Original article

The Association of Mental Health With Menstrual Health Among Secondary School Students in Uganda: A Longitudinal Cohort Study

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A B S T R A C T

Purpose: Poor menstrual health can affect mental health through multiple biopsychosocial pathways. Few studies have examined the associations using multiple dimensions of menstrual health.
Methods: We analyzed longitudinal data collected from female secondary school students in Uganda enrolled in a cluster-randomized trial. We administered a baseline survey from March to July 2022 and an endline survey from June to August 2023. We used the Strengths and Difficulties Questionnaire (SDQ) total difficulties score to assess mental health problems. We used mixed-effects linear regression to estimate adjusted mean differences (aMDs) for the effect of baseline menstrual-related exposures on the endline SDQ score. Models were adjusted for the baseline SDQ score and school-level clustering.
Results: At baseline, we enrolled 3741 postmenarche participants from 60 schools (mean age 15.6 years, standard deviation = 0.9). Of these, 2829 (75.5%) completed the endline survey. We found evidence for an association between multiple dimensions of poor baseline menstrual health and endline mental health problems, after adjusting for sociodemographic factors and the baseline SDQ score. Dimensions of menstrual health associated with mental health included lack of social support related to menstruation (aMD = 0.74, 95% confidence interval [CI] 0.26–1.21), poorer attitudes to menstruation (aMD = 0.38, 95% CI 0.03–0.73), lower menstrual health self-efficacy (aMD = 0.60, 95% CI 0.15–1.05 for lowest vs. highest tertile) and more unmet menstrual practice needs (aMD = 1.11, 95% CI 0.61–1.60).
Discussion: Negative menstrual experiences were associated with subsequent mental health problems among in-school Ugandan adolescents, but effect sizes were small. Interventions would need to achieve large improvements in multiple dimensions of menstrual health to lead to measurable improvements in mental health.
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IMPLICATIONS AND CONTRIBUTION

This longitudinal study is one of the first studies to show that multiple dimensions of menstrual health are associated with subsequent poor mental health. However, the observed effect sizes were small. Interventions would need to achieve large improvements in multiple dimensions of menstrual health to lead to measurable improvements in mental health.

Menstrual health is a state of complete physical, mental, and social well-being in relation to the menstrual cycle [1]. Challenges in attaining menstrual health include insufficient education and awareness about puberty; lack of support from teachers and peers; limited access to suitable menstrual products; and

inadequate water, sanitation, and hygiene facilities [2]. These challenges can affect girls' mental and physical well-being, both in and outside of school [2].

Mental health problems among adolescents are a global concern, impacting overall well-being and development. One in seven adolescents experiences a mental health disorder, accounting for 13% of the global burden of disease among adolescents [3]. A recent systematic review of studies involving a total of 97,616 adolescents from general populations in Sub-Saharan Africa found a median point prevalence of 40.8% for emotional and behavioral problems, 29.8% for anxiety disorders, 26.9% for depression, 21.5% for post-traumatic stress disorder and 20.8% for suicidal thoughts [4]. The prevalences of mental health problems were consistently higher among females than males [4].

There are multiple, bidirectional pathways between poor menstrual health and poor mental health. Firstly, menstrual-related mood disorders, which include premenstrual syndrome and premenstrual dysphoric disorder, are caused by menstrual-related hormonal changes. These hormonal changes can contribute to depression, anxiety and suicidal risk [5,6], and exacerbate underlying psychiatric disorders [7]. Secondly, dysmenorrhea (pain associated with menstruation) which affects between 61% and 84% of adolescents in Sub-Saharan Africa [8–11], can lead to reduced quality of life, poorer academic performance [12,13], and depression, anxiety, and psychological distress [14–16]. The associations between dysmenorrhea and mental health align with relationships between other chronic pain and mental health [17]. However, the mechanisms between dysmenorrhea and mental health are not fully understood. Most quantitative studies to date have been cross-sectional, with none from Africa [15]. Finally, three cross-sectional studies from high-income settings have shown evidence of at least a two-fold association between period poverty (i.e., not being able to afford menstrual products regularly) and depression and anxiety, after adjusting for socioeconomic [18] or sociodemographic [19,20] confounders. This is consistent with broader bidirectional causal relationships between poverty and mental illness [21].

Many qualitative studies have highlighted the consequences of poor menstrual experience for individuals' mental health [2]. For example, experiences of shame and distress during menstruation or lack of confidence to manage menstruation can affect self-esteem, well-being, anxiety, and depression. However, these relationships between the psychosocial aspects of menstrual health and mental health have rarely been quantified [22].

To better understand the psychosocial pathways between menstrual health and mental health, we need to (i) consider multiple dimensions of menstrual health, including both the social and physical environments, (ii) use validated measures for menstrual and mental health, (iii) use prospective, longitudinal designs to understand temporal relationships, and (iv) conduct studies with populations in low- and middle-income countries. This study aims to contribute to these evidence gaps by estimating the longitudinal associations between dimensions of menstrual health and subsequent mental health problems among female secondary school students in Wakiso and Kalungu districts, Uganda.

