5-2021

The impact of menstrual hygiene management interventions on adolescent female's school attendance in middle- and low-income countries: A systematic review of the literature

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University of Arkansas Honors College Thesis

Abstract

Background: Menstruation is an ongoing biological process that affects a large portion of the population and requires consistent health and medical care. However, menstruation does not affect women and girls equally in resource-poor communities and girl-unfriendly schools, particularly in low- and middle-income countries. Without proper menstrual hygiene management (MHM) and menstrual health and hygiene (MHH), girl's attendance at school is reported to decline or cease altogether. Providing the proper resources to fulfill women's and girl's menstrual hygiene needs may impact female's attendance rates at school, and furthering women's education is fundamental in advancing female's equality world-wide.

Purpose: The purpose of this systematic review is to synthesize the literature evaluating the impacts of menstrual hygiene management resource interventions and educational interventions on adolescent female's school attendance rates in low- and middle-income countries.

Methods: CINAHL, PubMed, and Web of Science, were systematically searched, along with a manual internet search, for journal articles that studied adolescent females in low- and or middle-income countries (P), and interventions of physical menstrual hygiene resources and education (I), with a comparison of study outcomes to control groups or existing groups within the community (C), resulting in reports on post-intervention school attendance rates (O).

Results: 21 peer-reviewed articles were retrieved through a database search of CINAHL, PubMed, and Web of Science, as well as a manual internet search. 19 articles were primary studies evaluating the PICO guidelines, and 2 articles were systematic reviews fitting PICO criteria. The included articles spanned seven countries, primary and secondary or both school types, rural and urban settings, and government and public or non-government and private

schools. Attendance rates were more often reported to improve after any MHM intervention type than they were reported to cause no effect or a decline in attendance.

Conclusions: Despite many studies presenting supportive evidence for MHM interventions improving attendance, no concrete conclusions can be made about their effect due to the variations between studies and the non-generalizability of the results. While education interventions alone proved to have the most unanimous results, there is a gap in the literature regarding which type of intervention is the most effective and the overall effect of a menstrual cup intervention. Further research is necessary to inform evidence-based practice and to determine the most successful interventions that should be used to eliminate menstrual disparities world-wide.

Introduction

According to the United Nation's International Children's Emergency Fund (UNICEF), menstruation is a normal and healthy biological process that affects half of the female population and collectively occurs for seven years of a woman's lifetime (2018). Menstruating females, therefore, are a large part of patient populations, especially in adolescent, adult, and women's health fields, making managing menstruation a priority in healthcare. Menstrual hygiene management (MHM) is defined as women and girls having access to clean menstrual management materials and resources to absorb and collect menstrual blood, privacy to change such resources, access to soap and water throughout the menstrual cycle, and safe and accessible facilities to dispose of soiled menstrual materials. MHM extends into menstrual health and hygiene (MHH), which encompasses accurate and timely information, affordable and available materials, washing and sanitation amenities, positive social norms, hygienic and safe disposal, and supportive policies and patient advocacy (UNICEF, 2019). Period poverty describes materials, resources, and environments that do not meet these standards.

Period poverty grossly affects adolescent girls and women in their daily lives. However, one of the most predominant areas that is impacted by period poverty is education. As of 2019, the gender parity index (GPI) for school enrollment in primary and secondary schools across the globe was 0.986 (The World Bank, 2020a). Comparatively, as of 2018, developing countries presented a GPI disparity among enrolled students of 0.894 (The World Bank, 2020b). The gender disparity is further marked by a widened gap in GPI between primary school enrollment and secondary school enrollment, 0.921 (The World Bank, 2020c) and 0.829 (The World Bank, 2020d) respectively, in low-income countries. The decline in enrollment rates of females compared to males from primary to secondary school may speak to the impacts of period poverty

on pubescent adolescent girls. Currently, one in three pubescent girls has never been to school, and 132 million school age girls are not attending or enrolled in school (UNICEF, 2020; UNICEF, n.d.). Resource disparities contributing to period poverty include inaccessibility to basic water, sanitation, and hygiene (WASH) facilities, which 500 million women and girls, collectively, were affected by in 2018 (The World Bank, 2018) and 335 million schoolgirls, specifically, were affected by in 2016 (UNICEF, 2019), as well as a lack of adequate MHM, which affects half of all girls across low- and middle-income countries (Hennegan & Montgomery, 2016), and a lack of preparation for and education about menses.

It is critical to address the inequality of female's education in low- and middle-income countries, and the disparities driving this inequality, not only because period poverty violates basic human rights to health and hygiene, but also because improving women's health is socially, economically, and educationally in the best interest of low- and middle-income countries. Women who are able to overcome barriers to MHM and obtain an education contribute to their country's development through obtaining better jobs, working in the formal labor market, and establishing themselves economically by earning higher wages (Alam et al., 2017). Furthermore, educated women have better health outcomes and fewer children, resulting in higher market productivity and therefore improving economies (Chinyama et al., 2019). Having an economic and occupational position of power or value may also elevate women's statuses, roles, and voices within stigmatized societies, therefore providing a greater opportunity to fight stigmas about menstruation. Many international organizations have recognized the importance of this issue and are working towards alleviating the burden of menstruation on women in resource-poor and girl-unfriendly schools and communities.

In 2014, UNICEF and Columbia University created an initiative, known as *MHM in Ten*, to address and improve poor menstrual hygiene management globally in ten years. The deadline for achieving the aims of this initiative are quickly approaching within the next three years, indicating the need for a review of the data that exists on MHM, the progress that has been accomplished, and the strides that still need to be made. UNICEF's initiative outlines five priorities for improving MHM, including "build[ing] a strong evidence base for MHM in schools…", "develop[ing] and disseminat[ing] guidelines for MHM in schools with minimum standards…. [and] adoption and implementation at national and sub-national levels", "advance[ing] MHM in schools through a comprehensive evidence-based advocacy program…", "allocate[ing] responsibility to designated governments for the provision of MHM in schools…", and "integrat[ing] MHM, and the capacity of resources to deliver inclusive MHM, into the education system" (Colombia University & UNICEF, 2016). An abundance of research has emerged that surveys adolescents about their absence at school and their perceptions of the impact of menstruation on their education. However, very few studies have implemented, evaluated, or surveyed the impact of interventions such as education, menstrual products, and WASH facilities on enrollment and attendance rates. Without intervention studies, especially those that provide quantitative data, the evidence-based foundation and aims of *MHM in Ten* cannot be accomplished.

The last systematic review over menstrual hygiene management intervention studies was conducted in 2017 (Kuhlmann et al.), with one other previous review in 2016 (Hennegan & Montgomery). Within these reviews, publications over the last 50 years were included, and several intervention studies were excluded due to differences in PICO guidelines, inclusion, and exclusion criteria. Since 2017, when the latest review was published, various other studies have

been conducted on MHM interventions and school attendance outcomes, and with the ever-changing socio-political environment a more current and timely literature review is needed to inform MHM practices and policies.

The purpose of this review is to analyze the impact education, material provision, and WASH facility interventions have on adolescent girl's school attendance in low- and middle-income countries. Education interventions may address and reduce stigmas, taboos, and menstrual practices that result in complications that remove girls from the school environment. Material provision includes disposable menstrual pads, reusable menstrual pads, hand-made menstrual pads, menstrual cups, cloth designated for menstruation, and other various interventions that increase accessibility to physical menstrual needs. Finally establishing, improving, and or monitoring WASH facilities addresses the amenity component of MHH by providing a safe and clean environment for MHM.

Methods

Foreground Research Question

Does providing menstrual hygiene management resources and education to adolescent females in low- and middle-income countries improve adolescent female's school attendance rates?

Information Sources

Data and supporting information were retrieved through a systematic review of research based in low- and middle-income countries to evaluate the impact of menstrual hygiene management resources and menstrual hygiene management education on school attendance rates. To complete the search, databases CINAHL, PubMed, and Web of Science were reviewed and a manual internet search for studies occurred. Primary documents were the main focus of this search, but systematic reviews and meta-analyses that fit the search strategy were included after being evaluated against PRISMA checklist guidelines.

Search Strategy

Within the CINHAL database, subject headings with Boolean operators and no field specification were used to identify preliminary sources, including: *menstrual cycle or menstruation or menses* AND *education or school or learning or teaching or classroom or education system* AND *absenteeism or absence or attendance*. MeSH terms and Boolean operators were selected within the PubMed database, including: *menstrual cycle* AND *school* AND *absenteeism*. Field tags, Boolean operators, and query sets were utilized in the Web of Science database and were as follows: *TS* = (*mens** AND (*absent* or attend**) AND (*poverty or impoverished or low-income*) AND (*school or education*)). *TS* is a field tag that refers to Topic. The use of an Asterix (*) after search terms expands the search strategy and increases the number

of articles returned (mens* includes menstruation, menstrual, menses; absen* includes absent, absence, absenteeism; attend* also includes attendance). Additional articles were identified through a manual internet search and included for review. Search limiters were applied across all three databases and manually retrieved articles, including: *Full text, English language, Peer-reviewed/ Journal article.* Due to the low prevalence of studies fulfilling all criteria of this PICO question, no time frame restriction was included.

