (range, 40-

3732), and the median hours of classroom teaching was 3 (range, 1-23). Figure 2 illustrates the focus of the school-based OM health interventions over time, from 1980 to 2019. In the first 25 years, there were three studies that predicated their interventions on ovulation awareness (Cabezón et al., 2005; Klaus et al., 1987; Roth, 1993), but none have been reported since then. From the year 2007 onward, studies focused on OM disturbances increased. Four studies covered dysmenorrhea exclusively (Bush, Brick, East, & Johnson, 2017; Chiou, Wang, & Yang, 2007; Savitha, Roopa, & Sridhara, 2016; Su & Lindell, 2016), and three included it with other disturbances (Fetohy, 2007; Haque, Rahman, Itsuko, Mutahara, & Sakisaka, 2014; Malathi, 2018). One study focused on polycystic ovarian syndrome (Suji, Kumari, & Santha, 2016), and four covered abnormal uterine bleeding or irregular cycles with other disturbances (Fakhri, Hamzehgardeshi, Golchin, & Komili, 2012; Fetohy, 2007; Haque et al., 2014; Malathi, 2018). Four studies covered PMS exclusively (Akbarzadeh et al., 2018; Chau & Chang, 1999; Kaur & Saini, 2016; Ramya, Rupavani, & Bupathy, 2014), and three included it with other disturbances (Fakhri et al., 2012; Haque et al., 2014; Malathi, 2018). In addition to the main program content, the interventions commonly included anatomy, physiology, cycle normality, hygiene, fertility, attitudes, beliefs, and lifestyle. No interventions covered both ovulation awareness and OM disturbances.

Risk of Bias

The Downs and Black (1998) checklist was modified to assess methodological quality across 20 items. The quality of the articles was determined by examining each of these 20 items and scoring it accordingly (see Table 3). The median score was 11.5 points of 24 (range 4-21). The small sample size of most studies limited their representativeness and impacted the power to detect effect.

There were only two randomized controlled trials (Akbarzadeh et al., 2018; Cabezón et al., 2005). One was a retrospective cohort study based on audit data and data from a single clinic (Bush et al., 2017). All other studies were quasi-experimental, with randomization in the school or class selection (Fetohy, 2007; Haque et al., 2014; Malathi, 2018) and allocation of students (Chiou et al., 2007; Roth, 1993; Savitha et al., 2016). Although the experimental studies included a process of randomization into the intervention groups, the lack of details about the sampling frames and the sampling techniques in these studies and in the retrospective cohort study (Bush et al., 2017) does not exclude the risk of selection bias (Higgins & Green, 2008). Four studies were post-test only (Bush et al., 2017; Cabezón et al., 2005; Fakhri et al., 2012; Fetohy, 2007), and seven did not have control groups (Bush et al., 2017; Haque et al., 2014; Kaur & Saini, 2016; Malathi, 2018; Ramya et al., 2014; Roth, 1993; Savitha et al., 2016), which eliminated the standards against which comparison could be made. Nine studies had controls (Akbarzadeh et al., 2018; Cabezón et al., 2005; Chau & Chang, 1999; Chiou et al., 2007; Fakhri et al., 2012; Fetohy, 2007; Klaus et al., 1987; Su & Lindell, 2016; Suji et al., 2016), and Table 3 reports the comparability of intervention and control group characteristics at baseline. The random assignment of participants to either intervention or control groups within one school risked contamination because students exposed to the education program could share knowledge with friends or family in the control groups. This explains the zero score for two studies (Cabezón et al., 2005; Fetohy, 2007). Five studies reduced this risk by allocating intervention and control groups to separate schools (Chau & Chang, 1999; Chiou et al., 2007; Klaus et al., 1987; Su & Lindell, 2016; Suji et al., 2016). All studies had a high risk of bias due to blinding because it was not possible to conceal the intervention from those who provided or received the programs. Similarly, studies that showed health improvements (Akbarzadeh et al., 2018; Chau & Chang, 1999; Chiou et al., 2007; Fakhri et al., 2012; Haque et al., 2014; Ramya et al., 2014; Su & Lindell, 2016; Suji et al., 2016) were vulnerable to self-report biases and may have been influenced by the absence of blinding. In addition, no studies indicated attempts to blind those who measured the main outcomes.