Methods

Study design

This longitudinal study is nested in the MENISCUS cluster-randomized trial. Details of the design and intervention effects have been published previously [23,24]. In brief, 60 secondary schools in two districts were randomized 1:1 to receive the MENISCUS intervention or optimized usual care. The multicomponent intervention included puberty education, a drama skit to reduce menstrual stigma, distribution of a menstrual kit containing reusable pads and an optional menstrual cup, training in pain management strategies, and improvements to school water, sanitation, and hygiene facilities. In each school, a "Menstrual Health Action Group" consisting of teachers, students, and/or parents was established to help coordinate and sustain the intervention. All 60 schools received printed copies of the government's guidelines on menstrual hygiene management and sexuality education. In addition, all male and female students in senior 2, the second year of secondary school, received a copy of the government menstruation management reader.

Participants: All female students in senior 2 who were present at the time of the baseline survey (March–July 2022) were eligible for recruitment. We sought parental consent for those aged <18 years, followed by student assent, or consent for those aged ≥18 years. For this analysis, we include participants who reported having started menstruating at baseline, and who were present at the endline survey (June–August 2023).

Ethics approval

We received approval for the study from the Uganda Virus Research Institute Research and Ethics Committee (reference GC/127/819), the Uganda National Council of Science and Technology (reference HS1525ES), and the LSHTM Research Ethics Committee (reference 22,952-2).

Data collection

Baseline and endline surveys were self-completed by participants on tablets using ODK Collect software (San Diego, CA). We conducted cognitive testing for a selection of baseline and endline survey items to ensure they were understood as intended. Data collected included (i) sociodemographic, caregiver, and household-level characteristics; (ii) multiple dimensions of menstrual health (Table 1); and (iii) items measuring mental health problems. Data were synchronized daily to a central server and exported to Stata (version 18) (College Station, TX) for further cleaning and analysis.

Outcome and exposure measures

Our outcome was self-reported mental health problems using the Strengths and Difficulties Questionnaire (SDQ) total difficulties score [25]. It is a dimensional measure of behavioral and emotional difficulties [26] and has been widely used among adolescents in Africa [27]. The SDQ total difficulties score includes 20 items covering emotional, peer, conduct, and hyperactivity problems. The scale can be divided into internalizing and externalizing subscales, which reflect the broad psychological impacts that can arise from negative menstrual experiences, namely self-esteem, anxiety and depression (internalizing), and social participation (externalizing) [2]. We hypothesized stronger pathways between menstrual health and internalizing mental health problems and therefore conducted secondary analyses with the SDQ internalizing subscale score as the outcome.

The SDQ total difficulties score can range from 0 to 40, with each item coded on a three-point scale from "not true" to "certainly true". Higher scores indicate more problems. We

Table 1
Baseline sociodemographic and menstrual-related factors by level of the conceptual framework

Level	Measure	Brief description	Calculation	Range and interpretation
1	School-level characteristics	District (Wakiso/Kalungu), school ownership (Government/Private), mean examination score (below/above median), proportion boarding (<50%, ≥50%), class size (below/above median), day/boarding		Binary
1	Individual-level sociodemographic characteristics	Age group (<15, 15,16,17,≥18); Religion, Ethnicity (Muganda/non-Muganda), Primary caregiver (Mother, father, self/other), Household size (≥8, 6–7, 0–5), Number of meals eaten the previous day (≥3, 2, ≤1), socioeconomic status quintile		Categorical
1	Individual-level menstrual-related	Age at first menstruation, duration of menstruation		
1	Mental health problems	Strength and Difficulties Total Difficulties score	Total score	0–40
2	Social support related to menstruation	An individual has someone who they feel okay asking for support for your period if needed (for advice, resources, emotional support)		Binary
3	Attitudes toward menstruation	Attitudes about what it is okay for people to do while menstruating and myths about painkillers	Number of 3 attitude questions answered positively	0–3
3	Knowledge of puberty and menstruation	Factual knowledge about puberty, menstruation, and the menstrual cycle	Number of 9 knowledge questions answered correctly	0–9
3	Adequate menstrual product use	Used at least one adequate menstrual material (i.e. a disposable pad or tampon that is always able to be immediately disposed; a reusable pad, cloth/towel, or homemade pad that is washed with water and soap and dry before use); or a menstrual cup that is boiled during or just before/after LMP; and no inadequate materials reported at LMP		Binary
4	Pain at LMP	Reported having any pain at LMP.	Binary	
4	Effective pain management strategy	Effective pain strategies defined as stretching, painkillers, eating foods with lots of water, exercising, drinking lots of clean water, holding a warm water bottle on the stomach. Ineffective methods defined as: doing nothing, taking antibiotics, eating spicy foods, drinking soda	Using at least one effective method and no ineffective methods, among girls reporting any pain at LMP.	Binary
4	Pain relief	The amount of pain reduced (none/some/most/all) among participants reporting any pain at LMP	All/most vs. none/some, among girls reporting any pain at LMP	Binary
4	Self-efficacy in addressing menstrual needs scale (SAMNS-26)	Individuals' confidence in their capabilities to address their menstrual needs.	Mean score	0–100, representing the mean percentage confidence in addressing needs. Higher % is greater confidence
4	Menstrual Practice Needs Scale (MPNS-36)	The extent to which individuals' menstrual management practices and environments were perceived to meet their needs during their LMP.	Weighted average of i) core items and school-specific items (75% weight) and ii) relevant material-specific items (25% weight).	Range 0–3. A higher score indicates fewer unmet menstrual needs (i.e. better than a lower score).
4	Experience of teasing	Whether boys or girls tease the participant about their period		Binary
5	Trouble participating in class during menses	Do you have trouble participating in class during periods		Binary