Inclusion/Exclusion Criteria

Articles from CINAHL, PubMed, and Web of Science that met the search strategy, as well as manually retrieved journals, were included for initial review and searched for duplication. After duplicate articles were removed, the remaining articles were evaluated through a full text review against inclusion and exclusion criteria. Inclusion and exclusion criteria were determined by the PICO components of the stated research question. Articles were included if (a) the research was conducted in a low- or middle-income country among school-age or adolescent females (P), if (b) the research discussed menstrual hygiene management resources or education programs OR discussed already existing groups within the community utilizing different menstrual hygiene resources (I), if (c) the research had a control group or compared intervention groups (C), and if (d) the research discussed school attendance rates (O). Articles were not included if (a) the research was conducted in a high-income country or among a population other than school-age or adolescent females, if (b) the research did not discuss the use of menstrual hygiene management resources or education programs as the primary interventions OR did not discuss already existing groups in the community utilizing different menstrual hygiene resources, if (c) the research did not have a control group or did not compare intervention groups, and if (d) the research did not discuss school attendance,.

For inclusion criteria (a) and exclusion criteria (a), the classification of study location as low- and middle-income or high-income was determined by The World Bank's classification of income level of the study location's country (The World Bank, 2020a; The World Bank, 2020b; The World Bank, 2020c; The World Bank, 2020d). For inclusion criteria (b) and exclusion criteria (b), resources for menstrual hygiene management were considered to include disposable menstrual pads, reusable menstrual pads, hand-made menstrual pads, menstrual cups, cloth designated for menstruation, water supply, sanitation measures, and WASH facilities; Menstrual education was considered to include teaching sessions and educational pamphlets or books or instructions. It is important to note that, unlike other reviews, dysmenorrhea, and interventions against dysmenorrhea, such as pain medication provision to adolescent schoolgirls, was not included in this review due to UNICEF's definitions of MHM and MHH not encompassing pain or discomfort. Furthermore, enrollment rates and drop-out rates were considered to fall under the umbrella term of attendance rates due to enrollment rates and dropout rates presenting data on female's overall presence in the classroom. Therefore, studies that presented attendance rates, enrollment rates, and or dropout rates after MHM interventions were included and evaluated.

Data Extraction

Information and data from the articles included for systematic review were independently collected and organized by the primary investigator. The data extracted included author, study location, study population, sample size, study type, study purpose, study interventions, control groups or method of comparison, and key findings. Extracted data is synthesized and depicted by Table 1.

Search Results

Through the outlined search strategy, 126 articles were retrieved from CINAHL (n=94), PubMed (n=14), and Web of Science (n=18) databases. 23 articles were identified through a manual internet search, for a total of 149 preliminary journal articles. Sources retrieved from the search strategy were refined by search limiters which resulted in 69 articles being excluded and 80 articles being included in the initial search. 13 articles were removed for duplication, and the remaining 67 articles were screened against the PICO requirements for inclusion and exclusion. After inclusion and exclusion criteria were applied through a full text review, 47 articles were removed. One additional journal article was identified through a hand-search of references (Dolan et al., 2013), totaling 21 peer-reviewed articles included in this systematic review. Despite no time frame restriction being applied, all qualifying articles were published between 2011 and 2020. The selection process of included studies is depicted by a PRISMA flow-diagram in Figure 1.

Figure 1. Selection Process of Included Studies.

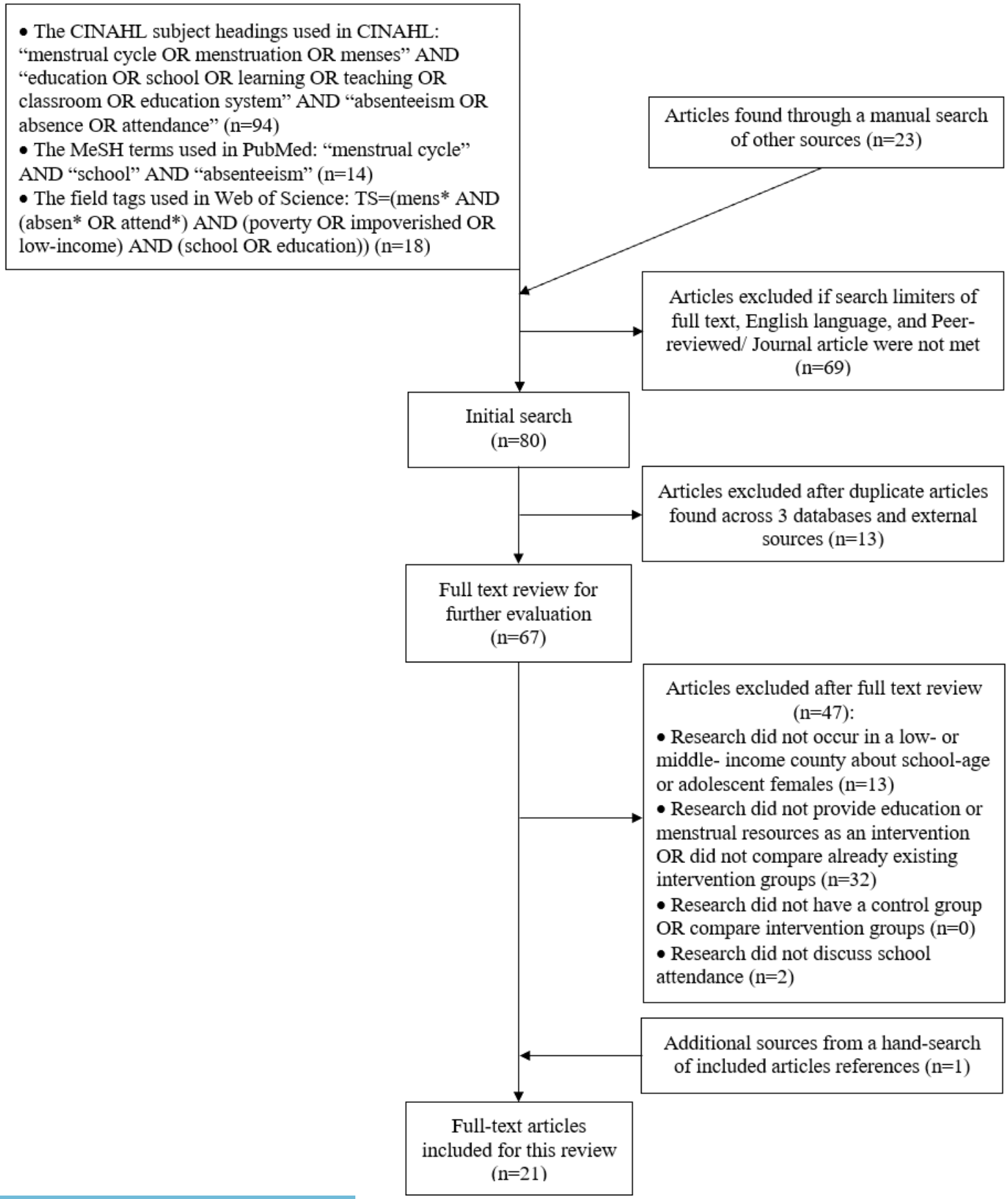

Table 1. Synthesis Table of Included Studies.

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
Belay et al., 2020	Ethiopia	• Female students (Grade 7 to 12) • Male students (Grade 7 to 12)	8839 students (51.8% female) across 15 schools in 10 urban and 5 rural areas	Pre-post intervention study	"Evaluate the effect on school attendance of a menstrual hygiene intervention that distributes educational booklets to school children and menstrual hygiene kits…"	• Educational booklets provided to both males and females (n= 12211) • Menstrual hygiene kits provided to females (n= 599)	Pre-intervention attendance rates compared to post-intervention attendance rates	• Girls had 24% fewer absences than boys after implementation of intervention • Intervention had a positive effect on girls' school attendance
Dolan et al., 2013	Ghana	Female students (12 years old and older)	120 girls across 3 peri-urban sites and 1 rural site, each site including a primary and junior secondary school	Non-randomized cluster control trial	"… presents the findings of a study that assessed the impact of sanitary care on the school attendance of post-pubertal girls…".	• Puberty education alone (peri-urban, n=25) • Sanitary pads and puberty education (peri-urban, n=39; rural, n=21	• No intervention/ control group (peri-urban, =35) • Rural and urban intervention groups compared to each other • Intervention groups compared to control group	• Pads and education improved attendance by 9%, or 6 days per term • Attendance showed no significant changes in the control group • Pads with education similarly effected urban and rural areas
Freeman et al., 2012	Kenya	All students (age NR)	6036 participants across 135 public primary schools	Randomized cluster control trial	"Improved school WASH conditions…may reduce pupil absence	• Hygiene promotion and water treatment	• No intervention/ control group (n=2013)	• Schools affected by post-election violence saw no difference

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
					by providing services and a learning environment that appeals to children, specifically girls who are menstruating …"	• Hygiene promotion, water treatment, and sanitation (n=4023)		in attendance rates Schools not affected by post-election violence: • 58% reduction in the odds of absence for girls with WT and HP intervention • Sanitation improvement with WT and HP resulted in similar drop in absence • WT and HP intervention may reduce girls' absence by 6.1 days per year • Sanitation improvement with WT and HP may reduce girls' absence by 6.8 days per year • Boys attendance was not affected by intervention