Health Outcome Model

Table 2 shows the first two health literacy domains. Two studies provided evidence for all skills or attributes listed under both functional and interactive health literacy (Haque et al., 2014; Su & Lindell, 2016). Five studies demonstrated acquisition of functional health literacy and at least one skill or attribute of interactive health literacy (Bush et al., 2017; Chau & Chang, 1999; Chiou et al., 2007; Fetohy, 2007; Suji et al., 2016). Five articles did not report on knowledge skills of functional health literacy, but the studies demonstrated at least one skill or attribute of interactive health literacy (Akbarzadeh et al., 2018; Cabezón et al., 2005; Fakhri et al., 2012; Klaus et al., 1987; Ramya et al., 2014). Four studies demonstrated acquisition of functional health literacy only (Kaur & Saini, 2016; Malathi, 2018; Roth, 1993; Savitha et al., 2016). No articles reported evidence of the final progression from interactive to critical health literacy skill acquisition.

Functional health literacy. Authors of six articles had their intervention materials reviewed by a gynecologist (Bush et al., 2017; Cabezón et al., 2005; Chiou et al., 2007; Haque et al., 2014; Kaur & Saini, 2016; Klaus et al., 1987), five interventions were implemented by staff at a medical college (Akbarzadeh et al., 2018; Fakhri et al., 2012; Ramya et al., 2014; Savitha et al., 2016; Suji et al., 2016), and two interventions were delivered by nurses (Roth, 1993; Su & Lindell, 2016). In contrast, two studies' materials were reviewed by nondescript experts (Chau & Chang, 1999; Malathi, 2018), and one did not indicate the factual validation of their program (Fetohy, 2007).

Transmission of knowledge was a key objective of all interventions. Table 2 lists the evidence from 11 studies for improved knowledge: girls' baseline knowledge was low, but it increased after their intervention. Only one study (Su & Lindell, 2016) included an independently validated measure of knowledge (Ali & Rizvi, 2010). All other researchers developed their own questionnaires, of which two described as having been informed by a literature review (Chiou et al., 2007; Haque et al., 2014). Four studies tested the retention of knowledge at 7 weeks (Su & Lindell, 2016), 3 months (Chau & Chang, 1999; Chiou et al., 2007) and 6 months (Haque et al., 2014) post-intervention.

Bias in results was acknowledged by determining other sources of knowledge, including mothers (Chiou et al., 2007; Fetohy, 2007; Haque et al., 2014; Kaur & Saini, 2016; Malathi, 2018), friends, teachers, and mass media (Fetohy, 2007; Haque et al., 2014; Malathi, 2018). Although these 11 studies showed evidence of improved knowledge, it is implicit in the remaining five studies that the knowledge level allowed the progression to the interactive health literacy domain where girls demonstrated personal application of knowledge to their own health.

Interactive health literacy. Table 2 shows the studies' outcomes reported as a personal application of knowledge, attitude, and engagement with healthcare providers. Three studies (Akbarzadeh et al., 2018; Chau & Chang, 1999; Ramya et al., 2014) used independently validated measures (Abraham, 1983; Steiner, Macdougall & Brown, 2003) to evidence an improvement in PMS following the interventions. Haque et al. (2014) used independently validated measures, which were designed to measure coping with stress and depression, to evidence an improvement in PMS (Cohen, Karmarck and Mermelstein, 1983; Kovacs, 1985). Of these three studies, two reported improvements in knowledge (Chau & Chang, 1999; Haque et al., 2014), which suggests that the observed amelioration in PMS may mean that improved knowledge had been personally applied.

Two studies facilitated fertility awareness based on the students' personal fertile and infertile cyclic phases, which involves frequent and regular charting of OM signs such as mucus and bleeding (Cabezón et al., 2005; Klaus et al., 1987). Klaus et al. (1987) noted their use of the Billings Ovulation Method (Billings, Brown, Billings, & Burger, 1972; Billings & Westmore, 1980). Both studies included 12 months of knowledge-based lessons and confidential one-on-one chart monitoring. These studies were not designed to test the effectiveness of fertility-awareness based methods, but rather used fertility awareness as a platform for abstinence-based teaching. These studies' evidence show a reduction in unintended pregnancies (Cabezón et al., 2005; Klaus et al., 1987). However their limitations are that reliable data on sexual activity, contraceptive use, and pregnancy terminations were not obtained.

