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Culture, self-esteem and menstrual hygiene management among adolescent girls in Uganda: the impact of economic and family strengthening

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Abstract

Background In many Sub-Saharan African countries (SSA), including Uganda, adolescent girls, especially those from low-income families, are disproportionately affected by inadequate menstrual hygiene management (MHM) facilities and supplies. This study assesses the impact of two interventions, including economic empowerment and family-strengthening interventions, on the self-esteem of adolescent girls and explores the moderating effects of cultural attitudes and menstrual hygiene knowledge.

Methods We analyzed longitudinal data from a 3-arm Cluster Randomized Control Trial, Suubi4Her study, with a follow-up period of 24 months (2018–2022). A total of 1260 adolescent girls, aged 14–17 years, and living within a family were recruited from 47 schools within five geopolitical districts in Southwestern Uganda. The three study arms were: control (n = 16 schools, n = 408 students), Economic Empowerment using incentivized youth development accounts (YDA) (n = 16 schools, n = 471 students), and YDA + a family strengthening intervention that uses Multiple Family Group (MFG) meetings to address adolescent girls' and family health and wellbeing (n = 15 schools, n = 381 students). We used mixed-effect linear regression models to assess the impact of economic empowerment on self-esteem, measured by the Rosenberg Self-Esteem Scale, and the moderation effect of menstrual hygiene knowledge, measured by a nine-item scale, and cultural attitudes, measured by self-reported school absence during menstrual periods.

Results Baseline demographic characteristics indicate no statistically significant difference across the intervention arms. We found statistically significant main effects for time ($\chi^2(2) = 102.07$, p < 0.001) and intervention-time interaction effects ($\chi^2(4) = 12.99$, p = 0.011). Pairwise group comparisons at the different assessment time points showed no significant differences in self-esteem between YDA group and the control at baseline ($\beta = 0.173$ (-1.453, 1.108), p = 0.791), at 12 months ($\beta = 0.372$ (-0.893, 1.637), p = 0.565), and at 24 months ($\beta = 0.153$ (-0.904, 1.210), p = 0.777), indicating no significant effect of the YDA intervention alone on self-esteem. Similarly, no significant differences in

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self-esteem were found between the YDA + MFG group and the control at baseline (β =-0.299 (-1.713, 1.114), *p*=0.678) and 12 months (β =0.986 (-0.495, 2.468), *p*=0.192). However, at 24-months follow-ups, the YDA + MFG group showed significantly higher self-esteem than the control (β =1.282 (0.084, 2.480), *p*=0.036). Additionally, those who reported school absenteeism due to cultural or religious reasons and received the YDA + MFG intervention reported higher self-esteem than usual care (β =1.57 (0.07, 3.07), *p*=0.004). No significant moderation by menstrual hygiene knowledge or cultural attitude was detected.

Conclusion The YDA + MFG intervention and natural age progression improved self-esteem, though reliance on self-reported data may introduce bias. However, the YDA intervention alone did not significantly improve self-esteem at any assessment point.

Keywords Adolescent girls, Economic empowerment, Menstruation, Self-Esteem, Sub-Saharan Africa

Introduction

In Sub-Saharan Africa (SSA), roughly 230 million women are of reproductive age group (15 to 49 years) [1-3]. Menstruation is a natural physiological process involving the release of blood from the uterus in women and adolescent girls [4]. On a global scale, over 500 million women and girls face inadequate facilities for Menstrual Hygiene Management (MHM) [5]. This problem is especially acute in low and middle-income countries (LMICs), where over half of adolescent girls face mhm challenges, including inadequate access to private toilets, running water, disposal facilities, sanitary pads, and lack of financial means for sanitary products [6, 7]. Adolescence, marked by physical and biological transformations, presents unique challenges for girls [8]. Research underscores the importance of providing children and young adolescents with reproductive health information before puberty, typically between the ages of 11 and 13 [9, 10]. However, UNESCO indicates that up to 66% of girls report lacking knowledge about menstruation until they experience menarche [11]. Inadequate mhm has severe implications for health and other societal outcomes [12]. A study conducted by Miiro in Uganda revealed that 19.8% of the girls in their study missed school at least once during their last menstrual cycle, with 17.3% reporting school absenteeism, specifically during their menstrual days [13]. However, it is important to note that the evidence on menstruation's role in school absenteeism is mixed, with some studies finding only a small or no significant link [14, 15].