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
Garn et al., 2013	Kenya	All students (age NR)	• 135 water available public primary schools • 50 water scarce public primary schools	Randomized cluster control trial	"…to measure the impact of a school-based water sanitation and hygiene (WASH) improvement on pupil enrolment and on gender parity enrolment…"	• Hygiene promotion and water treatment (water available, n=45 schools) • Hygiene promotion, water treatment, and sanitation (water available, n=45 schools; water scarce, n=25 schools)	• No intervention/ control group (water available, n=45 schools; water scarce, n=25 schools) • Pre-intervention enrollment rates compared to post-intervention enrollment rates • Water available school groups compared to water scarce school groups	• Female student's enrollment increased by 4% in intervention groups compared to control groups of water scarce schools over two years • Enrollment increase was most prevalent in grades 6-7 when females, on average, begin menarche • No change in girls' or overall enrollment was noted in intervention groups compared to control groups of water available schools
Haque et al., 2014	Bangladesh	Menstruating female students (11-16 years old, grade 6-8)	416 girls across 1 government high school and 2 semi-government high schools	Pre-post intervention study	"To assess the impact of a school-based menstrual education program on: (1) menstrual	Educational program provided by OBGYNs and research assistants on menstrual	Pre-intervention reports were compared to post-intervention reports	• No hard data • Significant improvements in school attendance during

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
					knowledge, beliefs and practices, (2) menstrual disorders experienced, and (3) restrictions on menstruating adolescents".	hygiene management		menstruation were reported
Hennegan et al., 2016b	Uganda	Menstruating female students (10-19 years old)	205 girls across eight rural schools	Quasi-randomized control trial	"……to assess differences in self-reported freedom of activity during menses according to menstrual absorbent".	Menstrual hygiene kit (n= 72)	No intervention/ control group (n=133)	• Reports no difference in school attendance rates between intervention pads and current MHM methods (17.2% and 21.9% missing school, respectively)
Hennegan et al., 2017	Uganda	Menstruating female students (12-17 years old)	27 girls across eight rural primary schools	Quasi-randomized qualitative control trial	"…compares schoolgirls' experiences of menstruation in rural Uganda at the conclusion of a controlled trial of puberty education and sanitary pad provision to elucidate pathways of effect in the interventions".	• Puberty education alone (n=8) • Menstrual hygiene kit alone (n=8) • Menstrual hygiene kit and education (n=6)	• No intervention/ control group (n=5) • Descriptive comparison to experience before and after interventions • Comparison between intervention groups • Comparison of intervention	• No hard data • Reports reduced menstrual-related absenteeism for intervention groups • Reports that girls receiving absorbents from the intervention more easily attended school

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
							groups to control group	• Girls more commonly left school to change pads in education only and control groups • Reports substantial attendance decline at control school over study period
Kansiime et al., 2020	Uganda	• Female students (12-20 years old) • Male students (13-21 years old)	369 students (188 female, 181 male) across two peri-urban secondary schools, one of which was government, and one of which was private	Pre/post intervention study	"… to pilot test an intervention to improve MHH and school attendance…".	• Menstrual hygiene kit and puberty education (n=188) • Education skit (n= 369) • Both school facilities improved to WASH standards (n=369)	Comparison of attendance in Term 3 2017 (baseline before intervention) to Term 2 2018 (endline after intervention)	• APR associated with missing school on period days compared to non-period days decreased from 1.84 to 1.16 • "Trainings improved our self-esteem and confidence because nowadays we are not scared of coming to school. We are comfortable coming to school during

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
								our menstruation". • Reports increase in attendance during menstruation at endline compared to baseline
Mason et al., 2015	Kenya	Female students (14-16 years old) with at least 3 previous menstrual cycles	30 rural primary schools (number of girls NR)	Randomized cluster control trial	"...examine the acceptability, use, and safety of menstrual products, and social and schooling experiences of girls…"	• Menstrual cups (n= NR) • Disposable pads (n= NR)	• No intervention/ control group (n= NR) • Comparison between intervention groups • Comparison of intervention groups to control group	• No hard data • Both students and parents of students that received interventions reported an increase in school attendance rates • School absenteeism was only reported by girls that continued to use traditional methods (control group) • No reported difference in attendance between intervention groups

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
Montgomery et al., 2012	Ghana	Menstruating female students (12-18 years old)	120 girls across 3 peri-urban sites and 1 rural site, each site including a primary and junior secondary school	Non-randomized cluster control trial	"…assess the role of sanitary pads in girls' education".	• Puberty education alone (peri-urban, n=25) • Disposable pads and puberty education (peri-urban, n=39; rural, n=21)	• No intervention/ control group (peri-urban, n= 35) • Comparison of pre-intervention and post-intervention attendance rates per intervention group	• Pads and education improved attendance by 9%, or 6 days per term, three months after intervention • Education alone improved attendance by 9% five months after intervention • Attendance at intervention schools were significantly higher than the control school
Montgomery, et al., 2016	Uganda	Female students (ages 10-18)	1124 girls across 8 rural primary schools	Quasi-randomized cluster control trial	"Assess the impact of providing reusable sanitary pads and puberty education on girls' school attendance…".	• Menstrual hygiene kit alone (n= 2 schools) • Puberty education alone (n= 2 schools) • Menstrual hygiene kit and puberty education (n= 2 schools)	• No intervention/ control group (n= 2 schools) • Comparison between intervention groups • Comparison of intervention groups to control group • Comparison of Term 1 and 2 of 2012 attendance records (baseline) to	• All groups resulted in decreased attendance, ranging from -5.2% to -24.5%, and increased drop-out rates • Groups with interventions had less severe drops in attendance rates than the control group • Girls who received an

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
							three weeks of attendance records across Term 1, 2, and 3 of 2014	intervention had 2.5 more days in school on average than control group students • No difference in effectiveness between intervention groups was reported • The control group had a 17.1% greater decrease in attendance compared to the intervention group
Mucherah & Thomas, 2017	Kenya	Female students (11 to 16 years old, 6th to 8th grade)	150 girls across 2 rural primary schools	Controlled intervention study	"…explore girls' perceptions of the impact of sanitary pads' intervention on their school attendance and grades".	Reusable pads and educational workshop (n=51)	• No intervention/ control group (n=99) • Comparison of intervention group to control group	• "Those who had received the pads reported significantly less negative influence on their attendance and schoolwork than those who did not have the pads". • Girls with pads function similarly to girls who have

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
								not yet menstruated
Muthengi & Austrian, 2018	Kenya	Female students (class 7)	3489 girls across 140 rural public primary schools	Randomized cluster control trial	"…to analyze the individual and combined contributions of sanitary pads and provision of comprehensive reproductive health education on girls' education…".	• Menstrual kit (n=NR) •Reproductive health education (n=NR) • Menstrual kit and reproductive health education (n=NR)	• No intervention/ control group (n=NR) • Comparison of intervention groups to control group	• No hard data • Hypothesizes that education and pads distributed through the Nia Project will increase school attendance and participation
Oster & Thornton, 2011	Nepal	Female students (7th-8th grade, mean age 14.2 years old)	198 girls across 4 schools	Randomized control trial	"…evidence on how much schoolgirls actually miss during their periods, and the causal effect of modern sanitary technology on school attendance".	Menstrual cup (n=100)	• No intervention/ control group (n=98)	• Menstrual cups do not improve attendance • The menstrual cup resulted in a 1.0% *decrease* in attendance • Menstruation does not cause significant absences in school (0.4 days in a 180-day school year)
Phillips-Howard et al., 2016	Kenya	Female students (14-16 years old) with at least 3	644 girls across 30 rural primary schools	Randomized cluster control trial	"…effect of menstrual hygiene on schoolgirls'	• Puberty education (n=644)	• No intervention/ control group (n=200)	• Menstrual cups and pads did not reduce

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
		previous menstrual cycles			school…outcomes".	• Menstrual cups (n=188) • Disposable pads (n=256)	• Comparison between intervention groups • Comparison of intervention groups to control group	school dropout rate • No hard data on self-reported attendance
Shah et al., 2013	India	Menstruating adolescent females (12-22 years old)	164 girls across 8 rural/tribal villages	Controlled intervention study	"…menstrual health and hygiene practices among adolescent girls…and their experiences using old cloths, a new soft cloth (falalin) and sanitary pads".	• Disposable pads (n=107) • Falalin cloth (n=141) *Participants were not split into intervention groups, but all had the option of consecutively trying each intervention for 3 months*	• No intervention/ control group (n=148) • Comparison between baseline of no intervention and experience with each intervention group	• Reported no school absences among disposable pad intervention group (n=0) • Reported fewer school absences with falalin cloth (n=5) than old cloth (n=16)
Sivakami et al., 2019	India	Menstruating female students (Class 8-10; 12 years old and older)	2564 girls across 43 government middle schools and high schools and 10 model schools	Cross-sectional	"…identify challenges related to menstruation, and facilitators of menstrual management in schools…".	No provided interventions, assessing different groups that already exist within the community	Study schools were compared to model schools supported by UNICEF and with menstrual education programs (better-case scenario)	• Reported that girls who used disposable pads were 14% more likely to attend school than those who used traditional cloths • Reported that girls who used reusable pads were

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
								10% more likely to attend school than those who used traditional cloths • Reported that having proper WASH facilities is associated with decreased absenteeism during menses
Tegegne & Sisay, 2014	Ethiopia	Female students (10-19 years old, 7th -8th grade)	595 girls across 7 urban and rural primary schools	Cross-sectional	"…examined knowledge about menstruation, determinants of menstrual management and its influence on school-attendance…".	No provided interventions, assessing different groups that already exist within the community	Comparison between different survey responses among participants	• Girls who used disposable pads were 5.37 times more likely to attend school compared to girls who used traditional cloths • The mean number of days absent was lower among girls who did used disposable pads
Wilson et al., 2014	Kenya	Menstruating female students	302 students in across 10 non-urban primary and secondary schools	Randomized cluster control trial	"…the short-term impact of training girls to make a reusable product on	Education on how to make a reusable pad (n=5 schools, 143 students)	No intervention/ control group (n= 5 schools, 159 students)	• All intervention schools reported a decrease or no

Table 1. (continued)

Author	Study Location	Study Population	Sample Size and Setting	Study Type	Study Purpose	Interventions	Control or Comparison	Key Findings
					school absenteeism…".			change in absences • Overall, intervention schools had a 68.8% decrease in absenteeism • Absenteeism in intervention schools decreased from an average of 9.9% to 3.1% of school days • All control group schools reported an increase or no change in absences

Note. NR = Not reported. Menstrual kit = provision of various numbers of pads and underwear and or soap provided. Pads = provision of pads alone, no provision of underwear or soap. No intervention/ control group = continued use of normal or traditional MHM methods.