Three studies measured changes in self-care behavior (Chiou et al., 2007; Suji et al., 2016; Su & Lindell, 2016) rather than amelioration of an OM disturbance or pregnancy avoidance. All three studies show improvements in knowledge, which may have led to personal application with improved self-care behavior. However, only one study (Su & Lindell, 2016) included independently validated measures of self-care behavior (Chang & Chen, 2008; Chang & Chuang, 2012).

Change in attitudes is another outcome predicted by the Health Outcome Model (Nutbeam, 2000). Table 2 lists five articles that provided evidence of attitudes toward menstruation. Two of these studies (Chiou et al., 2007; Su & Lindell, 2016) used modified versions of the Menstrual Attitude Scale (Brooks-Gunn & Ruble, 1980). Su and Lindell (2016) found that the study group perceived menstruation as less bothersome and more natural, although perceiving the menses as negative did not contradict perceiving it as natural. In contrast, Chiou et al. (2007) found no attitude change even though dysmenorrhea had improved. The remaining three studies did not use independently validated measures (Fakhri et al., 2012, Fetohy, 2007; Haque et al., 2014). Fetohy (2007) found that the study group had significantly higher scores than the control group, and Haque et al. (2014) found improved attitudes toward menses. Fakhri et al. (2012) did not provide evidence that the intervention had changed attitudes but did show that attitude is related to the level of health experienced.

Finally, another measurable outcome of interactive health literacy is engagement with healthcare providers, such as improved help-seeking behavior. Haque et al. (2014) reported an increase in consultation rates. Su and Lindell (2016) provided instruction on menstrual care behavior; their results showed that at baseline the lowest mean score item was informing a teacher or nurse about menstrual pain, and this score improved after the intervention. Bush et al. (2017) provided suggestive evidence that in one region where there was consistent program delivery from 2001 to 2015, the rate of women under 20 years of age who sought specialized endometriosis care was observed to have increased. All three studies reported increases in knowledge in the functional health literacy domain.

Critical health literacy. None of the 16 studies provided evidence of progression to this advanced health literacy domain.

Discussion

The results describe school-based OM health education programs that exhibit high degrees of variability in quality, content, delivery, and outcomes. None of the studies cited health literacy as an aim. Nonetheless, by providing information at the basic level of functional health literacy, the studies demonstrated that steps toward OM health literacy had commenced. The wide range in ethnicity, socio-economic status, and educational literacy of the samples make generalizations difficult. A low number of interventions were reported in middle-high income countries. This could be attributable to a suggested unwillingness to teach the taboo topic of OM health because of the shame and stigma that surrounds menstruation in some societies (Chrisler, 2011; Johnston-Robledo & Chrisler, 2013; Wister, Stubbs, & Shipman, 2013). It could also be due to an overcrowded school curriculum, a lack of resources, and limited teacher training (Burns & Hendriks, 2018). It is also likely that evaluations of OM health education are underreported in peer-reviewed journals and accessible grey literature.

Baseline knowledge of functional health literacy was universally low, as confirmed by other studies (Boivin, Sandhu, Brian, & Harrison, 2018; Heywood, Pitts, Patrick, & Mitchell, 2016; Sydsjö, Selling, Nyström, Oscarsson, & Kjellberg, 2006). Menstruation is obvious, but ovulation, the OM cycle's major event (Vigil et al., 2006), is hidden (Sievert & Dubois, 2005). This may explain the pervasive unfamiliarity with ovulation and fertility (Ayoola, Zandee, & Adams, 2016; Bunting, Tsibulsky, & Boivin, 2013; Daniluk, Koert, & Cheung, 2012; Hammarberg et al., 2013; Hampton, Mazza, & Newton, 2013; Lundsberg et al., 2014; Pedro et al., 2018), which may explain mothers', girls' primary source of information, lack of knowledge about the OM cycle. In addition, any negative attitudes mothers convey to daughters (Chrisler & Gorman, 2016) perpetuates OM shame and stigma through the generations (Stubbs & Costos, 2004).