In SSA, poverty is a prominent factor preventing adolescent girls from affording sanitary pads (commercial products), potentially driving them to engage in risky behaviors such as transactional sex to secure these essential hygiene items and maintain their education [16]. Throughout their lifetime, females anticipate spending over \$1000 on menstrual products, leading some individuals to resort to cheaper yet unsanitary alternatives [17]. Without access to adequate menstrual hygiene products, girls have no choice but to resort to improvised and unhygienic alternatives for mhm [18]. Unfortunately, these unhygienic makeshift solutions carry risks, including wet fabric that increases the likelihood of infections, such as urinary tract infections [19]. Recent studies in Kenya found that inadequate menstrual products increased the risk of infections, such as bacterial vaginosis and sexually transmitted diseases [20, 21]. Another study showed that the proper use of pads was associated with a reduced risk of infections [22]. Interventions supporting menstrual health and hygiene have been shown to support girls' equity and development [23] Moreover, tax strategies, such as reducing or eliminating the tax on menstrual products, have further enhanced the accessibility and affordability of these essential items [24]. In addition, Economic empowerment programs, such as cash transfers and micro-savings initiatives, have shown positive impacts on girls' health and educational outcomes by reducing the need for risky behaviors and enabling them to remain in school, supporting their long-term socioeconomic development [25, 26].

In the context of this study, difficulties related to menstruation can result in diminished self-worth. Situations of period poverty are linked with feelings of shame and embarrassment, further eroding self-esteem. Additionally, the belief that menstruation is impure adversely affects women's self-respect and dignity [27]. Self-esteem, defined as the self-evaluation of one's self-worth [28], is one of the psychosocial attributes affected during adolescence. Self-esteem is a critical factor in the development of mental health disorders [29] and social problems such as depression, anorexia, anxiety, and violence [30]. Self-esteem impacts how people think and respond to circumstances [31]. For example, people with low selfesteem are more likely to engage in risk-taking behaviors [32, 33], such as drug and alcohol misuse [34], that may impact these adolescents for life. Moreover, low self-esteem adversely affects girls' participation in physical activities during their cycle, as it compels them to remain self-conscious or leads to outright isolation at all times [35]. On the other hand, individuals with high selfesteem tend to feel more confident, allowing them to participate in physical activities [36]. Self-esteem is closely

associated with quality of life, significantly influencing overall well-being and life satisfaction [37].

The family significantly influences the development of human character and is crucial in shaping self-esteem [38]. A supportive family environment, characterized by love, affection, and involvement, positively influences children's self-esteem, leading to higher self-esteem in those children [39]. The Multiple Family Group (MFG) model, which combines group and family therapy, involves multiple families participating together in sessions [40]. These include various therapeutic components such as psychoeducation, communication skills, and problem-solving strategies [41]. MFGs are designed to foster peer support [42]. They enhance social support by connecting families, offering mutual aid, sharing experiences, and building hope through shared solutions [43]. Group-based interventions have been linked to enhanced self-efficacy [44], interpersonal learning, and self-understanding [45], affecting self-perception and self-esteem [46]. Additionally, having parents and their children gather to share information during MFGs helps address common concerns such as mhm and develop supportive networks, which can effectively address mental health issues and improve self-esteem [40].