Results

Characteristics of Included Studies

Study type. 21 articles were included in this systematic review, 19 of which evaluated the outcomes of menstrual hygiene management interventions on women's education, and two of which were systematic reviews of such studies. The two systematic reviews (Hennegan & Montgomery, 2016; Kuhlmann et al., 2017) were not included in the synthesis of information due to reporting on studies already included for review in this paper. Of the 19 studies, two were non-randomized control trials (Dolan et al., 2013; Montgomery et al., 2012), three were quasi-randomized control trials (Hennegan et al., 2016; Hennegan et al., 2017; Montgomery et al., 2016), seven were randomized control trials (Freeman et al., 2012; Garn et al., 2013; Mason et al., 2015; Muthengi & Austrian, 2018; Oster & Thornton, 2011; Phillips-Howard et al., 2016; Wilson et al., 2014), three were before-after (pre-post) intervention studies (Belay et al., 2020; Haque et al., 2013; Kansiime et al., 2020), two were unspecified controlled intervention studies (Mucherah & Thomas, 2017; Shah et al., 2013), and two were cross-sectional studies (Sivakami et al., 2019; Tegegne & Sisay, 2014).

Study population. The number of participants included across the 19 studies could not be calculated due to male students being included in three study populations without differentiation between sexes in the reported population size, one of which was related to a menstrual hygiene management education session (Belay et al., 2020) and two of which related to WASH facilities that were used by co-ed schools (Freeman et al., 2012; Garn et al., 2013). Total participants were also unable to be calculated due to intervention and control groups being allocated to clusters of schools instead of individual participants (Garn et al., 2013; Mason et al., 2015). Seven countries were evaluated; Two studies were conducted in Ethiopia (Belay et al., 2020; Tegegne & Sisay, 2014), two studies were conducted in Ghana (Dolan et al., 2013; Montgomery et al., 2012),

seven studies were conducted in Kenya (Freeman et al., 2012; Garn et al., 2013; Mason et al., 2015; Mucherah & Thomas, 2017; Muthengi & Austrian, 2018; Phillips-Howard et al., 2016; Wilson et al., 2014), one study was conducted in Bangladesh (Haque et al., 2013), four studies were conducted in Uganda (Hennegan et al., 2016; Hennegan et al., 2017; Kansiime et al., 2020; Montgomery et al., 2016), one study was conducted in Nepal (Oster & Thornton, 2011), and two studies were conducted in India (Shah et al., 2013; Sivakami et al., 2019). Of the studies, nine were conducted in primary schools alone (Freeman et al., 2012; Garn et al., 2013; Hennegan et al., 2017; Mason et al., 2015; Montgomery et al., 2016; Mucherah & Thomas, 2017; Muthengi & Austrian, 2018; Phillips-Howard et al., 2016; Tegegne & Sisay, 2014), two were conducted in secondary schools alone (Haque et al., 2013; Kansiime et al., 2020), four were conducted across both primary and secondary schools (Dolan et al., 2013; Montgomery et al., 2012; Wilson et al., 2014; Sivakami et al., 2019), and four studies did not report the school type evaluated (Belay et al., 2020; Hennegan et al., 2016; Oster & Thornton, 2011; Shah et al., 2013). Middle schools were categorized as primary schools, high schools were categorized as secondary schools, and journals that solely reported the grade levels or ages included in the study without categorization were recorded as *not reported* to avoid incorrect grouping of data due to variances in school type and grade levels across different countries. One study was conducted in an urban or peri-urban setting (Kansiime et al., 2020), nine studies were conducted in rural settings (Hennegan et al., 2016; Hennegan et al., 2017; Mason et al., 2015; Montgomery et al., 2016; Mucherah & Thomas, 2017; Muthengi & Austrian, 2018; Phillips-Howard et al., 2016; Shah et al., 2013; Wilson et al., 2014), four studies were conducted across both urban or peri-urban and rural settings (Belay et al., 2020; Dolan et al., 2013; Montgomery et al., 2012; Tegegne & Sisay, 2014), and five studies did not report the setting of their study (Freeman et al., 2012; Garn et al., 2013; Haque et al.,

2013; Oster & Thornton, 2011; Sivakami et al., 2019). Two studies were conducted in government or semi-government schools (Haque et al., 2013; Sivakami et al., 2019), three studies were conducted in a non-government or public school (Freeman et al., 2012; Garn et al., 2013; Muthengi & Austrian, 2018), one study occurred in both government or semi-government and non-government or private schools (Kansiime et al., 2020), 12 studies did not report the school type of participants (Belay et al., 2020; Dolan et al., 2013; Hennegan et al., 2016; Hennegan et al., 2017; Mason et al., 2015; Montgomery et al., 2012; Montgomery et al., 2016; Mucherah & Thomas, 2017; Oster & Thornton, 2011; Phillips-Howard et al., 2016; Tegegne & Sisay, 2014; Wilson et al., 2014), and one study did not occur in a school but still selected school-age females and evaluated their school attendance rates (Shah et al., 2013). Nine studies selected participants irrespective of menstrual status (Belay et al., 2020; Dolan et al., 2013; Freeman et al., 2012; Garn et al., 2013; Kansiime et al., 2020; Montgomery et al., 2016; Muthengi & Austrian, 2018; Oster & Thornton, 2011; Tegegne & Sisay, 2014). If the article stated that an entire school or all female students were included in the study, then the population was considered to be chosen irrespective of menstrual status. One study selected participants irrespective of menstrual status but later differentiated results between pre-menstrual and menstruating participants (Mucherah & Thomas, 2017). Nine studies chose participants respective of menstrual status, only including menstruating females (Haque et al., 2013; Hennegan et al., 2016; Hennegan et al., 2017; Mason et al., 2015; Montgomery et al., 2012; Phillips-Howard et al., 2016; Shah et al., 2013; Sivakami et al., 2019; Wilson et al., 2014). Four studies included male students in an intervention arm through either education or WASH facility improvement but reported separate findings for intervention outcomes on female school

attendance rates (Belay et al., 2020; Freeman et al., 2012; Garn et al., 2013; Kansiime et al., 2020).

Interventions: Menstrual hygiene management resources. As previously defined, menstrual hygiene management resources are encompassed by UNICEF's definition of adequate menstrual hygiene management. In this review, menstrual hygiene management resources included menstrual hygiene kits with pads and underwear and or soap, reusable pads, disposable pads, falalin cloth, menstrual cups, and WASH facilities. Nearly all studies evaluated the impact of multiple interventions through multiple arms; Six studies used menstrual hygiene kits as an intervention (Belay et al., 2020; Hennegan et al., 2016; Hennegan et al., 2017; Kansiime et al., 2020; Montgomery et al., 2016; Muthengi & Austrian, 2018), two studies used reusable pads as an intervention (Mucherah & Thomas, 2017; Wilson et al., 2014), four studies used disposable pads as an intervention (Mason et al., 2015; Montgomery et al., 2012; Phillips-Howard et al., 2016; Shah et al., 2013), one study used sanitary pads as an intervention without specifying if the intervention was reusable or disposable (Dolan et al., 2013), one study used falalin cloth as an intervention (Shah et al., 2013), and three studies used menstrual cups as an intervention (Mason et al., 2015; Oster & Thornton, 2011; Phillips-Howard et al., 2016). Three studies evaluated the impact of initiating or improving WASH facilities, including health promotion (HP) and water treatment (WT) and sanitation interventions, on absenteeism and correlated the results to menstruation, separately reporting findings for female students (Freeman et al., 2012; Garn et al., 2013; Kansiime et al., 2020). Studies varied in the number of resources that were given to intervention groups; Two studies provided 16 disposable pads per month to participants for the duration of the trial (Mason et al., 2015; Phillips-Howard et al., 2016), one study provided 12 disposable pads per month to participants for the duration of the trial (Montgomery et al., 2012),

one study provided ten disposable pads per month to participants for the duration of the trial (Muthengi & Austrian, 2018), three studies provided four reusable pads to participants for the duration of the trial (Belay et al., 2020; Kansiime et al., 2020; Mucherah & Thomas, 2017), two studies provided six reusable pads to participants for the duration of the trial (Hennegan et al., 2016; Hennegan et al., 2017) and one study provided six reusable pads to the population twice, with a year and half between distribution (Montgomery et al., 2016). Two studies did not report the number of physical resources provided to female participants (Dolan et al., 2013; Shah et al., 2013) and two studies provided no resources to girls due to implementing a cross-sectional analysis of already existing groups within the community (Sivakami et al., 2019; Tegegne & Sisay, 2014). One study evaluated the impact of reusable pads by educating participants on how to hand-make the pads, but it did not provide the resources to make them or report the average number made and used by the participants (Wilson et al., 2014). Three studies provided one menstrual cup to participants for the duration of the trial (Mason, et al., 2015; Oster & Thornton, 2011; Phillips-Howard et al., 2016).