When menstruation is presented as a positive sign of good health, adolescent girls tend to have more positive attitudes toward it (Chrisler, Johnston, Champagne, & Preston, 1994). More precisely, both ovulation and menstruation are signs of good health (Vigil, 2019). Accurate OM education informs girls about how their own bodies function, thus it corrects myths and misinformation and unmasks "the power of culture and social cognition on something as basic as a physiological process" (Chrisler, 2013, p.129). The 16 studies created an opportunity to counteract misinformation and negative OM attitudes by accurately and positively transmitting knowledge about OM health. However, both factual validation and positive OM messaging in the studies' interventions were inconsistent. Furthermore, there was little common ground between the ovulation awareness studies (Cabezón et al., 2005; Klaus et al., 1987; Roth, 1993) and the studies that addressed OM disturbances. The ovulation awareness studies explicitly demonstrated cycle-charting skills but did not consider OM disturbances; only two studies that addressed PMS encouraged girls to use a menstrual symptom diary (Chau & Chang, 1999; Ramya et al., 2014). Cycle charting is considered a beneficial practice to increase self-knowledge (American College of Obstetricans & Gynecologists [ACOG], 2015; Barron, 2004, 2013; Billings & Westmore, 1980; Vigil et al., 2006); it also reinforces cycles as a sign of good health (Chrisler & Gorman, 2016; Popat, Prodanov, Calis, & Nelson, 2008; Vigil, 2019) and as much a vital indicator (ACOG, 2015) as pulse, temperature, or respiration (Hillard, 2008, 2014, 2018). Unlike the other vital signs, the OM cycle presents as patterns which manifest over time. Therefore charting skills to identify both ovulation and menstruation are central to OM health literacy.

Teaching girls how to chart their cycles familiarizes them with their unique OM patterns and informs them about their own physiological functioning and facilitates evaluation of any changes as either healthy or problematic (Stubbs, 2016). Cycle charting may thus help adolescents to manage OM disturbances. For example, the fixity of luteal length (Barbieri, 2014; Blackwell, Vigil, Cooke, d'Arcangues, & Brown, 2013; Brown, 2011), as a more reliable predictor of menstruation than the last menstrual period, could help girls with irregular cycles (Barron, 2004). Furthermore, knowledge of the prophylactic use of mefenamic acid (e.g. Ponstel) to ameliorate dysmenorrhea (Chan, Yusoff Dawood, & Fuchs, 1981; French, 2008; Harel, 2012; Hillen et al., 1999; Jung & Lee, 2013) and time management or stress reduction strategies enacted prior to PMS onset (McShane et al., 2018) could help girls with these OM disturbances. Girls with abnormal uterine bleeding could use charting to distinguish ovulatory from anovulatory cycles and menstruation from breakthrough bleeding (Klaus & Martin, 1989). The omission of OM disturbances in the OM awareness studies (Cabezón et al., 2005; Klaus et al., 1987; Roth, 1993) was a missed opportunity to educate girls that their cycles can reflect their personal health.

The progression to interactive health literacy challenges health educators to move beyond information provision toward personal engagement, that is, interventions that invite participation, interaction, and critical analysis (Nutbeam, 2008). The studies show that students prefer small-group discussions, which promote participation and interaction (Akbarzadeh et al., 2018; Cabezón et al., 2005; Chiou et al., 2007; Fetohy, 2007; Haque et al., 2014; Su & Lindell, 2016). A longer program duration would allow for more personal forms of communication (Chiou et al., 2007).

Critical health literacy is defined as raising awareness and influence over the social determinants of health (Nutbeam, 2015). The social structures in which adolescent girls are likely located include family and school. Two studies recognized the value of including mothers, parents, teachers, school nurses, and the wider healthcare community in OM health initiatives (Chiou et al., 2007; Su & Lindell, 2016) to support girls' OM health.

