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Effect of a Multicomponent Intervention to Improve Menstrual Health and Hygiene and School Attendance Among Adolescent Girls in the Gambia (MEGAMBO Trial)

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A B S T R A C T

Purpose: Evidence on the effect of menstrual health and hygiene (MHH) interventions on education is scarce. This trial assessed the effect of a multicomponent intervention on school attendance, urogenital health, and other wellbeing outcomes among schoolgirls in rural Gambia.
Methods: A cluster-randomised controlled trial was conducted between July 2019 and December 2020 in 50 villages across 2 regions of The Gambia, selecting one school per village. Using restricted randomisation, half of the villages received a 3-month NGO-led intervention, which included Peer education camps, Mother's outreach sessions, Community meetings and improving school water, sanitation, and hygiene (WASH). The other 25 villages received no intervention. The primary outcome was self-reported schoolgirls' absenteeism of at least one-day due to last period. Secondary outcomes included: urinary tract infections measured with symptoms and biochemical markers, reproductive tract infections symptoms, menstruation-related wellbeing, social support and knowledge, attitudes, and practices toward menstruation. All menstruating schoolgirls 13 years and older were eligible for outcome assessment. We analyzed data on an intention-to-treat basis.
Results: Outcome assessment included 3556 schoolgirls (1832 [51.5%] in the intervention group and 1724 [48.5%] in the control group). Self-reported school absenteeism was only slightly lower in the intervention arm than the control arm (15.6% vs. 17.1%, risk difference = −1.4%, 95% CI = −4.6% −1.9%). The intervention had no effect on urogenital health but had broad positive effects on menstrual knowledge, attitudes, wellbeing, and social support.
Discussion: The multicomponent MHH intervention had no effect on absence due to last period, but achieved improvements in MHH knowledge, experiences, and needs.

IMPLICATIONS AND CONTRIBUTION

This study adds to a limited body of evidence on the effect of menstrual health interventions on schoolgirls. MEGAMBO multicomponent menstrual health intervention did not have relevant impact on girls' school attendance but had broad positive effects on knowledge, attitudes, perceptions and practices, menstrual-related wellbeing, and social support among Gambian schoolgirls.

Conflicts of interest: The authors have no conflicts of interest to disclose.
Clinical trial registry: This study is registered at PACTR, PACTR201809769868245.

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Menstrual health and hygiene (MHH) encompasses the complete mental, physical, and social wellbeing related to the menstrual cycle, not just the absence of disease [1]. Previous studies have demonstrated barriers faced by adolescent girls in maintaining safe, hygienic, and dignified menstrual experiences within school settings [2]. Challenges include lack of access to clean and effective absorbent materials; water, sanitation, and hygiene (WASH) facilities; and limited information before menstrual onset; inadequate health education about menstruation and puberty, and a lack of social support from teachers, families, and peers for managing menstruation both at school and home [1,3]. These challenges may be associated with adverse health outcomes such as urinary or reproductive tract infections (RTIs), mental health outcomes such as anxiety, shame, fear or depression, [4–6] and with girls' education outcomes [7–9] including difficulty in participating and engaging in the classroom, missed hours or days of school, and possibly contributing to school drop-out [10–13].

Longer school tenure is protective against early marriage, adolescent pregnancy, and HIV infections [14]. A systematic review of qualitative studies found girls and women reported that negative menstrual experiences impacted their physical and psychological health, as well as their education, employment, and social participation [2]. However, evidence for effective menstrual interventions to improve school attendance is scarce, due to limited studies, small size of studies, and challenges assessing attendance outcomes [2,9].

The 2019/2020 Gambian Demographic Health Survey found a net attendance ratio for girls at primary school of 78%, reducing to 50% for secondary schools, with even lower ratios in rural areas [15]. The Gambian government has implemented initiatives such as free schooling for girls [15], and the provision of free disposable sanitary pads by the Ministry of Basic and Secondary Education [16]. Previous studies conducted by our team in rural Gambia found that 27% of girls reported missing at least one-day of school due to menstruation, 21% of girls had symptoms suggestive of depression, and 75% reported at least one symptom suggestive of a urinary tract infection (UTI) [4,17,18]. Lack of knowledge of menstruation, cultural taboos and stigma, lack of adequate absorbents materials, and poor school WASH facilities contributed to school absenteeism. In addition, menstrual pain, fear of staining uniforms, and being discovered while menstruating were major concerns affecting girls' school participation and attendance [18].

This trial evaluated an intervention to support MHH and school attendance by targeting multiple MHH needs. This aligns with recommendations from a systematic review highlighting the need for MHH interventions to focus on interventions beyond only providing menstrual materials [2].

Here we report the results of a cluster randomised controlled trial to test the effectiveness of a multicomponent MHH intervention package on school attendance, health outcomes, and MHH knowledge and needs among Gambian schoolgirls.

Methods

Study design and participants

This parallel-arm cluster randomised controlled trial was conducted in 50 villages ("clusters"), across 2 rural regions of The Gambia: Lower River Region and North Bank Region (NBR). Details of the trial design and intervention setting are reported elsewhere [19]. All villages from these 2 regions that had schools with grade 7 and upward were eligible for enrolment. From the list of 65 villages, 50 villages were randomly selected using a computer generator sequence. One school per village was enrolled. If a village had 2 or more schools, the school with the largest number of enrolled girls was selected, to ensure sample size was reached. In total, 24 schools were selected from Lower River Region and 26 from NBR, including 14 Arabic-based (private) and 36 English-based (public) schools. Before the study start, discussions were held with the regional directors from the ministry of education to explain the study objectives.

Written informed consent was obtained from head teachers before randomisation to cover school-level research and intervention. Schoolgirls aged 13 years and older who has started menstruating were eligible for outcome assessment at endline. Participant consent and assent was taken before the start of the outcome assessment survey. For minors, a parent/guardian was invited to the school, the study was explained to them, and their consent was sought. An independent witness was present for the consenting discussions.

This study was approved by the Ethics Committee of the London School of Hygiene and Tropical Medicine, U.K (No. 15903) and The Gambian Government/MRCG Joint Ethics committee (SCC 1633).