Interventions: Education. 11 studies evaluated the impact of an education based intervention on menstruating girls' attendance rates, including educational booklets (Belay et al., 2020), educational workshops (Mucherah & Thomas, 2017) , educational skits (Kansiime et al., 2020), puberty or reproductive health education programs (Dolan et al., 2013; Haque et al., 2013; Hennegan et al., 2017; Kansiime et al, 2020; Montgomery et al., 2012; Montgomery et al, 2016; Muthengi & Austrian, 2018; Phillips-Howard et al., 2016), combining puberty education with resource provision (Dolan et al., 2013; Hennegan et al., 2017; Kansiime et al., 2020; Montgomery et al., 2012; Montgomery et al., 2016; Mucherah & Thomas, 2017; Muthengi & Austrian, 2018), and educating schoolgirls on how to make their own reusable pads (Wilson et

al., 2014). Each study that provided education varied in its approach to and length of time spent educating groups, ranging from one 75-minute educational session (Hennegan et al., 2017) to 12 45-minute educational sessions over six months (Haque et al., 2013).

No applied interventions. Two studies, both cross-sectional analyses, did not provide any interventions to the study population (Sivakami et al., 2019; Tegegne & Sisay., 2014). Instead, these studies evaluated already existing groups of girls using pads compared to girls without menstrual hygiene resources and the corresponding attendance rates of these groups, which were collected through community surveys.

Control groups. 14 studies had a control group with no interventions (Dolan et al., 2013; Freeman et al., 2012; Garn et al., 2013; Hennegan et al., 2016; Hennegan et al., 2017; Mason et al., 2015; Montgomery et al., 2012; Montgomery et al., 2016; Mucherah & Thomas., 2017; Muthengi & Austrian, 2018; Oster & Thornton, 2011; Phillips-Howard et al., 2016; Shah et al., 2013; Wilson et al., 2014). Three studies compared baseline to endline results (Belay et al., 2020; Haque et al., 2013; Kansiime et al., 2020). One intervention group was compared to best-case scenario model schools (Sivakami et al., 2019). One study compared variations within an already existing group (Tegegne & Sisay, 2014). Characteristics of included studies are synthesized in Table 1.

Confounding variables. The literature has repeatedly proven that religion, WASH facilities, and socioeconomic status are key confounding variables in menstrual hygiene management. Six of the included studies surveyed and or accounted for religion among the study population (Dolan et al., 2013; Haque et al., 2013; Kansiime et al., 2020; Montgomery et al., 2012; Sivakami et al., 2019; Tegegne & Sisay, 2014). When WASH facilities were not a primary intervention, 11 studies surveyed and or accounted for the quality and status of WASH facilities

available to study participants (Dolan et al., 2013; Haque et al., 2013; Hennegan et al., 2017; Kansiime et al., 2020; Mason et al., 2015; Montgomery et al., 2012; Montgomery et al., 2016; Muthengi & Austrian, 2018; Phillips-Howard et al., 2016; Shah et al., 2013; Sivakami et al., 2019). Ten studies surveyed and or accounted for socioeconomic statuses of the study participants (Dolan et al., 2013; Haque et al., 2013; Kansiime et al., 2020; Montgomery et al., 2012; Mucherah & Thomas, 2017; Muthengi & Austrian, 2018; Oster & Thornton, 2011; Shah et al., 2013; Phillips-Howard et al., 2016; Tegegne & Sisay, 2014). Additionally, two studies required participants to purchase their own interventions which contributed to socioeconomic status as a confounding variable in the studies (Shah et al., 2013; Wilson et al., 2014). Other various confounding variables besides religion, WASH facilities, and socioeconomic status were explored by 15 studies (Dolan et al., 2013; Freeman et al., 2012; Garn et al., 2013; Haque et al., 2013; Hennegan et al., 2016; Hennegan et al., 2017; Kansiime et al., 2020; Montgomery et al., 2012; Mucherah & Thomas, 2017; Muthengi & Austrian, 2018; Oster & Thornton, 2011; Phillips-Howard et al., 2016; Shah et al., 2013; Sivakami et al., 2019; Tegegne & Sisay, 2014).

Related studies. Many of the studies included in this systematic review are either related to each other or expand upon each other's findings. Freeman et al. (2012) and Garn et al. (2013) reported on the same clinical trials, however, Freeman et al. (2012) only reported on the water-available schools study arm, while Garn et al. (2013) evaluated both the water-available and water-scarce schools study arms. Hennegan et al. (2017) expanded upon the findings of the investigator's previous study, Hennegan et al. (2016). Both quasi-randomized studies (Hennegan et al., 2016; Hennegan et al., 2017) were based on the study *Menstruation and the cycle of poverty* by Montgomery et al. (2016). Dolan et al. (2013) and Montgomery et al. (2016) expanded upon the same pilot study conducted in Ghana by Montgomery et al. (2012). All

studies were separately evaluated, and this review strictly reported on each individual study's presentation of its results. The two systematic reviews that were included in this review (Hennegan & Montgomery, 2016; Kuhlmann et al., 2017) evaluated five of this review's included studies, which are Haque et al. (2013), Montgomery et al. (2012), Oster & Thornton (2011), Shah et al. (2013), and Wilson et al. (2014). The majority of studies included in the systematic reviews Hennegan & Montgomery (2016) and Kuhlmann et al. (2017) were not evaluated in this review due to differences in intervention and outcome criteria.

Quality Assessment of Included Studies

All 19 studies were evaluated against the Quality Assessment Tools by the National Heart, Lung, and Blood Institute (2019) per their respective study type. Quality questions about the studies were responded to with *Y* for *yes*, *N* for *no*, *P* for *partly*, *CD* for *cannot determine*, *NA* for *not applicable*, and *NR* for *not reported*. All studies were examined twice to ensure accuracy in the quality assessment, and any discrepancies between the first and second review resulted in a third reading and review of the article to determine the appropriate response. Of the before-after (pre-post) studies with no control group, only one study provided clear and reliable outcome measures (Belay et al., 2020), and only one study met and reported on having a loss to follow-up of less than 20% (Kansiime et al., 2020). No study populations in the before-after (pre-post) studies with no control group were representative of the general population. The quality assessments of before-after (pre-post) studies with no control group are presented in Table 2. Of the controlled intervention studies, no study blinded participants and or providers to treatment, and only one study met and reported on drop-out rate outcomes (Phillips-Howard et al., 2016). The quality assessments of controlled intervention studies are presented in Table 3. Of the cross-sectional studies, both (Sivakami et al., 2019; Tegegne & Sisay, 2014) received the same quality

assessment results and neither applied an exposure, but instead administered a one-time cross-sectional survey to a population, rendering much of the quality assessment to be not applicable. The quality assessments of the cross-sectional studies are presented in Table 4.

Individual study limitations and biases were also synthesized, using an objective analysis of potential biases within the studies through Cochrane Collaboration's tool for assessing risk of bias from *Cochrane's Handbook for Systematic Reviews of Interventions* (Higgins et al., 2021). Self-reported limitations and biases within the studies were also included in the synthesis table. The summaries of individual study limitations and biases are presented in Table 5.

Systematic reviews were evaluated against PRISMA checklist guidelines for quality assurance. Hennegan & Montgomery (2016) met all PRISMA checklist guidelines, while Kuhlmann et al. (2017) did not report on 12 of the checklist guidelines within its systematic review.

Major Findings of Included Studies

Education alone: Attendance improvement. Dolan et al. (2013) reported puberty education alone improving female's attendance rates by 9%, or six days, per school term. In a pre-post intervention study, Haque et al. (2013) found that there were significant improvements in the attendance of girls at school during menstruation compared to attendance rates before the educational program intervention. Hennegan et al. (2017) reported reduced menstrual-related absences for all intervention groups in its study, including an intervention arm of puberty education alone. Montgomery et al. (2012) implemented a puberty education intervention arm and reported an increase in female's attendance by 9% after five months of interventions, consistent with the findings of Dolan et al. (2013).

Education alone: No attendance improvement. There were no instances in which education alone did not positively impact attendance rates among female students.

Pads and menstrual kits alone: Attendance improvement. Hennegan et al. (2017) reported reduced menstrual-related absences for all intervention groups in its study, including an intervention arm of menstrual hygiene kits alone. Mason et al. (2015) provided disposable pads alone, and both students and the parents of students reported an increase in attendance rates. Shah et al. (2013) reported that disposable pads resulted in zero absences among female students receiving the intervention, as well as falalin resulting in fewer absences than traditional methods. Sivakami et al. (2019) reported that disposable pads resulted in females being 14% more likely to attend school and that reusable pads resulted in females being 10% more likely to attend school than girls who continued to use cloth.

Pads and menstrual kits alone: No attendance improvement. When comparing a menstrual hygiene kit intervention to a control group that continued to use traditional MHM methods, Hennegan et al. (2016) found no significant difference in female student's attendance rates, reporting 17.2% and 21.9% of female students missing school, respectively. Phillips-Howard et al. (2016) reported that disposable pads did not reduce school dropout rates.