In Uganda, menstruation education is typically provided in the third year of secondary education. However, as the onset of puberty and adolescence varies among girls, this creates gaps in menstrual knowledge, especially when menstruation begins prior to receiving information. Furthermore, menstruation in Uganda is associated with sociocultural norms. For instance, cultural beliefs link menstruation to sorcery, leading to young girls' fears associated with the disposal of menstrual absorbents [47]. Menstruation is considered a private matter, especially from men [48]. In other regions, girls are prohibited from bathing or coming into contact with water [49]. This restriction can contribute to lowered self-esteem, as it may exacerbate bad odor, feelings of shame, and isolation during menstruation [50]. Moreover, individuals experiencing menstrual pain, which can, in some cases, be very debilitating, are often expected to remain silent about it. Those who openly discuss menstruation are seen as straying from societal expectations [51], which affects both the physical and psychological health of adolescents [52, 53]. The qualitative findings of Tegegne's mixedmethods research in Ethiopia revealed that during menstruation, participants experienced feelings of shame and dehumanization, all of which suggest a significant reduction in self-esteem [54]. In addition, studies from Ethiopia and India show that urban girls have better menstrual hygiene practices and knowledge than their rural counterparts. Urban girls in both regions used sanitary pads more frequently and scored higher in menstrual hygiene practices [55, 56].

Despite the widespread acknowledgment of the multifaceted challenges associated with mhm in Sub-Saharan Africa, there remains a gap in our understanding of how these challenges intersect and influence the psychosocial well-being, specifically self-esteem of adolescent girls. The literature has treated economic, cultural, and knowledge-based factors as separate entities, examining their impacts on aspects of menstrual hygiene and adolescent health. However, this approach overlooks the complex interplay of these factors and their combined effect on a crucial aspect of adolescent development-self-esteem. While the studies have documented the impact of economic empowerment (EE) on psychosocial functioning [57, 58], they do not explore the potential interplay between economic, cultural, and knowledge-based factors in this context. Our research aims to extend these findings by examining how cultural attitudes and knowledge of menstrual hygiene management might interact with economic empowerment and family-strengthening to influence the self-esteem of menstruating girls in Southwestern Uganda.

Theoretical framework

We applied the Self Efficacy and the asset theories to better understand mhm. Bandura's self-efficacy theory [59] posits that an individual's belief in their abilities is important in managing challenges. According to the theory, self-efficacy is the confidence that one succeeds in executing the behavior required to meet desired outcomes. In the context of this study, this principle implies that increasing confidence in mhm can boost the selfesteem and well-being of the girls. For instance, teaching girls how to properly use and dispose of menstrual products, track their menstrual cycles, and handle menstrual discomfort can make them feel competent and self-assured [60, 61]. Self-efficacy can also be fostered through engagement in peer support groups, such as the MFGs, which bring together caregivers and adolescents. In these groups, girls can share their experiences and strategies for managing menstruation. By participating in these groups, girls can learn from each other and gain confidence in handling menstrual-related challenges [62]. Seeing their peers successfully manage similar issues can reinforce their belief in one's capabilities, thereby improving their self-esteem. This belief and actual economic empowerment are likely to significantly enhance an individual's autonomy and self-esteem.

Sherraden's Asset theory posits, in part, that ownership of assets significantly enhances overall well-being, including psychological well-being and investment in one's future. Asset ownership provides personal efficacy, self-esteem, and social connectedness [63]. Furthermore, individuals who own assets tend to be perceived differently by themselves and others [64, 65]. In this particular

context, the accumulation of assets, typically in the form of financial resources, enables individuals to acquire menstrual hygiene products, such as sanitary pads, tampons, or menstrual cups, and enables them to participate in health-related education and training programs that provide information about menstrual hygiene. Over time, the accumulation of assets resulting from economic empowerment and family-strengthening initiatives plays an important role in enabling individuals to effectively address their menstrual hygiene needs. This, in turn, has an impact on enhancing their self-esteem and overall well-being [57, 66, 67]. The assurance of managing menstrual hygiene without financial constraints fosters a sense of stability and positive self-image, ultimately elevating self-esteem levels. Additionally, the Asset theory indicates that assets can be passed on from generation to generation, benefiting the children [63]. According to the asset theory, acquiring of knowledge and building assets are crucial elements in achieving improved health outcomes.