Randomisation and masking

The 50 villages selected were randomised 1:1 to intervention or control groups using a restricted randomisation process to achieve balance in 9 village and school level sociodemographic variables: access to a tar road (binary), availability of electricity (binary), availability of mobile phone tower (binary), predominant building material of houses (binary), total number of girls in enrolled school, number of girls of menstruating age in enrolled school, distance to nearest major town (km), number of standpipes in village per number of household compounds, percentage of houses that own a TV dish. Randomizations not meeting the balance criteria were discarded. Further details of randomisation can be found in the MEGAMBO Trial Methodology paper [19]. The statistician was not involved in data collection or intervention delivery. Randomisation was done in Stata 17 [20]. The trial manager was aware of the allocation for logistic purposes; however, the enumerators collecting the end line survey data, and the statistician analyzing the data were blinded to the allocation. After initial statistical analysis, the allocations were revealed to the statistician to allow for subgroup analysis. The data collection team was different from the intervention delivery team.

Procedures

Intervention package. A multicomponent intervention package was developed using formative research from 2015 to 2017, together with relevant stakeholders. The intervention was delivered with the help of an NGO over a 3-months period. The package included (1) Peer Education Camps; (2) Mothers Outreach; (3) Community meetings; and (4) school WASH improvements. Peer Education Camps were delivered to all girls 13 years and older and 15 boys per schools, to improve puberty and menstrual knowledge, reduce taboos and increase conversations about the topic. Mother's Outreach sessions engaged 20 mothers per community in discussions about puberty, menstrual hygiene practices, and the importance of open conversations about menstruation with their children. Community meetings aimed to engage men in conversations about puberty and menstruation, aiming to break menstrual stigmas and taboos. School WASH improvements involved providing materials to improve water access and handwashing near the toilets and working with the schools to improve existing facilities. Further details on the intervention package have been published [19].

Outcome assessment

All outcomes were measured only at end-line using enumerator administered survey and rapid field-based urine dipstick tests. No individual-level baseline data were collected as repeated application of the same questionnaire has been shown to increase the potential for over-reporting of socially desirable outcomes [21]. In a sufficiently powered randomised trial using restricted randomisation, baseline differences are likely to have been minimised. Based on previous experience with cluster randomised trials on behaviour change, the team felt minimising responder bias by not conducting a baseline outweighs potential improvements in precision [21]. The survey captured data on sociodemographics, school attendance, MHH knowledge, attitudes, practices, wellbeing and social support, and intervention exposure. The Roche Combur 9-Test strips (Roche Diagnostics, FR) were used to measure urine Leucocytes and Nitrites from mid-stream urine samples provided by the participants. Unannounced WASH spot checks were conducted to captured data on accessibility, functionality, cleanliness and privacy of facilities, and availability of school sanitary pads.

The primary outcome was the proportion of girls reporting at least one-day school absence during their last period. The survey questions used were: “In the last 30 days how many days of school did you miss because of menstruation?” or “During your last period, how many days of school did you miss because of menstruation?” for girls who had not menstruate in the last 30 days.

Prespecified secondary outcomes included the following: (1) number of days of absence in last 30 days due to menstruation; (2) self-reported presence of urogenital infection symptoms, and biochemical markers, defining a UTI by a nitrite positive dipstick test, or a leucocyte positive dipstick test with at least one UTI symptom; (3) menstrual knowledge, attitudes, perception, and practices: Menstrual knowledge was assessed using 9 questions and the outcome was defined as proportion of girls giving correct answers to these questions. MHH attitudes and perceptions MHH were assed though 6 questions, and the outcome was defined as the proportion of girls giving correct answers and disbelief of common taboos known in this context. Menstrual Practice was assessed using 3 questions and were defined as proportion of girls having hygienic practices; (4) menstrual related wellbeing was assessed using 10 questions with binary responses. The questions were analyzed individually, before undergoing exploratory factor analysis (EFA) to construct scores summarizing menstruation related wellbeing (see statistical analysis section); and (5) Perceived menstruation-related social support, was assessed using 7 questions with 3-level response. Again, EFA was used to construct a score reflecting social support (see statistical analysis section) [19]. Finally, participants were asked 8 questions on intervention exposure.

Data management and statistical analysis

A sample size of 1862 girls per arm was estimated to be required to detect a 33% reduction in school absenteeism (from 16.8% to 11.2%) with 80% power (alpha = 0.05). Average enrolment aim was 75 girls per school, assuming an intraclass correlation coefficient of intracluster correlation coefficient 0.026 (based on pilot data) [19], resulting in a design effect of 2.9, with 25 schools required per study arm. There was a maximum cap of 300 menstruating girls per school. Further details about sample size calculations can be found in a separate paper [19].

Survey data was captured electronically using REDCap version 8.9·2 [22]. Restricted randomisation and all quantitative data analysis were done in Stata 17 [20].

Outcomes were compared between intervention and control arm on an intention-to-treat basis. For binary outcome variables binomial regression was used, with the identity link to calculate prevalence differences. For count variables (number of days missed) Poisson regression was used. Effect estimates are expressed as the rate difference (additive model). In all models, clustering at school level was adjusted for by using GEE models with robust standard errors. The strata used for randomisation were included as an indicator variable. In a secondary analysis the model was adjusted for all balance variables used for the restricted randomisation. Subgroup analyses were done for school type (English vs. Arabic), degree of urbanization (dichotomised), and school size ($<$150 girls vs. $\geq$ 150 girls enrolled). Since there was evidence of noncompliance at individual level within clusters, complier-average-causal effect estimates was also calculated using instrumental variable regression with 2-stage least squares, and robust standard errors to adjust for clustering at village level.

Because of COVID-19 restrictions, data collection in 5 schools could only be done 7 months after the other schools had been completed. These 5 schools were retained for the intention-to-treat analysis. However, a sensitivity analysis was conducted to explore the robustness of the main effect estimates to excluding these 5 schools from the analysis.

EFA was used to test the multidimensionality of the 2 sets of questions targeting menstruation-related wellbeing and social support. Due to the ordinal nature of the data, principal axis factoring was done using the polychoric correlation matrix. Factorability was determined through visual inspection of the polychoric correlation matrix and Kaiser-Meyer-Olkin (KMO) sampling adequacy. Scree plots were used, eigenvalues $>$1 (Kaiser criterion) and theoretical plausibility as criteria to determine the final factor structure. It was assumed a priori that emerging factors might be correlated and specified oblique rotation with Kaiser normalisation. Items with loadings $<$0.30 were considered to have poor loading. The final factors chosen as outcomes were collapsed into tertiles, which were then dichotomised into highest tertile versus the 2 other tertiles.