LMP = last menstrual period.

adjusted for baseline SDQ score as an a priori confounder as we hypothesized that it would be (i) strongly associated with end-line SDQ score and (ii) a partial proxy for unmeasured confounders associated with poor mental health at baseline.

The exposures of interest were baseline menstrual-related factors, detailed in Table 1. These included two validated measures of menstrual health: the menstrual self-efficacy assessed with the Self-Efficacy in Addressing Menstrual Needs (SAMNS) score [28] and the Menstrual Practice Needs Scale (MPNS) score [29]. The SAMNS is a 26-item scale that measures individuals' confidence in their capabilities to address their menstrual needs, for example, "How sure are you that you could change your

menstrual product at school if it became necessary". The score is calculated as the mean of a participant's responses to all items and can range from 0 to 100 with higher scores representing greater confidence. Word labels anchor either end with 0 = "No, I cannot do it at all" and 100 = "Yes, I am completely sure I can do it". The MPNS is a 36-item scale which measures the extent to which individuals' menstrual management practices and environments were perceived to meet their needs during their last menstrual period (LMP). For example, "During my last menstrual period, I had enough of my menstrual products to change them as often as I wanted to". Each item is scored from 0 ("never") to 3 ("all of the time [100% of the time]"). We calculated the score as
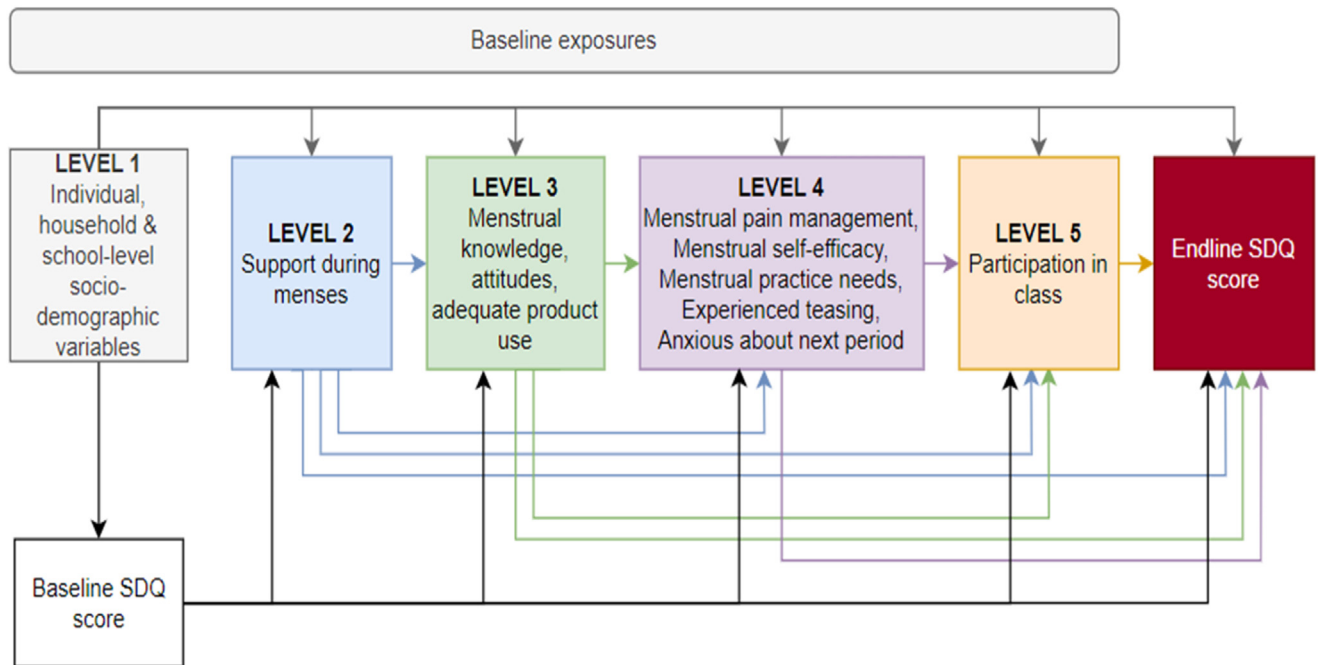
Figure 1. Conceptual framework showing hypothesized relationships between menstrual-related factors and subsequent mental health problems.