Hypotheses

H1. Participating in economic empowerment and family-strengthening interventions is associated with elevated self-esteem among adolescent girls in Uganda; H2. Cultural attitudes toward menstruation moderate the relationship between economic empowerment and family-strengthening interventions and self-esteem among adolescent girls; H3. Knowledge of menstrual hygiene management influences the relationship between economic empowerment and family-strengthening interventions and the self-esteem of adolescent girls; and H4. There is an interaction effect between the interventions, cultural attitudes, and menstrual hygiene management knowledge on the self-esteem of adolescent girls.

Methods

Study setting

Suubi4Her is a three-arm cluster-randomized trial conducted in 47 secondary schools in the greater Masaka region of Southwestern Uganda. The schools were in five geopolitical districts: Masaka, Kyotera, Lwengo, Rakai, and Kalungu. These districts are some of the hardest hit by the HIV epidemic in Uganda, with district-level prevalence estimates above the national average [68].

Recruitment and study population

All eligible participants were identified in collaboration with the school administration and Masaka Diocese. Informational flyers outlining the study and enrolment process were then distributed to these individuals. Interested adolescents and their caregivers subsequently had individual meetings with the local project coordinator to discuss eligibility criteria, the voluntary nature, and objectives of the study, the level of participation expected, potential risks and benefits, and safety and confidentiality considerations. To meet the eligibility criteria, participants needed to be (1) female, (2) between the ages of 14 and 17, and (3) in their first or second year of secondary school. Individuals residing in institutions or orphanages were deemed ineligible as one of the interventions was family-based. In total, 1260 adolescent girls were enrolled between March 2018 and February 2019, as shown in the consort diagram (Fig. 1). For details on recruitment, see the study protocol paper [69–71].

Randomization

After selecting the schools, all girls who fit the eligibility criteria were recruited and then randomized to three different study conditions at the school level. Stratified random sampling was used to allocate schools to four strata based on two variables: (1) student population size (medium size vs. large) and (2) geographical location (rural vs. urban), to ensure balance on those variables. The restricted randomization technique of Hayes and Moulton [72] was implemented within the four strata to ensure overall school balance across the three experimental groups. The control group (n = 16 schools, n = 408students) received usual care, which included a sexual and reproductive health curriculum delivered in school and school supplies (such as textbooks and notebooks). The two active treatment groups were as follows: Treatment 1 (n = 16 schools, n = 471 students) received everything the control group received, along with a savings-led Economic Empowerment (EE) Intervention (consisting of financial literacy training and Youth Development Accounts (YDA). Treatment 2 (n = 15 schools, n = 381students) received everything the control and Treatment 1 groups received, as well as a Family Strengthening (FS) intervention, which included a multiple family group (MFG) intervention. Below are the details of the interventions. Initially, all participants and their guardians provided consent based on the standard of care without prior knowledge of which specific intervention their school would receive. After the schools were assigned to the respective interventions, girls and their guardians were informed about the intervention details, and additional consent was obtained for their participation in the specific interventions.

Control arm Participants in the control arm received the usual sexual health education offered to adolescents in the region. Sexual health education included information from the Adolescent Sexual and Reproductive Health curriculum, a sex and health education handbook, and information on gender equality.



Fig. 1 Suubi4Her consort diagram

Economic empowerment using Youth Development Accounts (YDA) The YDA intervention arm included all components of the control arm. In addition, the YDA consisted of a matched savings program. A bank account was established in the adolescent's name, with their primary caregiver as a co-signer. To encourage long-term savings objectives, participants were enrolled in a 1:1 matched savings program funded by the study, where the matched funds could be utilized for activities supporting adolescent development. These funds could be allocated towards paying school fees (with fees sent directly to the school's bank) and investing in family-based incomegenerating activities (e.g., piggery, farming, and sewing). Access to the matching funds was contingent upon completing financial management workshops that covered income generation, utilization of financial institutions, saving, and asset-building during the intervention period.