Results

A total of 4,764 schoolgirls were screened for inclusion in the endline survey; 2,448 in the intervention arm and 2,316 in the control arm. Among these, 15% had not yet started menstruating, 4% could not be traced, 4% left the school and 1% declined to participate (Figure 1). Outcomes were assessed in the remaining 3556 schoolgirls (1832 [51.5%] intervention and 1724 [48.5%] control). Recruitment of schools and randomisation occurred between July and September 2019. The intervention was delivered at the beginning of the school year, from October-December 2019 and end-line outcome data collection started February 2020. Due to COVID-19 trial procedures had to be stopped on 19th March 2020 after completion of data collection in 44 schools. Data for the remaining 5 schools was collected in November–December 2020. Of the enrolled 50 schools, one control school dropped out of outcome assessment due to COVID-19 concerns.

The characteristics of control and intervention schools and study participants are shown in Table 1. The school which dropped-out was a control, Arabic-based school from NBR region. The mean age of the target schoolgirls was 16.9 years and 16.5 years in the control and intervention arm, respectively. The average age of first menstruation was 13.8 in both intervention and control schools. The socioeconomic indicators were similar between control and intervention schoolgirls.

In intention-to-treat analysis, self-reported school absenteeism of at least one-day due to last period (primary outcome) was only slightly lower in the intervention arm than in the control arm ((1832 (15.6%) versus 1724 (17.1%), risk difference (RD) −1.4%, 95% CI -4.6%, 1.9%). The intervention effect was not affected by excluding the 5 schools where data collection happened after the COVID-related lockdown (RD −0.7%, 95% CI −4.1%, 2.6%). Similarly, the intervention had no impact on the number of days missed in the last 30 days due to period (Table 2).

Prevalence of reported symptoms of UTI in the previous 7 days of the survey was high and similar among control and intervention schoolgirls (61.7% and 58.9%, respectively). The prevalence of suggestive UTIs was slightly lower in the

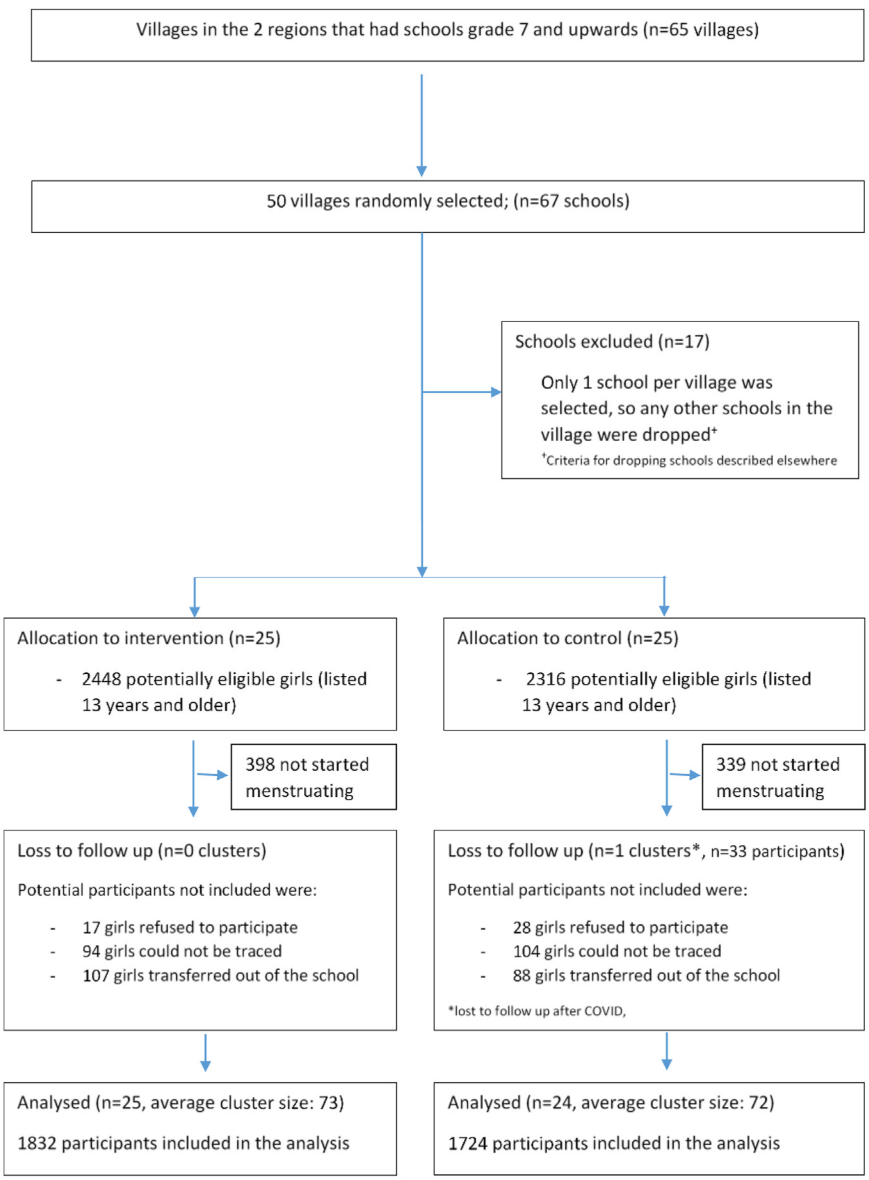

Figure 1. Trial profile.