Limitations

Relevant articles may have been missed due to language restriction. Publication bias is present because schools that provide OM health education may not have conducted formal evaluations or published their results externally. Interventions delivered to girls older than 16 years, or in community settings were not included.

Conclusion

The disciplines of education and health converge to produce health literacy. As a stigmatized biopsychosocial phenomenon, OM health renders such education complex. Nonetheless, in countries where education is compulsory, school-based interventions provide an opportunity to reach a sizable section of the population of adolescent girls. Our review highlights gaps in school-based adolescent OM health interventions, which varied in quality, content, delivery, and outcomes. Most interventions focused on OM disturbances, which risks perpetuating a view that the OM cycle is a negative event in need of a solution. Based on the evidence from our systematic literature review, we recommend that future OM health interventions ensure factual validation and positive OM messaging of educational materials. Furthermore, predicating the OM cycle as a vital sign (ACOG, 2015) of good health whilst realistically addressing OM disturbances could be achieved by combining elements from both the ovulation awareness studies and the OM disturbance studies. Finally, we recommend interventions raise awareness of OM health by including family, school healthcare staff and community healthcare providers. Further research could then ascertain whether adolescent girls had benefitted from such interventions and finally gained OM health literacy.

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Table 1: Search Strategy utilizing the PICO Framework (Schardt et al., 2007)

Population AND **P**roblem (keywords)	AND **I**nterventions for OM health (keywords)	**C**omparison or **C**ontrol	AND **O**utcomes (keywords)
Female* OR Girl* OR Wom* AND Adolesc* OR Youth OR Teen*	Interven*OR Educat* OR Instruct* OR Teach* OR School* AND	Compared to participants who did not receive the	Know* OR Aware* OR Understand* OR "Health literacy" OR Confidence

AND Dysmenor* OR Pain* OR Cramp* OR Endometriosis OR Pre?menstrual dysphoric disorder OR PMDD OR Pre?menstrual Symptom* OR Pre?menstrual Syndrome OR PMS OR Pre?menstrual Tension OR PMT OR Stress* OR Anxi* OR "Abnormal uterine bleeding" OR AUB OR "Dysfunctional uterine bleeding" OR DUB OR Amenor* OR Oligomenor* OR Menorrag* OR Polycystic Ovar* Syndrome OR PCOS	Puberty OR Fertil* OR Reproduc* OR Menstru*OR Mense* OR Period* OR "Menstrual health" OR "Menstrual cycle" OR Ovulat* OR Anovula* OR Mucus OR Mittleschmerz	intervention	OR Experience OR Chart* OR Diary OR Calendar OR Track* OR Monitor* OR "Help?seek* Behavio?r" OR Self?care OR Self?efficacy OR Attitude OR Opin* OR Feel* OR "Body image" OR "Body satisfaction" OR "Body consciousness"

Table 2: Study Characteristics, Intervention focus and Summary of Study Outcomes

Study | Country	Study Design | Sample	Focus of the Intervention	Functional Health Literacy: *Knowledge*	Interactive Health Literacy: *Personal Application*	*Attitude*	*Engagement*
Haque et al. (2014) Bangladesh	Quasi-experimental study | n= 416; 11–16 year old girls	Dysmenorrhea Irregular cycles AUB PMS	Knowledge increased ǂ Pre test 51% Post test 82%	Amelioration pre | post test: Dysmenorrhoea 62% | 53% AUB 11% | 3% PMS* 8% | 3%	Attitude to "menstrual blood is not impure" Pre test 67% Post test 96%	Consultation rates increased Pre test 90.8% Post test 99.8%
Su and Lindell (2016) China	Quasi-experimental control study | n=116; 12-15 year old girls	Dysmenorrhea	Knowledge increased ǂ* Pre | Post test Study 5.73±2.56|10.22±1.92 Pre | Post test Control 5.50±2.54 | 5.77±2.30	Self-care behavior changeǂ* Pre | Post test Study 3.05±1.50 | 3.26±1.30 Pre | Post test Control 3.07±1.36 | 3.04±1.34	Attitude to "natural"* Pre | Post test Study 2.44±0.75 | 2.16±0/85 Pre | Post test Control 2.23±0.78 | 2.28±0.85	Improved confidence and help-seeking behavior were evidenced.
Chiou et al. (2007) Taiwan	Quasi-experimental non-equivalent control study |	Dysmenorrhea	Knowledge increased ǂ Pre | Post test Study 10.7±2.5 | 15.1±2.5	Self-care behavior change ǂ Pre | Post test Study 31.3±5.4 | 34.1±6.3	Attitude change ǂ* Pre | Post test Study 152.1±14.1|144.8±18.1	