the weighted mean of (i) the core items and relevant school-specific items (75% weight) and (ii) the relevant material-specific items (25% weight). The score can range from 0 to 3 with higher scores representing fewer unmet needs.

In the MENISCUS trial, there was no evidence of an impact of the intervention on mental health problems, assessed by the SDQ total difficulties score (intervention effect adjusted mean difference [aMD] = 0.05, 95% confidence interval [CI] −0.40, 0.50) [24]. Given the lack of intervention effect on the SDQ score, we did not consider intervention arm to be a potential confounder. This is because it is not associated with the outcome and was randomized at baseline. Intervention arm could plausibly be an effect modifier and we examined this.

Statistical analyses

We constructed a conceptual framework for menstrual factors potentially related to poorer mental health (Figure 1) based on the integrated model of menstrual experiences among women in low- and middle-income settings [2]. We conducted a complete case analysis, using mixed-effects linear regression models to estimate aMDs and 95% CIs for the association of the endline SDQ total difficulties score with baseline menstrual-related variables at each level of the conceptual framework. Initially, minimally adjusted models were fitted, adjusting each exposure for a priori potential confounders: age group, district, and the baseline SDQ score as a continuous variable. We then fitted multiple multivariable models additionally adjusting for variables on the same or more distal levels. This was conducted for level 2 (social support for menstruation), level 3 (menstrual-related factors), level 4 (menstrual experiences), and level 5 (participation in class during menstruation). All models accounted for between-school clustering using a random effect for school. For each model we checked for multicollinearity by observing standard errors of the main effects when additional

variables were added, and removed variables that substantially increased the standard error. Likelihood ratio test was used to estimate p values.

We considered the possibility that the baseline SDQ score could be on the causal pathway between baseline menstrual-related exposures of interest and endline SDQ, as well as acting as a potential confounder of the association between these exposures and endline SDQ. For example, anxiety about one's next period at baseline may reflect past anxieties about menstruation and may increase the baseline SDQ score, which in turn may increase the endline SDQ score. To investigate this, we conducted a sensitivity analysis excluding adjustment for the baseline SDQ score.

Results

A total of 3878 female participants were enrolled at baseline, of whom 3741 (96.5%) reported having started menstruating. Of these, 2829 (75.6%) participants were attending a trial school at endline and seen at the endline survey (mean follow-up time 13.4 months (standard deviation [SD] = 1.2). Participants not seen at the endline survey were more likely to have a higher baseline SDQ score (mean 12.73 vs. 11.97; mean difference = 0.75, 95% CI 0.33–1.17; $p < .001$), and tended to be older ($p = .003$), be day versus boarding students ($p = .04$) and to report inadequate menstrual product use at baseline ($p = .02$). Twenty participants were missing the MPNS score at baseline. All other data were complete.

The mean age of participants at baseline was 15.6 years (SD = 0.9). Most participants attended a privately-owned school (63.9%), were day rather than boarding students (54.5%), were of Christian faith (71.1%), and reported Muganda ethnicity (69.2%). Approximately one-third lived in households of eight or more members (37.2%) and reported having at least three meals on the previous day (32.3%) (Table 2).

Table 2
Endline SDQ scores by baseline socio-demographic and mental health characteristics among 2829 female Ugandan secondary students