Table 1
Characteristics of schools and Sociodemographic and socioeconomic characteristics of intervention and control participants at endline

Schools	Control (N = 24)	Intervention (N = 25)
Region		
Lower River Region	12 (50%)	12 (48%)
North Bank Region	12 (50%)	13 (52%)
School type		
English	18 (75%)	18 (72%)
Arabic	6 (25%)	7 (28%)
Total number of girls, mean (SD, range)	200 (125, 25–559)	204 (175, 26–788)
Number of girls of menstruating age, mean (SD, range)	82 (80, 11–300)	80 (74, 16–300)
Participants	**Control (N= 1724)**	**Intervention (N= 1832)**
Age, mean (SD, range)	16.9 (1.9, 12–26)	16.5 (1.8, 11–29)
Average age at Menarche	13.84	13.75
Method to reach school		
Walking	85.4	88.9
Cycle	11.1	8.2
Motorized vehicle	3.5	2.8
Other	0.1	0.1
Father's education, (%)		
No formal education	29.2	30.5
Arabic	35.6	33.7
Some primary (1–4th year)	3.2	3.9
Completed primary (6th year)	2.1	3.3
Some secondary (7–10th year)	3.4	3.9
Completed secondary (13th year)	10.9	11.4
Higher	6.4	3.9
Unknown	9.2	9.6
Mother's education, (%)		
No formal education	53.3	53.2
Arabic	25.5	24.7
Some primary (1–4th year)	6.2	7.1
Completed primary (6th year)	3.2	3.7
Some secondary (7–10th year)	4.5	4.8
Completed secondary (13th year)	2.9	2.5
Higher	1.8	1.0
Unknown	2.7	3.0
Religion, (%)		
Muslim	99.6	99.5
Christian	0.4	0.5
Other	0.1	0.1
House walls, (%)		
Mud	51.2	49.3
Cement	48.7	50.7
Other	0.1	0.0
House floor, (%)		
Mud	14.3	13.8
Cement	76.3	76.6
Tile	9.3	9.6
Other	0.1	0.1
Water source, (%)		
Unprotected well	6.4	4.7
Protected well	2.8	2.8
Community hand pump	5.7	7.3
Community standpipe	57.4	52.2
Household water	27.2	32.8
Other	0.4	0.1
Time required for round trip to water source		
<30 minutes	74.1	74.7
≥30 minutes	25.9	25.3
Sanitation, n (%)		
Pit latrine without slab	11.3	9.3
Pit latrine with slab	72.9	75.9
Pour flush/flush toilet	15.8	14.7
Other	0.0	0.1

intervention arm compared to the control arm (RD: −3.2%, 95% CI: −7.0%–0.5%), and the intervention showed no statistically significant effect on RTI symptoms (RD: −2.8%, 95% CI: −9.5%–3.9%) (Table 2).

Of the girls reporting UTI symptoms, 22.1% (44/1991) missed school in the preceding 30 days compared to 12.4% (193/1561) of girls not reporting these symptoms (Risk ratio 1.8, 95% CI 1.5, 2.1). Similarly, of the girls reporting RTI symptoms, 21.0% (454/2160) missed school compared to 12.9% (179/1392) in those not reporting symptoms (RR 1.6, 95% CI 1.4, 1.9).

The intervention had broad positive effects on self-reported menstrual knowledge, attitudes, perceptions and practices. and on girls menstrual-related wellbeing (Table 3). EFA on wellbeing suggested the presence of 2 factors. The first factor had items related to how happy/comfortable girls felt attending to schools and managing menstruation (questions 1–5). A 11.6% difference was noted for this factor (40.9% intervention vs. 27.1% control; 95% Cl 5.9%,17.4%). A second factor had relevant factor loadings by questions directly related to worries/stress about menstrual management while in schools (questions 6–10). A 11.8% difference was noted for this factor (37.4% intervention vs. 26.7% control; 95% Cl 6.9%,16.8%).

Schoolgirls in the intervention arm reported higher social support than their peers in the control schools (RD: 10.2%, 95% CI 6.3%, 14.1%). We could observe positive effects on attitudes toward talking/discussing menstruation with mothers/caregivers and teachers in schools. However, there was little effect on certain individual items such being comfortable discussing menstruation related issues with friends and being unconcerned regarding being teased by boys (less than 15% of girls in both arms reported not being worried about this) (Table 3).

During the trial, no adverse events were reported.

At the final visit post-intervention, pads were available in 12 of 21 intervention schools visited (57%), versus 16 of 22 schools in the control arm (73%, $p = .284$).

There was little increase in water availability inside the toilet before and after the intervention in either group (30.0%–26.1% control vs. 16.7%–33.3% intervention). The main differences seen were in having water around the toilets and soap at handwashing station (Table S1).

The effect of the intervention on the primary outcome, the menstruation-related wellbeing and the social support score was not substantially affected by school type (English vs. Arabic), school size and village development rank (Table 4). However, there was some indication that for the knowledge and attitude scores, effect sizes were higher in Arabic compared to English schools and attitudes toward menstruation were more positive in smaller schools.

There was some level of exposure to discussions on menstruation in both arms but far more in the intervention arm (90.8%) than in the control arm (36.4%). For the control group it mainly stemmed from conversations with teachers while that for intervention schools was often by an outsider to the school (Table S2). For the complier-average-causal effect analysis compliance in an individual girl was defined as reporting attending a session on MHH led by a peer or an outsider (this applied to 81.1% of girls in the intervention arm). The resulting effect estimate of the intervention on the primary outcome among compliers of −1.4% (95% CI −5.0%, 2.1%) was very similar to the overall estimate (Table 2).

Table 2
Effect of intervention on school absence and urogenital health outcomes

	Control		Intervention		Difference	p value	95% CI
	N	Mean % or mean counts[a]	N	Mean % or mean counts[a]			
Primary outcome							
Proportion of girls with at least one day absence due to last period	1724	17.1%	1832	15.6%	−1.4%[b]	0.407	−4.6%, 1.9%
Secondary outcomes							
Number of days of absence in last 30 days due to period	1651[e]	0.4	1759[e]	0.4	−0.04[c]	0.386	−0.13, 0.05
Urinary tract infection symptoms	1723[g]	61.7%	1829[g]	58.9%	−1.7%[b]	0.587	−7.6%, 4.3%
Reproductive tract infection symptoms	1723[g]	67.7%	1829[g]	64.0%	−2.8%[b]	0.412	−9.5%, 3.9%
Urine dipstick							
Positive for leukocytes	1444[f]	19.0%	1695[f]	19.4%	−2.1%[b]	0.305	−6.0%, 1.9%
Positive for nitrites	1444[f]	0.3%	1695[f]	0.8%	0.4%[b]	0.158	−0.1%, 0.9%
Positive for blood	1444[f]	15.0%	1695[f]	14.7%	3.7%[b]	**0.016**	0.7%, 6.7%
Suggestive of UTI[d]	1444[f]	14.0%	1695[f]	12.4%	−3.2%[b]	0.090	−7.0%, 0.5%

Bolded p-values indicate statistical significance ($p < 0.05$).
[a] Means of cluster-level means.
[b] risk difference calculated using binomial regression (binomial family, identity link) adjusted for stratum (fixed effect) and school-level clustering (GEE).
[c] difference in counts calculated using Poisson regression (Poisson family, identity link) adjusted for stratum (fixed effect) and school-level clustering (GEE).
[d] At least one UTI symptom and positive for either nitrites or leucocytes.
[e] N different to total N because girls that had experienced a period in the last 30 days did not answer this question.
[f] N different to total N because we were unable to get a urine sample from all girls, either because they were unable to provide a sample at that time, they refused to provide a sample, the school refused for samples to be collected.
[g] N different from total N because some participants did not provide an answer for those particular questions.