Youth development accounts and multiple family group intervention arm (YDA+MFG) The YDA+MFG intervention condition involved a novel combination of the YDA and Family Strengthening (FS) intervention delivered through MFGs. This intervention comprised a structured curriculum incorporating elements of group therapy, family support, systemic family therapy, and behavioral parent training across 16 sessions. Specifically, the intervention emphasized the "4 Rs": Rules, Responsibility, Relationships, and Respectful communication, alongside factors related to family engagement in mental health services under the "2Ss": Stress and Social support. Each group session involved 12-20 families, and other extended family members, including uncles, aunts, other siblings, and grandparents, were invited to attend the sessions. The MFG approach provided an avenue for adolescents and their families to share their experiences with others in similar circumstances, fostering hope through social support, normalization of shared experiences and challenges, and the exchange of practical solutions. The sessions included Introduction to Amaka Amasanyufu (Happy Families), Behavioral Health Knowledge and Prevention, Puberty, HIV and STDs Knowledge and Prevention, Building on Family Strengths, Rules for Home and Problem Solving for Broken Rules, Respectful Communication, Responsibilities at Home, Family Relationships, Dealing with Stress in Families, Dealing with Environmental Stressors, Who can we turn to-Building Support, Good Family Practices, Building Families Up, Everyone Does their Share to Solve Problems, Everyone gets a Chance to be Heard and Group Review and Ending Celebrations.

A total of 12 trained Community Health Workers and Parent Peers facilitated the delivery of the MFG intervention. Facilitators needed to be fluent in both written and spoken Luganda, the local language of the study area. To be recruited, facilitators had to be trusted and accepted members of the community, recommended by school leadership, reside within 1 mile of the participating schools, commit to 60 min per week for 16 weeks, be willing to attend and complete training as a peer facilitator, and preferably be between the ages of 30 and 60. They underwent a 2-day training conducted by trained research assistants at the field offices in Masaka and were provided with manuals to deliver the intervention. At the end of the training, facilitators took the Knowledge Skills and Attitude Test (KSAT), and those scoring 85% or higher were selected. Successful facilitators were awarded certificates of completion. Each school had a pair of facilitators (one male and one female) who delivered all sessions together. Families were given assignments to complete at home before the next session. Trainers (research assistants) met with the facilitators bi-weekly to assess progress and address concerns.

Two research assistants attended all sessions to ensure fidelity across sessions delivered and manage logistics, including providing transport reimbursements to the families. They observed the sessions, completed fidelity assessments at the end of each session, and shared feedback with the facilitators afterward. Overall, participants attended an average of 10 MFG sessions (M = 10.60, SD = 5.90; range, 1–16). Of the 317 that attended the intervention, 34.38% (N=109) completed all 16 sessions, and 17.38% (N=54) completed 15 sessions. However, 13.56% (N=43) did not attend any sessions [73].

The interventions were implemented over 24 months, with data collection occurring at baseline (Preintervention), during the intervention (at 12 months), and at 24-months follow-up (after the intervention). Due to the number of schools receiving the treatment (n = 31), the intervention delivery was staggered. This approach involved administering the intervention in one group of schools at a time and, upon completion, moving on to the next group. For schools assigned to treatment arm 2, the YDA component was provided continuously throughout the 24 months. Consequently, follow-up data were collected at 12 and 24 months after the start of the intervention to ensure all schools received an equal duration of treatment and follow-up [71].

Ethical considerations

The study protocols underwent review and approval by the Institutional Review Board (IRB) at Washington University in St. Louis (IRB- #201703102), as well as by local IRBs in Uganda, including the Uganda Virus Research Institute-Research Ethics Committee (GC/127/17/07/619), and the Uganda National Council for Science and Technology (SS4406). Caregivers provided written informed consent, and adolescents provided assent before participating in the study.