	n=455; 15-16 year old girls		Pre | Post test Control 11.1±2.6 | 11.4±3.2	Pre | Post test Control 33.3±6.9 | 33.2±6.6	Pre | Post test Control 150.3±15.7|144.9±14.2	
Fakhri et al. (2012) Iran	Quasi-experimental control study | n=698; 14-18 year old girls	Irregular cycles AUB PMS		Reported good health Study 8.6% Control 4.9%	Reported that attitude is related to the level of health experienced	
Fetohy (2007) Saudi Arabia	Randomised control study | n=248; 14-17 year old girls	Dysmenorrhea Irregular cycles AUB	Knowledge increased ǂ Study 27.84±2.30 Control 19.75±3.96		Attitude improved ǂ Study 54.76±5.89 Control 43.06±6.81	
Bush et al. (2017) New Zealand	Retrospective cohort study | n=3732; 13-18 year old boys + girls	Dysmenorrhea	1998:<10% awareness 2015:32+% awareness in selected regions			Increasing rate of young women seeking care for endometriosis
Chau and Chang	Quasi-experimental non-equivalent	PMS	Knowledge increased ǂ Pre test 16.57±2.41 Post	Amelioration of PMS* Pre | Post test Study		

(1999) China	control study | n=94; 14-18 year old girls		test 19.73±2.81	9.22±6.42 | 6.92±5.03 Pre | Post test Control 8.04±5.19 | 8.20±6.00	
Suji et al. (2016) India	Quasi experimental non-equivalent control study | n=100; 15-18 year old girls	Irregular cycles AUB	Knowledge increased Study 23.1±3.5 Control 15.3±1.8	Self-care behavior change Study 11.64±3.7 Control 9.38±1.8	
Akbarzadeh et al. (2018) Iran	Randomised control trial | n=200; 14-18 year old girls	PMS		Amelioration of PMS ǂ* Pre | Post test Study 37.94±15.85 | 11.30±10.07 Pre | Post test Control 38.02±16.25| 28.1±18.57	
Cabezón et al. (2005) Chile	Randomised control trial | n=1259; 15-16 year old girls	Ovulation awareness		Pregnancy rate 1997 | 1998 Study 3.3% | 0.4% Control 18.9% | 22.6%	

Klaus et al. (1987) USA	Quasi-experimental study | n=309; 14-17 year old girls	Ovulation awareness		Number of pregnancies Study n=1 Control n=4	
Ramya et al. (2014) India	Quasi-experimental study | n=955; 12-15 year old girls	PMS		Amelioration of PMS* Pre test 9.84±7.97 Post test 4.13±4.93	
Kaur and Saini (2016) India	Pre-experimental study | n=60; 13-18 year old girls	PMS	Knowledge increased Pre test 10.4±1.59 Post test 22.3±2.59		
Malathi (2018)	Quasi-experimental study | n=40; 14-15 year old girls	Dysmenorrhea Irregular cycles AUB PMS	Knowledge increased Pre test 17.63±4.12 Post test 28.3±1.24		
Roth (1993)	Quasi-experimental study | n=66; 13-16	Ovulation awareness	Knowledge increased Pre test mean 29%		

USA	year old boys + girls		Post test mean 74%	
Savitha et al. (2016) India	Pre-experimental study | n=60; 12-14 year old girls	Dysmenorrhea	Knowledge increased Pre test 12.3±2.9 Post test 21.8±4.5	

AUB: Abnormal Uterine Bleeding. PMS Pre-Menstrual Syndrome.
ⱡ Significance set at p<0.001 * Independently validated questionnaires were used.