The intracluster correlation coefficient was 0.016 for the primary outcome, 0.059 for the menstruation related wellbeing score (first factor), and 0.043 for the social support score.

Discussion

Our findings show no evidence that this multicomponent MHH intervention in rural Gambia reduced girls school absenteeism due to their last period. However, positive effects were documented for secondary outcomes, including MHH knowledge, experiences and needs among schoolgirls.

Other studies have found mixed evidence on the relationship between menstruation and school attendance [13,23–26]. The low effect on school attendance observed in our study might be because the behavioural and structural factors that were targeted by the intervention activities were insufficient to change other intermediate outcomes that could translate in higher impacts on attendance, such as concentration, participation, learning, self-esteem, enjoyment of learning and school environment. Lack of appropriate and sufficient menstrual material could be another cause, as government supplies are not always available during the whole school year, and menstrual products were not distributed by the trial. The intervention was developed to mainly focused on improving perceptions of the menstrual absorbents currently available and promoting best practices for the different types of materials available, rather than promoting any particular material as a way to ensure sustainability. There was an increase in satisfaction with materials used, but access was still a concern for many girls. Further work needs to be done to explore sustainable access to menstrual absorbents.

Although the intervention included aspects of pain management strategies in the peer education sessions, no painkillers were provided to the girls. Previous studies have shown that menstrual pain is a significant barrier to school attendance [5,18,25,27].

The lack of effect on school absence in this study could be also related to challenges in collecting school absenteeism data due to recall bias. Bias could also have been introduced by girls being absent from school due to menstruation at the time of the outcome assessment not being included in the estimate. However, the daily prevalence of school absence due to menstruation was probably too low for this to cause substantial bias, as the 30-day period prevalence used as outcome was already below 20%. Other groups have documented similar challenges in measuring school attendance in low resource settings [5,8,28], suggesting the need for exploring better ways of measurement, or the use of proxy outcome variables.

We observed only a small effect on urogenital symptoms and UTI infections. In previous observational studies, use of reusable material was associated with urogenital infections, while toilets privacy was protective for Bacterial vaginosis [29]. This lack of effect could be associated with the intervention not being successful in providing enough disposable materials, girls not being able to wash and dry reusable material hygienically or not being able to provide sufficient privacy at the schools WASH facilities to manage menstruation hygienically and with comfort. Bacterial vaginosis was not measured in girls, potentially missing an impact on this asymptomatic type of RTI. Our intervention did not address other determinants of urogenital health such as sexual activity, or history of previous urogenital infections. The high proportion of girls reporting UTI and RTI symptoms, and the strong effect these symptoms had on missing school is concerning, suggesting that interventions targeting these conditions more specifically could contribute to reducing school absence.

In many contexts menstruation is associated with negative attitudes and perceptions, resulting in limited discussions, lack of preparedness for menarche and many misconceptions about menstruation [2,8,11,17,25,30]. This intervention successfully improved knowledge, attitudes and perceptions of menstruation among all groups, such as increased social support, improved confidence and well-being in school while menstruating. But did

Table 3
Effect of intervention on Menstrual Knowledge, Attitudes, Practices, Wellbeing and Social Support Outcomes