Education and pads or menstrual kits: Attendance improvement. Belay et al. (2020) reported that the combination of educational and menstrual hygiene kit interventions improved female's attendance rates, resulting in 24% fewer absences of female students than male students after the intervention. Similarly, Dolan et al. (2013) found that providing pads and education together improved attendance rates by 9% per school term for females. Hennegan et al. (2017) reported reduced menstrual-related absences for all intervention groups in the study, including puberty education with menstrual hygiene kits. Consistent with Dolan et al. (2013), Montgomery

et al. (2012) reported a 9% increase in girl's attendance after three months of an educational and disposable pad intervention. Montgomery et al. (2016) reported that girls receiving educational and menstrual hygiene kit interventions attended school for 2.5 more days over the study period than female students who did not receive an intervention. Mucherah & Thomas (2017) reported that the combination of reusable pads and an education workshop resulted in a positive influence on female's attendance rates, resulting in attendance rates that are comparable to non-menstruating female's attendance rates. Tegegne & Sisay (2014) reported that disposable pads improved girl's likelihood to attend school by 5.37 times, and that the disposable pad intervention arm had fewer absences compared to girls not using disposable pads. Teaching girls how to make their own pads in Wilson et al. (2014) resulted in an overall 68.8% decrease in absenteeism across intervention schools, dropping absenteeism from an average of 9.9% to 3.1% of school days per term.

Education and pads or menstrual kits: No attendance improvement. Montgomery et al. (2016) implemented interventions of both puberty education and menstrual hygiene kits and reported a decrease in female's attendance rates across all arms, ranging from 5.2%-24.5%, including increased dropout rates. While there was no improvement in the attendance rates in Montgomery et al. (2016), populations that received intervention arms had the least severe drops in attendance rates over the study period.

Menstrual cups alone: Attendance improvement. Mason et al. (2015) provided menstrual cups alone, and both students and the parents of students reported an increase in attendance rates.

Menstrual cups alone: No attendance improvement. Oster & Thornton (2011) reported that an intervention of menstrual cups did not improve female's attendance rates, but instead

resulted in a 1.0% decrease in attendance. Similarly, Phillips-Howard et al. (2016) reported that menstrual cups did not reduce school dropout rates.

WASH facilities: Attendance improvement. Freeman et al. (2012) reported that schools not affected by post-election violence presented a 58% reduction in the odds of female students being absent after providing sanitation, HP, and WT interventions. Furthermore, Freeman et al. (2012) calculated that its HP and WT intervention reduced female student absences by 6.1 days per year while sanitation along with HP and WT interventions reduced female student absences by 6.8 days per year. Similarly, Garn et al. (2013) reported a positive impact of WASH interventions on female enrollment in water-scarce schools, with a higher prevalence of impact at the peak of menses onset in grades six and seven. Specifically, Garn et al. (2013) reported a 4% increase of female's enrollment in intervention schools compared to control schools in the water-scarce arm. Sivakami et al. (2019) reported that proper WASH facilities result in decreased absenteeism.

WASH facilities: No attendance improvement. Freeman et al. (2012) reported no difference in attendance rates when implementing WASH facilities in schools that were affected by post-election violence during the study period. Garn et al. (2013) reported no enrollment improvement in WASH intervention schools that had adequate access to water prior to the intervention.

Control groups: Attendance. No studies reported male student's attendance being affected by interventions, positively or negatively. No studies reported control groups improving in attendance. Hennegan et al. (2017) reported a substantial decline in the attendance rates of females that did not receive education, menstrual pads or hygiene kits, or both as an intervention. After a menstrual cup and disposable pad intervention, Mason et al. (2015) reported that the only

school that continued to experience absenteeism was the control group, which continued to use traditional, pre-intervention MHM resources. Montgomery et al. (2016) reported that individuals not receiving MHM interventions had a 17.1% greater decrease in attendance rates. Interventions on female participants are the only instances in which attendance rates are reported to have improved.

Urban v. rural schools: Attendance improvement. Dolan et al. (2013) reported that providing pads with education to both urban and rural schools similarly improved attendance rates in both of the population types. Montgomery et al. (2012) reported comparable outcomes between urban and rural schools receiving the same intervention. Belay et al. (2020) and Tegegne & Sisay (2014) did not differentiate results between urban and rural schools.

Table 2. Study Quality Assessment for Before-After (Pre-Post) Studies with No Control Group.

	Belay et al., 2020	Haque et al., 2014	Kansiime et al., 2020
1. Was the study question or objective clearly stated?	Y	Y	Y
2. Were eligibility/ selection criteria for the study population prespecified and clearly described?	Y	Y	Y
3. Were the participants in the study representative of those who would be eligible for the test/ service/ intervention in the general or clinical population of interest?	N	N	N
4. Were all eligible participants that met the prespecified entry criteria enrolled?	Y	Y	Y
5. Was the sample size sufficiently large to provide confidence in the findings?	NR	NR	N
6. Was the test/ service/ intervention clearly described and delivered consistently across the study population?	CD	CD	CD
7. Were the outcome measures prespecified, clearly defined, valid, reliable, and assessed consistently across all study participants?	Y	N	N
8. Were the people assessing the outcomes blinded to the participants' exposures/ interventions?	NR	N	NR
9. Was the loss to follow-up after baseline 20% or less? Were those lost to follow-up accounted for in the analysis?	NR	NR	Y
10. Did the statistical methods examine changes in outcome measures from before to after the intervention? Were statistical tests done that provided p values for the pre-to-post changes?	Y	Y	Y
11. Were outcomes measures of interest taken multiple times before the intervention and multiple times after the intervention? (Interrupted time-series design?)	N	N	N
12. If the intervention was conducted at a group level, did the statistical analysis take into account the use of individual level data to determine effects at a group level?	N	Y	Y

Note: Y = yes, N = no, P = partly, CD = cannot determine, NA = not applicable, NR = not reported.

Table 3. Study Quality Assessment for Controlled Intervention Studies.

Controlled intervention studies	Dolan et al., 2013	Freeman et al., 2012	Garn et al., 2013	Hennegan et al., 2016b	Hennegan et al., 2017	Mason et al., 2015	Montgomery et al., 2012	Montgomery et al., 2016	Mucherah & Thomas, 2017	Muthengi & Austrian, 2018	Oster & Thornton, 2011	Phillips-Howard et al., 2016	Shah et al., 2013	Wilson et al., 2014
1. Was the study described as randomized, a randomized trial, a randomized clinical trial, or an RCT?	N	Y	Y	P	P	Y	N	P	N	Y	Y	Y	N	Y
2. Was the method of randomization adequate (i.e., use of randomly generated assignment)?	NA	Y	Y	N	N	NR	NA	N	NA	Y	Y	Y	NA	CD
3. Was the treatment allocation concealed (so that assignments could not be predicted)?	NA	Y	Y	N	N	N	NA	N	NA	Y	Y	Y	NA	NR
4. Were study participants and providers	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Table 3. (continued)

Controlled intervention studies	Dolan et al., 2013	Freeman et al., 2012	Garn et al., 2013	Hennegan et al., 2016b	Hennegan et al., 2017	Mason et al., 2015	Montgomery et al., 2012	Montgomery et al., 2016	Mucherah & Thomas, 2017	Muthengi & Austrian, 2018	Oster & Thornton, 2011	Phillips-Howard et al., 2016	Shah et al., 2013	Wilson et al., 2014
blinded to treatment group assignment?														
5. Were the people assessing the outcomes blinded to the participants' group assignments?	NR	N	N	N	NR	NR	NR	N	NR	NR	NR	Y	NR	NR
6. Were the groups similar at baseline on important characteristics that could affect outcomes (e.g., demographics, risk factors, co-morbid conditions)?	N	Y	Y	N	N	NR	N	N	NR	Y	Y	Y	Y	N
7. Was the overall drop-out rate from the study at	NR	NR	NR	NR	NR	NR	NR	N	NR	NA	NR	Y	NR	NR

Table 3. (continued)

Controlled intervention studies	Dolan et al., 2013	Freeman et al., 2012	Garn et al., 2013	Hennegan et al., 2016b	Hennegan et al., 2017	Mason et al., 2015	Montgomery et al., 2012	Montgomery et al., 2016	Mucherah & Thomas, 2017	Muthengi & Austrian, 2018	Oster & Thornton, 2011	Phillips-Howard et al., 2016	Shah et al., 2013	Wilson et al., 2014
endpoint 20% or lower of the number allocated to treatment?														
8. Was the differential drop-out rate (between treatment groups) at endpoint 15 percentage points or lower?	NR	NR	NR	NR	NR	NR	NR	N	NR	NA	NR	Y	NR	NR
9. Was there high adherence to the intervention protocols for each treatment group?	NR	N	N	CD	CD	CD	Y	NR	NR	NA	Y	N	CD	Y
10. Were other interventions avoided or similar in the groups (e.g.,	NR	Y	Y	NR	NR	NR	NR	NR	NR	NR	NR	Y	N	NR

Table 3. (continued)

Controlled intervention studies	Dolan et al., 2013	Freeman et al., 2012	Garn et al., 2013	Hennegan et al., 2016b	Hennegan et al., 2017	Mason et al., 2015	Montgomery et al., 2012	Montgomery et al., 2016	Mucherah & Thomas, 2017	Muthengi & Austrian, 2018	Oster & Thornton, 2011	Phillips-Howard et al., 2016	Shah et al., 2013	Wilson et al., 2014
similar background treatments)?														
11. Were outcomes assessed using valid and reliable measures, implemented consistently across all study participants?	N	N	Y	N	N	N	Y	N	N	NA	Y	N	N	N
12. Did the authors report that the sample size was sufficiently large to be able to detect a difference in the main outcome between groups with at least 80% power?	NR	Y	NR	N	N	NR	N	Y	NR	Y	NR	NR	NR	NR

Table 3. (continued)

Controlled intervention studies	Dolan et al., 2013	Freeman et al., 2012	Garn et al., 2013	Hennegan et al., 2016b	Hennegan et al., 2017	Mason et al., 2015	Montgomery et al., 2012	Montgomery et al., 2016	Mucherah & Thomas, 2017	Muthengi & Austrian, 2018	Oster & Thornton, 2011	Phillips-Howard et al., 2016	Shah et al., 2013	Wilson et al., 2014
13. Were outcomes reported or subgroups analyzed prespecified (i.e., identified before analyses were conducted)?	N	N	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	N
14. Were all randomized participants analyzed in the group to which they were originally assigned, i.e., did they use an intention-to-treat analysis?	NR	N	Y	Y	N	N	Y	Y	N	Y	Y	Y	N	N

Note: Y = yes, N = no, P = partly, CD = cannot determine, NA = not applicable, NR = not reported.