	N (%)	Mean endline SDQ score (SD)	Adjusted mean difference[a] (95% CI)
District			$p = .004$
Wakiso	2205 (77.9%)	10.81 (5.52)	Reference
Kalungu	624 (22.1%)	9.86 (5.17)	−0.85 (−1.43, −0.28)
School-level characteristics			
School ownership			$p = .53$
Private	1807 (63.9%)	10.68 (5.54)	Reference
Government	1022 (36.1%)	10.46 (5.31)	−0.17 (−0.69, 0.36)
High/low school-mean UNEB score			$p = .52$
Below median	1329 (47.0%)	10.45 (5.51)	Reference
Above median	1500 (53.0%)	10.73 (5.41)	0.16 (−0.33, 0.66)
Proportion boarding at baseline			$p = .41$
<50%	1552 (54.9%)	10.61 (5.46)	Reference
≥50%	1277 (45.1%)	10.59 (5.45)	0.21 (−0.29, 0.70)
Class size			$p = .03$
Below median (N < 59 female students)	888 (31.4%)	10.15 (5.17)	Reference
Above median (N ≥ 59 female students)	1941 (68.6%)	10.81 (5.57)	0.58 (0.07, 1.08)
Day versus boarding student			$p = .13$
Day	1541 (54.5%)	10.56 (5.46)	Reference
Boarding	1288 (45.5%)	10.65 (5.45)	0.30 (−0.08, 0.68)
Individual and household sociodemographic and economic characteristics			
Age group			$p = .06$[b]
<15	252 (8.9%)	10.82 (5.59)	Reference
15	1192 (42.1%)	10.56 (5.49)	−0.17 (−0.81, 0.46)
16	1014 (35.8%)	10.61 (5.39)	−0.41 (−1.06, 0.24)
17	290 (10.3%)	10.56 (5.51)	−0.51 (−1.31, 0.29)
18+	81 (2.9%)	10.69 (5.28)	−0.75 (−1.93, 0.43)
Religion			$p = .04$
Catholic	920 (32.5%)	10.35 (5.42)	Reference
Protestant/born again/Seventh Day Adventist	1092 (38.6%)	10.60 (5.60)	0.23 (−0.19, 0.66)
Muslim	807 (28.5%)	10.87 (5.30)	0.69 (0.21, 1.17)
None/other	10 (0.4%)	12.30 (4.42)	1.06 (−1.87, 3.98)
Ethnicity			$p = .04$
Muganda	1957 (69.2%)	10.69 (5.50)	Reference
Non-Muganda	872 (30.8%)	10.41 (5.35)	−0.40 (−0.78, −0.02)
Primary caregiver			$p = .42$
Mother	1657 (58.6%)	10.58 (5.52)	Reference
Father	705 (24.9%)	10.58 (5.43)	0.05 (−0.36, 0.46)
Self and others	467 (16.5%)	10.71 (5.26)	−0.30 (−0.78, 0.19)
Household size			$p = .12$
≥8	1053 (37.2%)	10.31 (5.39)	Reference
6–7	919 (32.5%)	10.52 (5.42)	0.04 (−0.37, 0.46)
0–5	857 (30.3%)	11.05 (5.54)	0.42 (−0.01, 0.84)
Number of meals eaten the previous day			$p = .05$
Three or more	916 (32.3%)	10.32 (5.46)	Reference
Two	1420 (50.2%)	10.30 (5.32)	−0.20 (−0.58, 0.20)
One or fewer	493 (17.4%)	12.00 (5.63)	0.42 (−0.10, 0.94)
Socioeconomic status quintile			$p = .37$
Highest	565 (20.0%)	10.88 (5.40)	Reference
Medium-high	591 (20.9%)	10.35 (5.43)	−0.24 (−0.78, 0.30)
Medium	556 (19.7%)	10.27 (5.39)	−0.49 (−1.04, 0.07)
Low-medium	572 (20.2%)	10.38 (5.42)	−0.45 (−1.01, 0.11)
Low	545 (19.3%)	11.17 (5.60)	−0.14 (−0.72, 0.44)
Age at first menstruation			$p = .11$
≤12 years	615 (21.7%)	11.24 (5.45)	Reference
13 years	1056 (37.3%)	10.33 (5.26)	−0.40 (−0.87, 0.06)
14 years	895 (31.6%)	10.62 (5.54)	0.07 (−0.48, 0.50)
≥15 years	263 (9.3%)	10.16 (5.59)	−0.57 (−1.27, 0.13)
Duration of menstruation			
≤ 1 year	723 (25.6%)	10.5 (5.6)	Reference
2 years	993 (35.1%)	10.4 (5.5)	−0.19 (−0.66, 0.27)
3 years	691 (24.4%)	10.8 (5.2)	0.07 (−0.46, 0.60)
≥ 4 years	422 (14.9%)	10.9 (5.7)	−0.01 (−0.66, 0.65)
Mental health − baseline SDQ			$p < .001$
Low (0–9)	1040 (36.8%)	7.88 (4.29)	Reference
Medium (10–14)	920 (32.5%)	10.48 (4.68)	2.59 (2.16, 3.02)
High (15–40)	869 (30.7%)	13.99 (5.60)	6.10 (5.67, 6.54)

CI = confidence interval; SD = standard deviation; SDQ = Strengths and Difficulties Questionnaire; UNEB = Uganda National Examination Board.
[a] Adjusted for a-priori defined potential confounders (age group, district and, continuous SDQ score at baseline).
[b] p value for trend.

The mean baseline SDQ score was 11.97 (SD 5.58), and the mean endline SDQ score was 10.60 (SD 5.46). The endline SDQ score was strongly associated with the baseline SDQ score tertile (aMD = 6.10, 95% CI 5.67–6.54 for those in the highest vs. lowest baseline SDQ tertile; adjusted for age group and district; Table 2).