	Control		Intervention		Difference %	*p* value	95% CI
	N	Mean %[a]	N	Mean %[a]			
Knowledge							
Old women do not menstruate	1724	74.8	1830[d]	81.7	5.0[b]	**0.005**	1.5, 8.5
Menstruation is not a disease	1724	65.4	1830[d]	76.2	10.4[b]	**0.001**	4.4, 16.3
Pregnant women do not menstruate	1724	75.4	1830[d]	82.0	5.8[b]	**0.003**	1.9, 9.6
Menstrual blood does not come from stomach	1724	65.3	1830[d]	79.2	9.9[b]	**<0.001**	5.9, 13.8
Menstrual blood comes from womb	1724	55.8	1830[d]	71.7	10.3[b]	**<0.001**	6.6, 14.0
A girl can get pregnant before first period	1724	14.0	1830[d]	34.6	20.1[b]	**<0.001**	14.0, 26.3
Girls and women do not start their period on the same day each month	1724	57.9	1830[d]	58.8	−0.9[b]	0.696	−5.7, 3.8
Knows that duration of period is 2–7 days	1724	65.4	1830[d]	72.3	8.3[b]	**0.002**	2.9, 13.6
Knows that duration of cycle is 21–45 days	1724	21.7	1830[d]	31.2	10.1[b]	**<0.001**	5.1, 15.1
Proportion of correct responses	1724	55.1	1830[d]	65.1	9.4[c]	**<0.001**	6.8, 11.9
Attitude & perception							
Does not believe disposable pads cause disease	1724	48.5	1830[d]	63.3	10.8[b]	**<0.001**	5.6, 15.9
Does not believe that someone else seeing the menstrual absorbents results in infertility	1724	33.4	1830[d]	45.0	8.3[b]	**0.002**	3.1, 13.6
Thinks it is acceptable to burn absorbent	1724	10.6	1830[d]	17.3	7.3[b]	**<0.001**	4.2, 10.4
Thinks it is acceptable to cook while menstruating	1724	50.8	1830[d]	67.9	13.8[b]	**<0.001**	7.3, 20.4
Thinks it is acceptable to go out while menstruating	1724	84.5	1830[d]	92.2	7.6[b]	**<0.001**	3.9, 11.4
Thinks it is acceptable to go to school while menstruating	1724	93.6	1830[d]	96.9	2.6[b]	**0.018**	0.4, 4.7
Proportion of positive attitudes & perceptions	1724	53.5	1830[d]	63.6	8.7[c]	**<0.001**	6.1, 11.1
Practice							
During heavy bleeding changes absorbent material 3 or more times a day	1723[d]	71.0	1829[d]	80.4	8.9[b]	**<0.001**	5.1, 12.7
Has changed absorbent material while at school at least once in last 3 months	1723[d]	20.7	1829[d]	34.2	13.2[b]	**<0.001**	6.9, 19.4
Dries reusable cloth in bathroom/toilet without roof or outside in sun	1562[e]	71.4	1657[e]	84.9	13.4[b]	**<0.001**	8.2, 18.5
Proportion of positive practices	1562[e]	54.0	1657[e]	66.3	11.6[c]	**<0.001**	7.9, 15.4
Menstruation related wellbeing							
Happy about usual activities while menstruating at school?	1723[d]	22.6	1829[d]	32.1	6.6[b]	**0.001**	2.7, 10.6
Happy about using the school toilets while menstruating?	1723[d]	18.2	1829[d]	31.1	11.4[b]	**<0.001**	7.4, 15.4
Happy about using your menstrual absorbent in the school this month?	1722[d]	31.0	1829[d]	40.7	8.7[b]	**0.004**	2.9, 14.6
Happy about participating in class during your period?	1723[d]	27.1	1829[d]	36.8	6.9[b]	**0.010**	1.7, 12.1
Happy feeling about when you are on your period as compared to when you are not	1723[d]	49.5	1829[d]	59.8	8.2[b]	**0.014**	1.6, 14.8
Not worried about not having access to absorbent material when you are menstruating in school?	1722[d]	20.3	1829[d]	27.0	6.7[b]	**0.001**	2.6, 10.8
Not worried about what to do with the used absorbent material when you change in the school	1722[d]	30.8	1829[d]	39.7	12.0[b]	**<0.001**	7.3, 16.7
Not worried about amount of water you have in the toilet at school	1723[d]	32.9	1829[d]	33.0	2.4[b]	0.359	−2.8, 7.7
Not worried about staining your uniform at school	1723[d]	16.4	1829[d]	16.9	1.8[b]	0.386	−2.3, 5.9
Not worried about people will know that you are menstruating	1722[d]	16.8	1829[d]	18.5	3.2[b]	0.112	−0.8, 7.2
Menstruation-related wellbeing factor 1 (“Comfort”): highest tertile (“happy/not comfortable”)	1722[d]	27.1	1829[d]	40.9	11.6[b]	**<0.001**	5.9, 17.4
Menstruation-related wellbeing factor 2 (“Not stressed”): highest tertile (“happy/not worried”)	1722[d]	26.7	1829[d]	37.4	11.8[b]	**<0.001**	6.9, 16.8
Social support							
Happy going to school during your last period	1723[d]	24.0	1829[d]	30.5	6.0[b]	**0.028**	0.6, 11.4
Happy in your usual activities while menstruating at home	1723[d]	31.4	1829[d]	39.1	4.0[b]	0.155	−1.5, 9.5
Happy to talk with your mother/female caregiver about menstruation	1723[d]	52.6	1829[d]	61.0	7.5[b]	**0.009**	1.9, 13.1
Happy to talk with teachers about menstruation in school	1723[d]	36.9	1829[d]	46.7	7.7[b]	**0.002**	2.9, 12.5
Happy to talk about menstruation with other friends or school peers	1723[d]	82.4	1829[d]	85.0	2.1[b]	0.164	−0.9, 5.1
Not worried boys will tease you in school because you are menstruating	1723[d]	13.4	1829[d]	14.5	0.8[b]	0.699	−3.4, 5.0
Mother/care giver prepared me well for menstruation	1723[d]	50.4	1829[d]	53.8	1.2[b]	0.71	−5.3, 7.8
Social support score: highest tertile (“good support”)	1723[d]	26.6	1829[d]	37.5	10.2[b]	**<0.001**	6.3, 14.1

Bolded *p*-values indicate statistical significance ($p < 0.05$).
[a] Means of cluster-level means.
[b] Risk difference calculated using binomial regression (binomial family, identity link) adjusted for stratum (fixed effect) and school-level clustering (GEE).
[c] Difference in proportion of correct or positive of responses calculated using Linear regression adjusted for stratum (fixed effect) and school-level clustering (GEE).
[d] N different from total N because some participants did not provide an answer for those particular questions.
[e] N different from total N because the question was only answered by participants who used reusable menstrual absorbents.

not reduce stigma related factors such as girls' fears of being discovered while menstruating, fear of teasing from boys or fear of staining the uniform.

The WASH observational data suggests there was an increase in water and soap inside or around the school toilets in the intervention school; however, most girls still reported being worried