Table 4. Study Quality Assessment for Observational Cohort and Cross-Sectional Studies.

	Sivakami et al., 2019	Tegegne and Sisay, 2014
1. Was the research question or objective in this paper clearly stated?	Y	Y
2. Was the study population clearly specified and defined?	Y	Y
3. Was the participation rate of eligible persons at least 50%?	Y	Y
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	N	N
5. Was a sample size justification, power description, or variance and effect estimates provided?	Y	Y
6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	NA	NA
7. Was the timeframe sufficient so that one could reasonably expect to see an exposure and outcome if it existed?	NA	NA
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	NA	NA
9. Were exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	NA	NA
10. Was the exposure(s) assessed more than once over time?	NA	NA
11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	NA	NA
12. Were the outcome assessors blinded to the exposure status of participants?	NA	NA
13. Was loss to follow-up after baseline 20% or less?	NA	NA
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	P	P

Note: Y = yes, N = no, P = partly, CD = cannot determine, NA = not applicable, NR = not reported.

Table 5. Limitations and Bias Assessment of Included Studies.

Study	Limitations	Bias
Belay et al., 2017	• No individual data • School drop-outs unidentified • Cannot separate impact of menstrual hygiene kits from educational sessions • No non-intervention comparison; Established plausibility but not causality • Participants selected irrespective of menstrual status • Comparative attendance data from previous years not available for all enrolled participants	• Risk of attrition bias due to incomplete data about loss to follow-up • Risk of performance bias due to lack of intervention blinding
Dolan et al., 2013	• Participants selected irrespective of menstrual status • Longer trial length needed to confirm results	• Risk of selection bias due to study not being randomized • Risk of attrition bias due to incomplete data about loss to follow-up • Risk of performance bias due to lack of intervention blinding • Risk of hoc analysis • Risk of bias in interpretation of qualitative data • Risk of recall bias with self-reported data
Freeman et al., 2012	• Established plausibility but not causality of menstruation causing gender differences in outcome • Study sites effected by post-election violence had school closures for 4 months • Unmeasured confounders • Limited power to detect differences between intervention groups • Low uptake or adherence to interventions • Participants selected irrespective of menstrual status	• Risk of performance bias due to lack of intervention blinding • Risk of detection bias due to lack of outcome assessment blinding • Risk of attrition bias due to incomplete data about loss to follow-up • Risk of hoc analysis
Garn et al., 2013	• No individual data • Established plausibility but not causality of menstruation causing gender differences in outcome • Migration of districts due to political changes may have effected enrollment • Low uptake or adherence to interventions • Participants selected irrespective of menstrual status	• Risk of performance bias due to lack of intervention blinding • Risk of detection bias due to lack of outcome assessment blinding • Risk of attrition bias due to incomplete data about loss to follow-up

Table 5. (continued)

Study	Limitations	Bias
Haque et al., 2014	• No hard data • Difference in persons applying the intervention, potentially leading to inconsistency and an unstandardized intervention	• Risk of recall bias with self-reported data • Risk of performance bias due to lack of intervention blinding • Risk of attrition bias with incomplete data about loss to follow-up • Risk of hoc analysis • Risk of bias in interpretation of qualitative data
Hennegan et al., 2016b	• 23 girls in the intervention group switched to the control group throughout the study • "…issues with current outcome assessment in menstrual management research and discrepancies between girls' perceptions of absorbents and their lived experiences". • Girls whose attendance would have more likely been affected by an intervention had possibly already dropped out of school, skewing the results towards better attendance rates overall • Small sample size and insufficient power • Sociodemographic confounders not accounted for in analysis • Further validity and reliability analyses need to occur	• Risk of recall bias with self-reported data • Risk of selection bias due to quasi-randomization, inadequate method of randomization, and no concealment of allocation • Risk of performance bias due to lack of intervention blinding • Risk of detection bias due to lack of outcome assessment blinding • Risk of attrition bias due to incomplete data about loss to follow-up • Risk of bias towards social desirability reporting by collecting results in the school setting and around other students • Reports results are "highly suggestive of girls providing biased, desired responses"
Hennegan et al., 2017	• No hard data • Small sample size and insufficient power • Inadequate WASH facilities not accounted for in analysis • Inconsistent intervention implementation • Use of multiple interpreters	• Risk of selection bias due to quasi-randomization, inadequate method of randomization, and no concealment of allocation • Risk of performance bias due to lack of intervention blinding • Risk of attrition bias due to incomplete data about loss to follow-up • Risk of hoc analysis • Risk of bias in interpretation of qualitative data
Kansiime et al., 2020	• Trained teachers developed their own plan for puberty education, which could lead to inconsistency in education and variable outcomes • Cannot differentiate the impact of WASH facilities from education and menstrual kit provision due to WASH being implemented across all intervention groups • Participants selected irrespective of menstrual status	• Risk of recall bias with self-reported data • Risk of social desirability reporting by using same team to obtain results as implemented the study • Risk of performance bias due to lack of intervention blinding • Risk of hoc analysis • Risk of bias in interpretation of qualitative data

Table 5. (continued)

Study	Limitations	Bias
	• Small sample size and insufficient power at endline	
Mason et al., 2015	• No hard data • Assesses short-term impact only • Inadequate WASH facilities not accounted for in analysis • Further validity and reliability analyses need to occur	• Risk of performance bias due to lack of intervention blinding • Risk of selection bias due to no concealment of allocation • Risk of attrition bias due to incomplete data about loss to follow-up • Risk of hoc analysis • Risk of bias in interpretation of qualitative data • Risk of social desirability reporting due to qualitative data being obtained from focus group discussions
Montgomery et al., 2012	• Small sample size and insufficient power • Short study duration	• Risk of selection bias due to study not being randomized • Risk of performance bias due to lack of intervention blinding • Risk of attrition bias due to incomplete data about loss to follow-up
Montgomery et al., 2016	• Significant participant drop-out; Retention rate of 57.5% • High dropout rate stratified the difference between control and intervention attendance outcomes • Participants selected irrespective of menstrual status • Inconsistent delivery of interventions across study population; Poor fidelity • Insufficient power to explain differences between interventions • Change in data collection strategy mid-trial	• Risk of reporting bias with lack of intervention blinding • Risk of selection bias due to quasi-randomization, inadequate method of randomization, and no concealment of allocation • Risk of performance bias due to lack of intervention blinding • Risk of detection bias due to lack of outcome assessment blinding • Risk of attrition bias due to loss to follow-up greater than 20%
Mucherah & Thomas, 2019	• Entire intervention group lost to follow-up	• Risk of selection bias due to not being randomized • Risk of performance bias due to lack of intervention blinding • Risk of attrition bias due to incomplete data about loss to follow-up

Table 5. (continued)

Study	Limitations	Bias
Muthengi & Austrian, 2018	• No hard data • Trial is still underway • Only hypothesizes increase in school attendance with no qualitative or quantitative data to support theory • Participants selected irrespective of menstrual status	• Risk of performance bias due to lack of intervention blinding • Risk of attrition bias due to incomplete data about loss to follow-up
Oster & Thornton, 2011	• 60% uptake of intervention by intervention group • Participants selected irrespective of menstrual status • Intervened in a population that had minimal difference in attendance rates between period and non-period days at baseline	• Risk of performance bias due to lack of intervention blinding • Risk of attrition bias due to incomplete data about loss to follow-up • Risk of hoc analysis
Phillips-Howard et al., 2016	• Self-reported data was rare and inaccessible • Short intervention period • Low uptake or adherence to interventions • Attendance data may be skewed by reasons for absences other than menstruation	• Risk of self-reporting bias due to cultural taboos • Risk of performance bias due to lack of intervention blinding
Shah et al., 2013	• Short intervention period for effects to be observed • Only 33.5% of adolescent girls in the study were students • Students participating in each intervention group may skew follow-up due to comparison/ preferences of interventions • Required participants to buy products which could skew the results based on socioeconomic status and family value on sanitary products/education	• Risk of selection bias due to not being randomized • Risk of performance bias due to lack of intervention blinding • Risk of attrition bias due to incomplete data about loss to follow-up • Risk of hoc analysis • Risk of bias in interpretation of qualitative data
Sivakami et al., 2019	• Cross-sectional analysis cannot determine causality • Evaluating already existing groups skews results of interventions by sociodemographic group • Incomplete surveys returned	• Risk of recall bias due to self-reported data
Tegegne & Sisay, 2014	• Cross-sectional analysis cannot determine causality • Evaluating already existing groups skews results of interventions by sociodemographic group	• Risk of recall bias due to self-reported data • Risk of selection bias due to purposeful selection of participants in qualitative part of the study • Risk of bias in interpretation of qualitative data

Table 5. (continued)

Study	Limitations	Bias
	• Participants selected irrespective of menstrual status	
Wilson et al., 2014	• Small sample size and insufficient power • Could not locate school registers • Assesses short-term impact only • Students variably had difficulty locating supplies • Further validity and reliability analyses need to occur • One school entirely lost to follow-up Required students to find own resources which may skew results of intervention	• Risk of recall bias due to self-reported data • Risk of performance bias due to lack of intervention blinding • Risk of attrition bias due to incomplete data about loss to follow-up • Risk of hoc analysis • Risk of social desirability reporting due to writing responses in the classroom

Discussion

Overview

Menstrual hygiene management and health that meets UNICEF's standards for adequacy are essential for the social, economic, and educational well-being of women world-wide. However, millions of girls and women in low- and middle-income countries lack access to necessary resources to meet the specified criteria for MHM and MHH (Hennegan & Montgomery, 2016; UNICEF, 2019). When MHM and MHH are inadequate, education is one of the first areas of a female's life to be affected, with heightened consequences at the beginning of menses and between primary and secondary school. Education is the foundation for women's life outcomes, including women's ability to family plan, make healthcare decisions, obtain a job in the formal labor market, and become established economically (Alam et al., 2017; Chinyama et al., 2019). Therefore, without education, women suffer, and the root cause of such suffering is period poverty. Addressing period poverty with evidence-based practice and effective interventions to improve education is necessary and needed immediately for the advancement and empowerment of women, specifically in low- and middle-income countries.