After adjusting for the a priori potential confounders, having a higher endline SDQ score was associated with being in Wakiso district (aMD = 0.85, 95% CI 0.28–1.43), attending a school with above average class size (aMD = 0.58, 95% CI 0.07–1.08), being of younger age (aMD = 0.19, 95% CI 0.01–0.39 for each decrease in year of age), being Muslim (vs. Catholic) (aMD = 0.69, 95% CI 0.21–1.17), being Mugandan ethnicity (aMD = 0.40, 95% CI 0.02–0.78), and having one or fewer meals the previous day versus at least three meals (aMD = 0.42, 95% CI –0.10 to 0.94) (Table 2).

After adjusting for factors at the same or more distal levels, there was strong evidence that mental health was modestly poorer among girls with poorer social dimensions of menstrual health, including lack of social support related to their period (12.2 vs. 10.3 for those with social support; aMD = 0.74, 95% CI 0.26–1.21), poorer attitudes to menstruation (11.1 vs. 10.2 for those with 0–1 vs. 2–3 positive responses; aMD = 0.38, 95% CI 0.03–0.73), lower menstrual self-efficacy (11.8 vs. 9.5 for those with high self-efficacy; aMD = 0.60, 95% CI 0.15–1.05) and reporting teasing by boys (13.2 vs. 10.4; aMD = 0.66, 95% CI –0.02 to 1.35) (Table 3).

Participants also had poorer endline mental health if they had poor menstrual health management practices, including use of inadequate menstrual materials (12.1 vs. 10.5; aMD = 0.91, 95% CI 0.28–1.54), poor pain management (aMD = 0.45, 95% CI –0.03 to 0.94 for pain using no effective management vs. no pain at LMP) or poor pain relief (aMD = 0.46, 95% CI 0.01–0.91 for non/some pain relieved vs. no pain at LMP) and more unmet menstrual practice needs (12.5 vs. 8.8 for those with a low vs. high MPNS score; aMD = 1.11, 95% CI 0.61–1.60) (Table 3). Finally, endline mental health was associated with feeling anxious about the next period (11.9 vs. 9.5; aMD = 0.309, 95% CI 0.02–0.77) and with reporting trouble participating in class during periods (12.1 vs. 9.5; aMD = 0.69, 95% CI 0.31–1.08) (Table 3).

There was no evidence that intervention arm modified the effect of any of the menstrual-related exposures (results not shown).

Supplementary Table 1 shows the aMDs without adjustment for the baseline SDQ score. This strengthened the associations between baseline menstrual factors and the endline SDQ score. However, this analysis may overestimate the true association due to residual confounding by the baseline SDQ score. Results were similar when using the internalizing SDQ subscale score as the outcome (Supplementary Table 2).

Discussion

In this study among female adolescents in Uganda, multiple dimensions of poor menstrual health were associated with subsequent poorer mental health. These dimensions included inadequate social support during menstruation, negative attitudes toward menstruation, inadequate use of menstrual products, poor pain management, lower menstrual self-efficacy, unmet menstrual needs, and teasing by boys. Strong evidence for these associations remained after adjustment for confounders including the baseline SDQ score, suggesting a specific influence of menstrual health on mental health in this population.

To our knowledge, this is the first longitudinal study to estimate associations between psychosocial aspects of menstrual health with mental health problems. Most previous quantitative studies have been cross-sectional [30] or focused on the relationship between mental health and specific characteristics such as dysmenorrhea [15], menstrual cycle disorders [5,6], or affordability of menstrual products [19–21].

This study highlights the pathways between poor social support during menstruation, negative attitudes toward menstruation, and menstrual-related teasing on adolescent mental health problems. We found that inadequate social support during menstruation is associated with increased mental health problems. In our earlier work in this setting, we documented lack of engagement regarding puberty and menstruation from parents [31]. These observations are consistent with a cross-sectional survey of 500 women in central Uganda, which identified an association between lack of social support at work and poor well-being, measured by the World Health Organization-5 [32]. A systematic review of qualitative studies hypothesized that lack of social support, including lack of open communication with mothers, can affect menstrual experiences, which in turn can affect psychological well-being [2].

The finding that negative attitudes toward menstruation were associated with poorer subsequent mental health aligns with findings from a cross-sectional study among adolescent girls in China, which saw an association between negative menstrual attitudes with heightened psychological stress [33]. The association of poor mental health with reported teasing from boys likely reflects distress from the experience of being teased [2], although there was little evidence of an association with reported teasing from girls.

To our knowledge, our research provides the first estimate of the effect of lower menstrual self-efficacy (or menstrual care confidence) on mental health problems, using the recently developed and validated SAMNS tool [28]. This finding persisted after adjusting for other factors such as social support, and is aligned with qualitative studies suggesting that confidence in managing menstruation is a pathway through which negative menstrual experiences impact individuals' broader well-being [2].