Table 4
Subgroup analysis

	Control		Intervention		Difference %[a]	95% CI	p (interaction)
	N	Mean %[a]	N	Mean %[a]			
Primary outcome							
By school type							0.567
English	1577	17.9	1700	16.1	−1.0	−4.3, 2.3	
Arabic	147	14.7	132	14.3	−3.6	−14.3, 7.1	
By school size							0.408
<150	349	15.8	609	17.0	−1.9	−9.4, 5.6	
≥150	1375	18.0	1223	14.1	−1.1	−4.4, 2.2	
By village development							0.565
Less developed	897	18.9	970	16.1	−3.3	−8.4, 1.7	
More developed	827	14.1	862	14.6	−1.1	−7.4, 5.2	
Menstruation-related wellbeing score (highest tertile)							
By school type							0.279
English	1575	28.5	1697	37.4	10.6	5.3, 15.6	
Arabic	147	22.5	132	45.1	17.9	−1.5, 37.3	
By school size							0.634
<150	348	25.5	608	42.4	13.3	1.9, 24.7	
≥150	1374	28.6	1221	36.8	10.7	4.0, 17.4	
By village development							0.983
Less developed	896	28.7	968	43.0	10.0	1.7, 18.4	
More developed	826	24.1	861	32.2	5.1	0.0, 10.6	
Social support score (highest tertile)							
By school type							0.293
English	1576	26.7	1697	36.6	9.5	5.3, 13.6	
Arabic	147	26.2	132	39.7	14.0	4.1, 24.8	
By school size							0.956
<150	348	27.0	608	36.4	10.6	2.2, 19.0	
≥150	1375	26.2	1221	38.6	11.3	5.3, 17.4	
By village development							0.570
Less developed	897	25.7	968	39.6	10.6	5.2, 16.0	
More developed	826	27.9	861	32.9	7.7	0.4, 15.1	
Knowledge score							
By school type							**0.036**
English	1577	56.2	1702	64.9	8.2	5.5, 10.9	
Arabic	147	51.6	132	65.7	14.3	8.3, 20.4	
By school size							0.547
<150	349	53.0	611	63.9	10.8	6.0, 15.6	
≥150	1375	56.6	1223	66.5	9.2	6.4, 12.1	
By village development							0.683
Less developed	897	55.0	972	64.5	8.2	5.7, 10.6	
More developed	827	55.2	862	66.5	11.3	5.6, 17.0	
Attitude score							
By school type							0.053
English	1577	53.5	1702	62.2	7.5	5.0, 10.0	
Arabic	147	53.6	279	67.3	15.1	8.3, 21.9	
By school size							**0.011**
<150	349	52.1	611	65.5	12.8	8.4, 17.3	
≥150	1375	54.6	1223	61.6	5.7	3.0, 8.3	
By village development							0.797
Less developed	897	54.6	972	64.5	10.2	6.3, 14.1	
More developed	827	51.8	862	61.7	8.1	4.5, 11.6	
Practice score							
By school type							0.159
English	1422	56.3	1531	66.5	10.3	6.1, 14.5	
Arabic	140	47.1	126	66.0	18.4	10.1, 26.0	
By school size							0.300
<150	319	51.7	562	66.6	14.6	6.8, 22.4	
≥150	1243	55.6	1095	66.1	10.1	4.9, 15.2	
By village development							0.443
Less developed	803	54.5	906	65.8	9.0	4.3, 13.8	
More developed	753	53.2	751	67.4	13.0	3.4, 22.7	

Bolded p-values indicate statistical significance ($p < 0.05$).
[a] Risk difference calculated using binomial regression (binomial family, identity link) adjusted for stratum (fixed effect) and school-level clustering (GEE).

there being not enough water at the toilets and reported not being happy to use school toilets while menstruating. Results indicated that effective and sustainable solutions to create girl friendly WASH environments need to be explored.

This study is limited by the constraints placed on the period for intervention delivery and follow-up. Although short interventions (which reduce intervention costs) were deemed necessary to achieve scale, it restricted the nature of the intervention, as changes in some behaviours, cultural beliefs can take longer time to achieve a measurable impact [31]. School register data intended for verifying reported school absenteeism data was found incomplete and unsuitable for this purpose, necessitating reliance on only participant-reported data. To minimise recall bias, all outcomes focused on recent events.

Strengths of our study included the large sample size and the randomisation at the village-level to avoid contamination effects of the intervention. Novel aspects of the intervention include the inclusion of schoolboys and parents as intervention targets to improve the social environment.

Our findings raise important questions about what components and duration MHH interventions need to include to have an impact on girls' education. Our study showed that the multicomponent intervention was able to change important factors related to the menstrual experience, including knowledge, perceptions, practices, wellbeing and social support, but it did not have a clear impact on school attendance. This study also questions if school absenteeism behaviour while enrolled in school is the most useful outcomes for MHH interventions, as well as how an overreliance on these outcome measures may limit MHH policy impact. Similar conclusions have been reported by other researchers since the inception of this project [32–34]. We suggest that interventions may need a longer duration and more creative strategies to address menstrual stigmas and taboos that surround the schoolgirls' physical and psychosocial environment. We also recommend to link MHH intervention to other sexual and reproductive health interventions, strengthening pain management strategies and to invest in better and more sustainable improvements on school WASH systems. Interventions aiming to promote student MHH by modifying the whole-school and family environment can have effects of public health importance across a broad range of important outcomes in adolescent girls. We also recommend against overreliance on absenteeism as the sole outcome and consider other outcomes such as concentration, learning, self-esteem or wellbeing while in school.

Further investment is warranted, in The Gambia and in other contexts, to invest in MHH programs at school and community level to improve menstrual experiences of adolescent girls, which in turns could translate in better education achievements.

Data sharing

Deidentified participant data and a data dictionary will be made available upon publication. Requests for data can be made via email to the corresponding author. Data will be available up to 5 years post publication.

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Contributors: VS conceptualised the study and was involved in formal analysis, investigation, methodology, data curation, funding acquisition, project administration, supervision, visualisation, writing of the original draft, and writing and reviewing the manuscript. WPS was involved in formal analysis, methodology, funding acquisition, data visualisation, writing of the original draft, and writing and reviewing the manuscript. BS was involved in data curation, and writing and reviewing the manuscript, ES was involved in methodology, and writing and reviewing the manuscript. FM was involved in methodology, investigation, and writing and reviewing the manuscript. JH was involved in methodology, data visualisation, data interpretation and writing and reviewing the manuscript. PPH was involved in methodology, data interpretation and writing and reviewing the manuscript. BT conceptualised the study and was involved in formal analysis, investigation, methodology, data curation, funding acquisition, project administration, supervision, visualisation, writing of the original draft, and writing and reviewing the manuscript. VS and WPS accessed and verified all data. All authors had access to all data in the study and had final responsibility for the decision to submit for publication.

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Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2024.12.018.