The purpose of this review is to evaluate the impact of MHM resources and education on attendance rates, including enrollment and dropout rates, of adolescent schoolgirls in low- and middle- income countries. Prior to beginning this review, it was hypothesized that menstrual management resource interventions and education interventions would improve attendance rates, and when combined, improvement in attendance would exceed the effects of the individual interventions. 21 articles were identified that evaluated intervention effects on attendance outcomes, and of the 21 articles 19 studies implemented intervention trials. Overall, intervention studies reported high uptake and feasibility of interventions.

Major Findings Assessment

The only consistent finding that has gone unrefuted by the literature is that MHM education alone improves attendance rates. All studies that evaluated the impact of education alone reported improved attendance, enrollment, or dropout rates among the study population, with multiple studies reporting a 9% improvement in attendance rates (Dolan et al., 2013; Montgomery et al., 2012). No studies reported that education interventions alone resulted in no improvement or a decline in attendance rates. However, pads and or menstrual kits alone, education combined with pads and or menstrual kits, and WASH facility interventions reported mixed outcomes of attendance, enrollment, and dropout rates. Seven intervention studies that implemented education along with pads or menstrual hygiene kits reported an improvement in attendance rates (Belay et al., 2020; Dolan et al., 2013; Hennegan et al., 2017; Montgomery et al., 2012; Mucherah & Thomas, 2017; Tegegne & Sisay, 2014; Wilson et al., 2014), whereas one study (Montgomery et al., 2016) reported a decline in attendance rates after the intervention was implemented. However, it can be concluded that the intervention provided by Montgomery et al. (2016) was actually effective, despite the overall drop in attendance rates, because intervention arms had a significantly less severe drop in attendance than control arms. Therefore, the one study (Montgomery et al., 2016) that potentially refuted the evidence of all seven trials reporting increased attendance with education and pad or menstrual kit interventions together, actually supports the use of MHM resources in improving attendance rates. Similarly, three studies reported an increase in female's attendance and enrollment in schools that received WASH facility interventions (Freeman et al., 2012; Garn et al., 2013; Sivakami et al., 2019), and although two WASH studies reported no improvement in attendance (Freeman et al., 2012; Garn et al., 2013), the reported no improvement in attendance was most likely due to the impact of war

in the study areas and not due to the intervention. Therefore, there is support for WASH facility interventions maintaining and or improving the attendance rates of adolescent females. All studies providing pads or menstrual kits alone either improved or maintained attendance rates, with no studies reporting a decline in attendance with the intervention. In fact, one study reported that pads alone resulted in zero absences in the study population (Shah et al., 2013), therefore, the effect of pads and or menstrual hygiene kits ranges from maintaining baseline attendance rates to perfect attendance rates. Finally, the intervention of menstrual cups included one study that reported improvement in attendance rates (Mason et al., 2015), one study that reported no change in attendance rates (Oster & Thornton, 2011), and one study that reported a decline in attendance rates (Phillips-Howard et al., 2016), making the outcome of a menstrual cup intervention on attendance inconclusive. Overall, studies that reported an improvement in attendance, regardless of intervention type, were more numerous than studies that reported no improvement or a decline in attendance. However, due to the wide range of study types, study implementation, locations and cultures, ages within adolescence, unidentified or large drop-out rates, confounding variables, and findings of plausibility but not causality, the results of these studies are non-generalizable, are hardly comparable, and while they may provide supportive findings to MHM interventions they cannot completely set the foundation for evidence-based practice.

Limitations

Limitations of included studies. Due to the significant study differences between the compared trials, conclusions about the effects of MHM are not concrete and can only be theorized. For example, studies were conducted across seven different countries, and while a wide range of locations and populations may contribute to generalizability, variations in cultural

taboos, stigmas, and challenges may have affected uptake, reportings, and therefore results. Populations that experience fewer stigmas may have been more open and receptive to the interventions, or populations that suffered from cultural taboos about menstruation may have experienced increased liberation with menstruation after interventions when compared to already free societies. Cultural differences are intangible and immeasurable between individual studies, and therefore the comparability of the results is limited. There was also a variation in age of participants due to primary, secondary, or both levels of school being included across all intervention types. Age is significant to this review because study participants in primary school are less likely to have begun menses than study participants in secondary school. Menstrual status would directly impact the usefulness and effectiveness of an intervention, and while some studies accounted for menstrual status when selecting participants, others did not. Furthermore, participants in secondary school are more likely to have experience with and developed strategies for managing their menstrual cycle, which may result in deflated outcomes compared to the outcomes of participants that received proper resources while they were still inexperienced in managing their period. Some studies attempted to account for these differences by including both school levels, and others selected primary schools alone to try and intervene at the onset of menses. While all study populations included adolescent females, there was still a wide range of participants within the study population, making the overall findings incomparable. School type of public or government or non-government or private also impact the comparability of study results because cost of enrollment may vary across school type, contributing to a socioeconomic confounding variable. Not only may socioeconomic status vary across school types, but government schools may be required to uphold specific WASH standards or provided menstrual resources to students, which would contribute to the school type as a confounding factor for

being girl-friendly and or providing previous exposure to the intervention. Study populations in the urban setting were also more likely to have previous exposure to the study interventions than rural populations because of the differences in resource accessibility and socioeconomics between urban and rural settings. Studies also provided various amounts of resources within intervention arms, specifically by providing different numbers of pads or amount of time spent educating, to the study populations. If girls received too few pads for their menstrual period, their attendance would therefore be impacted, and the results would not be comparable to studies that provided girls with a sufficient number of pads. Furthermore, populations that received more through and in-depth education may have had greater attendance improvements. Finally, studies that provided education interventions to both males and females must be cautiously compared to studies that only provided interventions to females because educating both sexes may have had the immeasurable impact of improving the social environment, especially in stigmatized populations. Specific study limitations are outlined in Table 5.

Bias of included studies. Every study included was determined to be at risk for multiple types of bias. While biases were found to vary between studies, all studies were at risk for interpretation bias due to multiple translations of results from native languages to English. Specific study biases are outlined in Table 5.

Limitations of this review. This review was limited by search databases and resources available to undergraduate students at the University of Arkansas. The author of this review has no conflicts of interest.

Bias of this review. This review is at risk for selective reporting bias due to including studies that evaluated or reported on the stated PICO question in any capacity, but not as the studies' sole purposes. For example, some studies set out to additionally evaluate psychosocial

outcomes or dysmenorrhea interventions, and therefore results may have been impacted by other study interventions, outside of the PICO guidelines, that were not accounted for in this review. Furthermore, while the results were non-generalizable, the consistent outcome of education alone improving attendance rates by 9% (Dolan et al., 2013; Montgomery et al., 2012) was reported on by studies that expanded upon each other, increasing the likelihood for a similar response, and decreasing the likelihood that these reportings substantiate each other. The same limitation exists for other studies that were based on one another or expanded upon past findings.

Conclusions

Gaps in the literature. While there are various outcomes that support the hypothesis that menstrual hygiene management interventions improve adolescent female's school attendance in low- and middle-income countries, there is insufficient evidence to determine the degree of intervention impact and to accurately compare current study results. Furthermore, the most effective individual intervention among pads, menstrual hygiene kits, education, and WASH facilities cannot be determined by the current literature. The inconclusive results from menstrual cup interventions also leaves a gap in the literature about the efficacy of this intervention. More studies are needed to explore this research question with generalizable and comparable results so the most effective intervention can be determined and implemented globally. The Nia Project that is currently underway will likely provide the next significant findings, and it should be closely followed for the most updated study results regarding the impact of menstrual hygiene management interventions on adolescent female's attendance rates in low- and middle-income countries (Muthengi & Austrian, 2018).

Implications for future trials. Based on past studies, future trials should survey the socio-cultural environment for stigmas and taboos about menstruation and account for these factors

when interpreting results. Other confounding variables such as socioeconomic status, religion, current quality of school WASH facilities, and previous exposure to intervention arms should be considered when interpreting results. Furthermore, the age range of participants should be restricted to the most common age for the onset of menses or should only include menstruating females. Effectively implementing studies that account for confounding and immeasurable variables will require employing holistic care and analyses of the study population, principles of community health nursing, and cultural competency. Once thorough, comparable, and foundational evidence is established about the effect of menstrual hygiene interventions on female's attendance, studies can move towards measuring the actual impact of changes in attendance through grades and class performance to develop a deeper understanding of the association between menstrual health and educational outcomes.

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