Our finding that dysmenorrhea is associated with poorer mental health supports findings from a systematic review of qualitative studies of menstrual experiences among women and girls in low- and middle-income countries [2] and a meta-analysis of 44 quantitative epidemiological studies. These reviews found that women experiencing more severe dysmenorrhea suffer from higher levels of psychological distress [15]. The chronic and recurring nature of menstrual pain can disrupt daily functioning, leading to emotional exhaustion, anxiety, and depression, which can in turn exacerbate the perception of pain [32]. In our study, there was some evidence of poorer mental health problems among participants with pain who did not report using effective pain management strategies, compared to those with pain who did use effective strategies, but the difference was fairly small (SDQ score of 11.4 vs. 10.8). Similar associations with endline SDQ were seen with the subjective report of pain relief (Table 3). Notably, about one-third of participants with menstrual pain did not report using an effective pain management strategy, and further work is needed to improve levels of knowledge of pain management in this setting.

We found that use of inadequate menstrual products and unmet menstrual practice needs contribute to poor mental

Table 3
Associations of endline SDQ score with baseline menstrual-related exposures

Menstrual-related exposures	N (%)	Mean endline SDQ score (SD)	Minimally-adjusted mean difference SDQ score (95% CI)[a]	Fully-adjusted mean difference SDQ score (95% CI)[b]
Level 2 exposures				
Social support related to period			*p* = .002	*p* = .002
Yes	2363 (83.5)	10.28 (5.30)	Reference	Reference
No	466 (16.5)	12.20 (5.96)	0.74 (0.27, 1.21)	0.74 (0.26, 1.21)
Level 3 exposures				
Number of attitude questions answered positively (of 3)			*p* = .02	*p* = .03
Good (2—3)	1436 (50.8)	10.15 (5.32)	Reference	Reference
Poor (0—1)	1393 (49.2)	11.07 (5.55)	0.41 (0.06, 0.76)	0.38 (0.03, 0.73)
Number of knowledge questions answered correctly (of 9)			*p* = .10[c]	*p* = .19[c]
High (7—9)	444 (15.7)	10.13 (5.11)	Reference	Reference
Medium (4—6)	1997 (70.6)	10.61 (5.46)	0.39 (−0.09, 0.88)	0.39 (−0.09, 0.88)
Low (0—3)	388 (13.7)	11.09 (5.77)	0.52 (−0.13, 1.18)	0.42 (−0.24, 1.08)
Adequate menstrual product use[d]			*p* = .005	*p* = .005
Yes	2597 (91.8)	10.47 (5.35)	Reference	Reference
No	232 (8.2)	12.07 (6.34)	0.90 (0.27, 1.53)	0.91 (0.28, 1.54)
Level 4 exposures				
Menstrual pain management			*p* = .006[c]	*p* = .007[c]
No pain at LMP	745 (26.3)	9.46 (5.08)	Reference	Reference
Pain, used ≥1 effective strategy at LMP[d]	1309 (46.3)	10.80 (5.36)	0.31 (−0.12, 0.74)	0.28 (−0.16, 0.72)
Pain, used no effective strategy at LMP[d]	775 (27.4)	11.37 (5.77)	0.70 (0.22, 1.18)	0.45 (−0.03, 0.94)
Menstrual pain relief at LMP			*p* = .003[c]	*p* = .04[c]
No pain at LMP	745 (26.3)	9.46 (5.08)	Reference	Reference
All/most pain relieved at LMP	851 (30.1)	10.72 (5.54)	0.20 (−0.27, 0.66)	0.19 (−0.29, 0.66)
None/some pain relieved at LMP	1233 (43.6)	11.21 (5.51)	0.63 (0.20, 1.06)	0.46 (0.01, 0.91)
SAMNS score (tertiles)			*p* < .001[c]	*p* = .009[c]
High (high self-efficacy; 69.7—100)	960 (32.6)	9.50 (5.01)	Reference	Reference
Medium (52.4—69.6)	946 (34.1)	10.50 (5.52)	0.49 (0.06, 0.91)	0.35 (−0.07, 0.78)
Low (low self-efficacy; 0—52.3)	923 (33.3)	11.77 (5.59)	1.09 (0.66, 1.52)	0.60 (0.15, 1.05)
MPNS score (tertiles)			*p* < .001[c]	*p* < .001[c]
High (few unmet needs; 2.39—3.0)	926 (32.7)	8.84 (4.83)	Reference	Reference
Medium (1.89—2.38)	923 (32.6)	10.44 (5.22)	0.57 (0.14, 1.00)	0.48 (0.04, 0.92)
Low (many unmet needs; 0—1.88)	960 (33.9)	12.47 (5.65)	1.46 (1.00, 1.91)	1.11 (0.61, 1.60)
Experienced teasing about menstruation by boys			*p* = .002	*p* = .06
No	2616 (92.5)	10.39 (5.32)	Reference	Reference
Yes	213 (7.5)	13.20 (6.39)	1.08 (0.41,1.75)	0.66 (−0.02, 1.35)
Experienced teasing about menstruation by girls			*p* = .15	*p* = .47
No	2564 (92.6)	10.45 (5.40)	Reference	Reference
Yes	265 (9.4)	12.13 (5.78)	0.45 (−0.16, 1.06)	0.23 (−0.39, 0.84)
Anxious about next period			*p* < .001	*p* = .04
No	1528 (54.0)	9.53 (5.12)	Reference	Reference
Yes	1301 (46.0)	11.86 (5.57)	0.80 (0.44, 1.16)	0.39 (0.02, 0.77)
Level 5 exposures				
Trouble participating in class during periods			*p* < .001	*p* = .001
No	1634 (57.8)	9.54 (5.05)	Reference	Reference
Yes	1195 (42.2)	12.05 (5.65)	1.04 (0.68, 1.41)	0.69 (0.31, 1.08)