References

[1] Hennegan J, Winkler IT, Bobel C, et al. Menstrual health: A definition for policy, practice, and research. Sex Reprod Heal matters 2021;29:1911618.
[2] Hennegan J, Shannon AK, Rubli J, et al. Women's and girls' experiences of menstruation in low- and middle-income countries: A systematic review and qualitative metasynthesis. PLoS Med 2019;16:e1002803.
[3] Haver J, Long JL, Caruso BA, Dreibelbis R. New directions for assessing menstrual hygiene management (MHM) in schools: A bottom-up approach to measuring program success (Dispatch). Stud Soc Justice 2018;12:372–81.
[4] Nabwera HM, Shah V, Neville R, et al. Menstrual hygiene management practices and associated health outcomes among school-going adolescents in rural Gambia. PLoS One 2021;16:e0247554.
[5] Miiro G, Rutakumwa R, Nakiyingi-Miiro J, et al. Menstrual health and school absenteeism among adolescent girls in Uganda (MENISCUS): A feasibility study. BMC Wom Health 2018;18:4.
[6] Van Eijk AM, Sivakami M, Thakkar MB, et al. Menstrual hygiene management among adolescent girls in India: A systematic review and meta-analysis. BMJ Open 2016;6:e010290.
[7] Schoep ME, Adang EMM, Maas JWM, et al. Productivity loss due to menstruation-related symptoms: A nationwide cross-sectional survey among 32 748 women. BMJ Open 2019;9:e026186.
[8] Sumpter C, Torondel B. A systematic review of the health and social effects of menstrual hygiene management. PLoS One 2013;8:e62004.
[9] Hennegan J, Montgomery P. Do menstrual hygiene management interventions improve education and psychosocial outcomes for women and girls in low and middle income countries? A systematic review. PLoS One 2016;11:e0146985.
[10] Sommer M, Sahin M. Overcoming the taboo: Advancing the global agenda for menstrual hygiene management for schoolgirls. Am J Public Heal 2013; 103:1556–9.
[11] Phillips-Howard PA, Caruso B, Torondel B, et al. Menstrual hygiene management among adolescent schoolgirls in low- and middle-income countries: Research priorities. Glob Health Action 2016;9:33032.
[12] Alam MU, Luby SP, Halder AK, et al. Menstrual hygiene management among Bangladeshi adolescent schoolgirls and risk factors affecting school absence: Results from a cross-sectional survey. BMJ Open 2017;7:e015508.
[13] Oster E, Thornton R. Menstruation, sanitary products, and school attendance: Evidence from a randomized evaluation. Am Econ J Appl Econ 2011; 3:91–100.

[14] Montgomery P, Ryus CR, Dolan CS, et al. Sanitary pad interventions for girls' education in Ghana: A pilot study. PLoS One 2012;7:1–7.
[15] Gambia Bureau of Statistics, ICF. The Gambia demographic and health survey 2019-20. 2021. https://dhsprogram.com/pubs/pdf/FR369/FR369.pdf. Accessed May 3, 2023.
[16] Gender Education Unit. Study into the impact of the supply of sanitary pads on girls''schooling. Banjul, Gambia: Ministry for Basic and Secondary Education; 2011.
[17] Shah V, Nabwera HM, Sosseh F, et al. A rite of passage: A mixed methodology study about knowledge, perceptions and practices of menstrual hygiene management in rural Gambia. BMC Publ Health 2019;19:277.
[18] Shah V, Nabwera H, Sonko B, et al. Effects of menstrual health and hygiene on school absenteeism and drop-out among adolescent girls in rural Gambia. Int J Environ Res Public Heal 2022;19:3337.
[19] Shah V, Phillips-Howard P, Hennegan J, et al. Puberty health intervention to improve menstrual health and school attendance among adolescent girls in the Gambia: Study methodology of a cluster-randomised controlled trial in rural Gambia (MEGAMBO TRIAL). Emerg Themes Epidemiol 2022;19:6.
[20] Stata; Version 17. Software for Statistics and data Science | Stata. Available at: https://www.stata.com/. Accessed January 8. 2021.
[21] Schmidt WP, Chauhan K, Bhavsar P, et al. Cluster-randomised trial to test the effect of a behaviour change intervention on toilet use in rural India: Results and methodological considerations. BMC Publ Health 2020;20:1389.
[22] REDCap Software, https://projectredcap.org/software/. Accessed May 6, 2021.
[23] Phillips-Howard PA, Nyothach E, Ter Kuile FO, et al. Menstrual cups and sanitary pads to reduce school attrition, and sexually transmitted and reproductive tract infections: A cluster randomised controlled feasibility study in rural Western Kenya. BMJ Open 2016;6:e013229.
[24] Grant M, Lloyd C, Mensch B. Menstruation and school absenteeism: Evidence from rural Malawi. Comp Educ Rev 2013;57:260–84.
[25] Tegegne TK, Sisay MM. Menstrual hygiene management and school absenteeism among female adolescent students in Northeast Ethiopia. BMC Publ Health 2014;14:1118.
[26] Wilson E, Reeve J, Pitt A. Education. Period. Developing an acceptable and replicable menstrual hygiene intervention. Dev Prac 2014;24:63–80.
[27] Ezebialu I, Ezenyeaku C, Umeobika J. Prevalence of dysmenorrhea and its contribution to school absenteeism among Nigerian undergraduate students. Ann Heal Res 2021;7:59–66.
[28] Kansiime C, Hytti L, Nalugya R, et al. Menstrual health intervention and school attendance in Uganda (MENISCUS-2): A pilot intervention study. BMJ Open 2020;10:31182.
[29] Torondel B, Sinha S, Mohanty JR, et al. Association between unhygienic menstrual management practices and prevalence of lower reproductive tract infections: A hospital-based cross-sectional study in Odisha, India. BMC Infect Dis 2018;18:473.
[30] Thakur H, Aronsson A, Bansode S, et al. Knowledge, practices, and restrictions related to menstruation among Young women from low socioeconomic community in Mumbai, India. Front public Heal 2014;2:72.
[31] Aboud FE, Singla DR. Challenges to changing health behaviours in developing countries: A critical overview. Soc Sci Med 2012;75:589–94.
[32] Benshaul-Tolonen A, Zulaika G, Sommer M, Phillips-Howard PA. Measuring menstruation-related absenteeism among adolescents in low-income countries. In: Bobel C, Winkler IT, Fahs B, et al., eds. The Palgrave Handbook of Critical Menstruation Studies. Singapore: Palgrave Macmillan; 2020:705–23.
[33] Sommer M, Caruso BA, Torondel B, et al. Menstrual hygiene management in schools: Midway progress update on the "MHM in ten" 2014–2024 global agenda. Heal Res Policy Syst 2021;19:1.
[34] Hennegan J. In: Bobel C, Winkler IT, Fahs B, et al., eds. Interventions to Improve Menstrual Health in Low- and Middle-Income Countries: Do We Know what Works? Singapore: Springer; 2020.