Table 3: Quality Ratings of the Included Studies

Questions on the Quality Items [1, 2 … 20]	Included Studies																Total score	Maximum total score	Percentage Total Score
	Akbarzadeh et al. (2018)	Bush et al. (2017)	Cabezón et al. (2005)	Chau and Chang (1999)	Chiou et al. (2007)	Fakhri et al. (2012)	Fetohy (2007)	Haque et al. (2014)	Kaur and Saini (2016)	Klaus et al. (1987)	Malathi (2018)	Ramya et al. (2014)	Roth (1993)	Savitha et al. (2016)	Su and Lindell (2016)	Suji et al (2016)			
[1] Were the study aims, objectives, or hypotheses described? Yes = 1; No = 0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**16**	16	**100.0**
[2] Was the study design clearly stated? Yes = 1; No = 0	1	0	1	1	1	1	1	0	0	0	1	0	0	1	1	1	**10**	16	**62.5**
[3] Were the interventions clearly described? Yes = 1; No = 0	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	0	**12**	16	**75.0**
[4] Were the main outcomes to be measured clearly described before the Results section? Yes = 1; No = 0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**15**	16	**93.8**

[5] Were the main findings of the study clearly described? Yes = 1; No = 0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**15**	16	**93.8**
[6] Were the participants' characteristics described (inclusion / exclusion criteria, source of controls)? Yes = 2; Partially = 1; No or unable to determine = 0	1	0	1	1	1	0	0	1	1	1	0	1	0	0	1	0	**9**	32	**28.1**
[7] Were the hosting staff, sites and facilities representative of the education setting for the target population? Yes = 1; No or unable to determine = 0	0	1	1	1	0	1	0	1	0	0	1	0	0	0	1	0	**7**	16	**43.8**
[8] Did the study have sufficient power to detect effect where P<0.05? Yes = 1; No or unable to determine = 0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	**3**	16	**18.8**
[9] Were the sampling procedures sufficiently described? Yes = 2; Partially = 1; No or unable to determine = 0	2	0	2	2	2	0	1	1	1	0	0	0	1	1	0	1	**14**	32	**43.8**

[10] Were the participants representative of the target population, as described by selection and randomisation? Yes = 1; No or unable to determine = 0	1	0	0	1	1	1	0	1	0	0	0	0	1	0	0	0	**6**	16	**37.5**
[11] Were the study and control participants from the same population? Yes = 1; No or unable to determine = 0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	**7**	16	**43.8**
[12] Were the study and control participants recruited at the same time? Yes = 1; No or unable to determine = 0	1	0	0	1	1	1	1	0	0	1	0	0	0	0	1	0	**7**	16	**43.8**
[13] Were participants randomised to the intervention and control groups? Yes = 1; No or unable to determine = 0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**2**	16	**12.5**
[14] Were study and control participants kept separate? Yes = 1; No or unable to determine = 0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	1	1	**5**	16	**31.3**

[15] Were response rate, compliance rate, and / or proportion of dropouts or exclusions reported? Yes = 1; No = 0	0	1	1	0	0	0	0	0	0	1	0	0	1	0	1	0	**5**	16	**31.3**
[16] Were the main outcome measures valid and reliable? Yes = 2; Partially = 1; No or unable to determine = 0	0	0	2	2	2	2	2	2	1	2	0	0	0	0	1	0	**16**	32	**50.0**
[17] Were valid definitions used for outcomes? Yes = 2; Partially = 1; No or unable to determine = 0	2	2	2	2	2	0	0	0	0	2	0	1	2	1	1	0	**17**	32	**53.1**
[18] Was data distribution described and presented appropriately, such as SDs, confidence intervals, range, interquartile range for non-normally distributed data? Yes = 1; No = 0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	**3**	16	**18.8**
[19] Were actual probability values reported? Yes or not applicable = 1; No =	1	0	1	1	1	1	1	1	0	1	0	1	0	0	1	0	**10**	16	**62.5**

0																			
[20] Were the statistical tests to assess the outcomes appropriate? Yes or not applicable = 1; No = 0	1	0	1	1	1	1	0	1	0	1	0	1	1	0	0	0	**9**	16	**56.3**
Total score (Maximum score = 24)	**18**	**8**	**18**	**21**	**19**	**13**	**11**	**12**	**6**	**14**	**5**	**8**	**10**	**6**	**15**	**4**			

Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram – Study Selection Flow Chart (Moher et al. 2009)

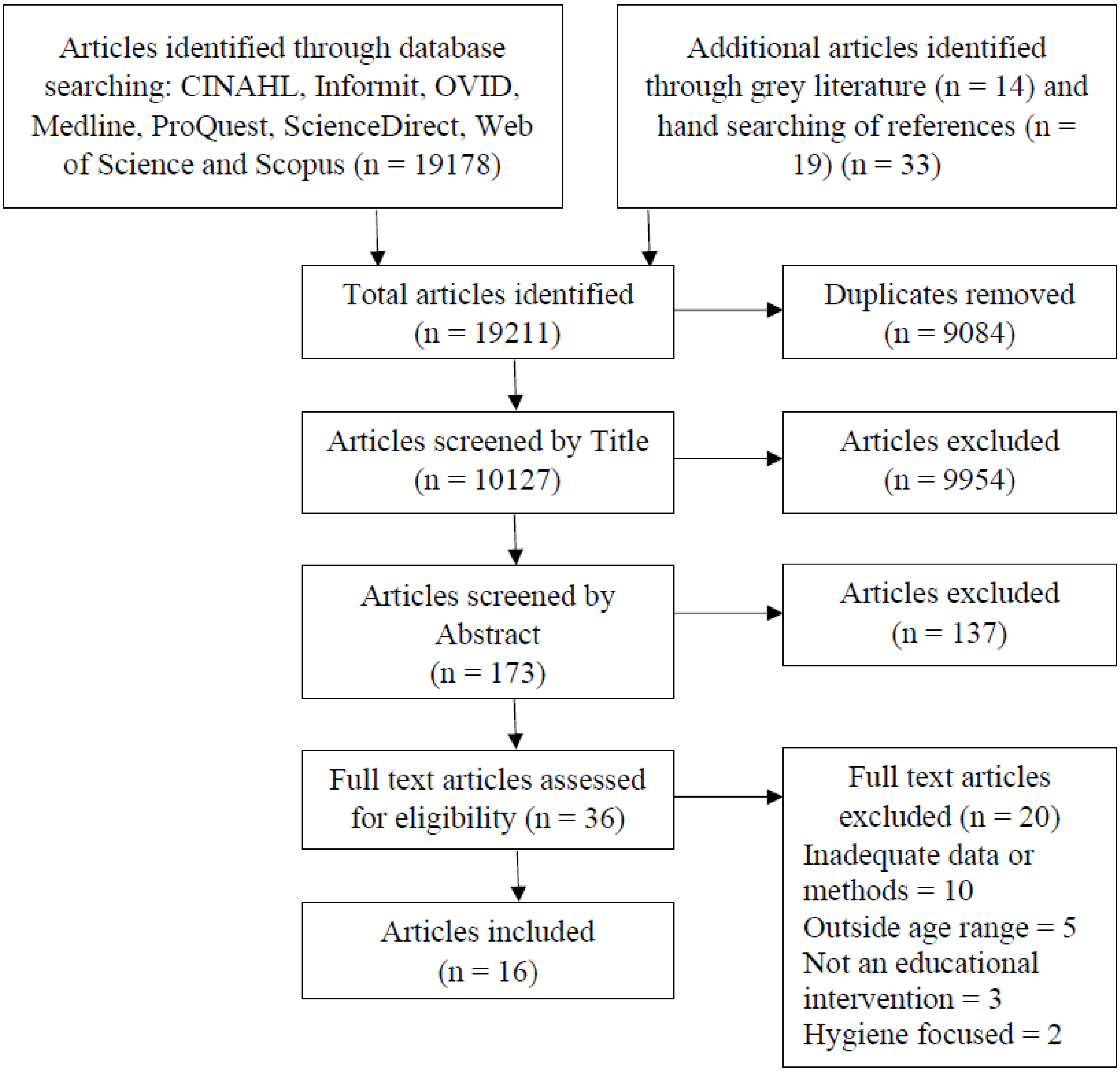

Figure 2: Timeline of Interventions