CI = confidence interval; MPNS = Menstrual Practice Needs Scale; SAMNS = Self-Efficacy in Addressing Menstrual Needs; SD = standard deviation; SDQ = Strengths and Difficulties Questionnaire.
  [a] Adjusted for a priori potential (age group, district and SDQ score at baseline).
  [b] Adjusted for variables at the same level, a priori confounders and variables at lower levels.
  [c] *p* value for trend.
  [d] At least one effective strategy used, and no ineffective strategies.

health among adolescent girls. Previous studies have indicated that this association may be due to embarrassment due to the risk of bloodstains [29,34], linked with the anticipation of teasing and ridicule from peers [2] which was also associated with poor mental health in our study. Similarly, in a qualitative study in rural Kenya, participants viewed blood leakage as a shameful event, as it often resulted in soiled dresses and subsequent ridicule, especially in a classroom setting [35].

Strengths of this study include its use of validated measures of different dimensions of menstrual health and longitudinal design. This enabled us to assess temporal associations between social and physical aspects of menstrual health, including key aspects like menstrual self-efficacy, with subsequent mental health. By adjusting for baseline sociodemographic factors and baseline mental health, we minimized confounding of the relationship between menstrual health and mental health. The strong statistical evidence for associations indicates the findings are unlikely to be due to chance.

A key limitation of our study is that the SDQ does not fully capture the complexities of mental health issues such as depression and anxiety [27]. Although the SDQ is a widely used and validated assessment of general mental health problems in adolescents, psychosocial dimensions of menstrual health may be more strongly associated with clinical measures of anxiety and depression, or with more proximal measures of self-esteem or anxiety during menstruation. However, our understanding of

these pathways is limited by the lack of validated tools for measuring common mental disorders among a general population of adolescents in Sub-Saharan Africa [36]. We found that substantial differences in menstrual health (e.g., lowest vs. highest MPNS score tertile) were associated with only modest aMDs in the SDQ total difficulties score (0.4–1.1 point). A one point difference in the mean SDQ score has a meaningful impact on the odds of subsequent clinical diagnoses of psychopathology (assessed using the Development and Well-Being Assessment [37]) in nationally-representative surveys of UK children and adolescents aged 5–17 years (odds ratio = 1.16, 95% CI 1.13–1.18) [26]. This suggests a role for menstrual health on psychological well-being through pathways described above, but further work is needed to understand relationships between menstrual health and specific depression and anxiety measures.

Additional limitations include potential bias due to the use of self-reported measures. We sought to mitigate social desirability bias by using self-completed questionnaires. Although a key strength of our study is its longitudinal design, it is also possible that the effect of menstrual health on changes in mental health may increase over a longer follow-up period, after more repeated menstrual experiences. Approximately 25% of our baseline participants were not seen at endline due to changes in school enrollment, and these participants had poorer mental health at baseline. This may have underestimated mental health problems at endline in the population but should not bias the magnitude of associations observed with mental health. Finally, we had limited measures of participants' home environment, which likely plays an important role in their menstrual experience through availability facilities and caregiver attitudes. We have previously shown that the baseline SDQ score in this population was associated with socioeconomic status and menstrual experiences at baseline [30]. By adjusting for baseline mental health, we are likely to be accounting for some residual confounding that may have otherwise been introduced by these unmeasured factors.

Conclusions

Mental health is a critical problem among adolescents globally and has multiple causes. Using longitudinal data, we have shown that poor menstrual health is associated with poor mental health in adolescents. However, despite this consistent and strong evidence for the effect of menstrual health on mental health, the estimated effect sizes were small. Our research shows that to see short-term improvements in mental health, menstrual health programs will need to make significant progress in improving menstrual health. Such interventions are more likely to be effective if they are multicomponent, addressing the multiple social, environmental, and individual factors required to achieve menstrual health [1,22].

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Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2025.04.014.

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