Data collection procedure

Initially, the survey instruments were translated into Luganda, the local language spoken in the study area. To ensure consistency and accuracy, the survey instruments were back-translated into English, supervised by trained experts from Makerere University School of Languages, Literature, and Communication in Uganda. The translators each hold a bachelor's degree with a specialization in Luganda and English at the college level. They are all trained in the local language Luganda, and they speak Luganda. In addition, they all studied English starting from primary school throughout the university, making them fluent in both English and Luganda. The written translations were reviewed and cross-checked by at least three people to ensure accuracy in wording and meaning. Local research assistants, fluent in English and Luganda, were responsible for collecting the data. The research

assistants received training in good clinical practice, data collection techniques, and human subjects' protection and completed the Collaborative Institutional Training Initiative (CITI) Human Subjects certificate. Following enrolment, participants underwent a structured interview (baseline interviews), each lasting between 60 and 90 min. Follow-up interviews were conducted at 12 and 24 months after enrolment. High completion rates, 96.7%, and 92.5%, were achieved at 12 and 24-month follow-ups, respectively. Details are shown in the consort diagram (Fig. 1).

Study measures

Outcome variable

The outcome assessed in this study is self-esteem, measured using the Rosenberg Self-Esteem Scale [74]. The 10-item scale measures individual self-esteem on a fourpoint Likert scale (1=strongly disagree to 4=strongly agree). One item in the opposite direction was reversecoded for higher scores to indicate higher self-esteem. Sample scale items include: "I feel that I am equal to other people.", "I take a positive attitude toward myself.", and "I am satisfied with myself." The theoretical range is 10 to 40 (alpha=0.66), with higher scores indicating higher self-esteem.

Sociodemographic characteristics

Participants' sociodemographic characteristics included; (1) age, (2) Orphanhood status categorized as double orphan, single orphan, and non-orphan; (3) Primary caregiver categorized as biological parent, grandparent, and other relative; (4) total number of individuals living in a household; (5) number of children living in a household; and (6) asset ownership assessed by a 21-item index in which participants were asked, "Does the family you live in own the following: house, rentals, car, coffee plantation, banana plantation, etc.?" Coded 1 if they owned the assets and 0 if they did not. The total number was summed up to get the total number of assets in a household. Notably, some participants had not started menstruating at baseline.

Moderator variables

The moderating variables in the study were: (1) Menstrual hygiene knowledge: This was measured using a nine-item scale, where participants indicated whether statements about menstrual knowledge were true (1) or false (0). Sample statements include: "Women stop menstruating as they grow old," "Pregnant women menstruate," and "Pain during the menstruation period means that someone is sick." Statements in the opposite direction were reverse-coded to ensure that higher scores indicated higher menstrual knowledge. The theoretical range for this variable is 0-9 (Cronbach alpha=0.572). (2) Cultural Attitudes: This was assessed by asking the question: "Do you miss school during your menstruation period because of cultural or religious reasons?" Participants responded with either Yes (1) or No (0).

Data analysis procedure

The data was analyzed in Stata version 18.0. We summarized the baseline characteristics using means and standard deviations for continuous variables and counts and percentages for categorical variables. Summary statistics for baseline characteristics were stratified per study arm. We utilized mixed-effects linear regression analysis to examine the effect of the interventions on self-esteem. We adjusted for clustering, given that study participants were randomized at the school level. The model included three levels, that are repeated observations (level 1) nested within study participants (level 2) who are also nested within schools (level 3). We included the random effect for the schools and participants to address the variability between schools and the participants respectively. During model construction, we opted for an unstructured covariance structure for the random effects, the most flexible covariance structure. In the unstructured covariance, each variance and covariance are estimated separately without imposing any pattern or structure. We examined the models to determine that the residuals were normally distributed, there was homoskedasticity (VIFs were below 5), and no multicollinearity was detected. Additionally, the model included categorical effects for the group (control vs. YDA vs. YDA + MFG) and time (assessment time points), and the interaction between group and time as fixed effects. We also included cultural attitudes and menstrual hygiene knowledge as fixed effects in the model and their interaction terms with the interventions.

After running the mixed-effects model, we calculated the predicted values for self-esteem across different time points for each study group. Using these predictions, we created a margins plot to visually represent changes over time (Fig. 2). Additionally, we evaluated the self-esteem progression by comparing the rate of change (slopes) between the treatment groups and the control group at each follow-up interval. We evaluated pairwise group comparisons in self-esteem at different visits while applying Sidak's adjustment statistics for adjusting *p*-values to account for multiple comparisons. The intra-class correlation coefficients were determined using the calculated variances at each level. We reported beta coefficients along with their Huber-White cluster-adjusted confidence intervals. Statistical significance was established at a *p*-value of 0.05.



Fig. 2 A graph showing mean scores of self-esteem over time by the three study arms

Table 1 Baseline characteristics

	Total sample N=1260	Control n=408	YDA n=471	YDA + MFG n = 381
Age mean (SD) (Range: 14–17)	15.37 (0.87)	15.18 (0.86)	15.49 (0.82)	15.43 (0.90)
Orphanhood status				
Double orphan	24 (1.90)	7 (1.72)	8 (1.70)	9 (2.36)
Single orphan	191 (15.16)	59 (14.46)	72 (15.29)	60 (15.75)
Non-orphan	1045 (82.94)	342 (83.82)	391 (83.01)	312 (81.89)
Primary caregiver				
Biological parent	965 (76.59)	312 (76.47)	370 (78.56)	283 (74.28)
Grandparent	140 (11.11)	46 (11.27)	54 (11.46)	40 (10.50)
Other parent	155 (12.30)	50 (12.25)	47 (9.98)	58 (15.22)
Number of people in a household size (mean(SD) (Range: 2–31))	7.00 (2.71)	6.81 (2.61)	7.03 (2.66)	7.17 (2.85)
Number of Children in a household size (mean(SD) (Range: 0–13))	3.50 (2.10)	3.40 (2.06)	3.49 (2.17)	3.62 (2.05)
Asset ownership (mean(SD) (Range: 0–20))	11.46 (3.26)	11.23 (3.25)	11.81 (3.14)	11.27 (3.39)
Missing school during menstruation due to cultural or religious reasons (Cultural attitudes)				
Yes	201 (17.90)	60 (16.71)	71 (16.63)	70 (20.77)
No	922 (82.10)	299 (83.29)	356 (83.37)	267 (79.23)
Menstrual knowledge (mean(SD) (Range: 0–9))	3.52 (1.93)	3.64 (1.94)	3.54 (2.00)	3.34 (1.79)
Self-esteem (mean (SD) (Range: 16–40)	34.01 (4.57)	33.90 (4.68)	34.47 (4.41)	33.57 (4.62)

MFG = multiple family group; YDA = youth development account; SD = standard deviation

Results

Baseline sample characteristics

Participants' baseline characteristics are shown in Table 1. The mean age was 15.4 years. Most of the participants were non-orphans (82.9%), and the majority reported biological parents as their primary caregivers (76.6%). Each household/family comprised an average of 7 individuals and an average of 3 children. At baseline, the participants' mean self-esteem was 34.01 (SD=4.57),

on a scale with a range of 16–40. At baseline, 89.1% reported to have started menstruating. All baseline characteristics were comparable across the three study arms.

Impact of the interventions and time on self-esteem

Results from the mixed effects model (Table 2) show that the main effect for time was statistically significant ($\chi^2(2) = 102.07$, p < 0.001), suggesting improvement of self-esteem over time, irrespective of the study

Table 2 Mixed-Effects regression model on the effect of the intervention on self-esteem

Parameter	β (95% Cl)	<i>p</i> -Value
Menstrual Knowledge	-0.16 (-0.36, 0.04)	0.120
Cultural attitudes		
No (ref)		
Yes	-1.00 (-2.19, 0.19)	0.099
Group x Menstrual knowledge		
Usual care x Menstrual knowledge (ref)		
YDA x Menstrual knowledge	0.14 (-0.10, 0.39)	0.255
YDA + MFG x Menstrual knowledge	-0.01 (-0.28,0.26)	0.928
Group x Cultural attitudes		
Usual care x Cultural attitudes (ref)		
YDA x Cultural attitudes	0.14 (-1.34, 1.61)	0.856
YDA + MFG x Cultural attitudes	1.57 (0.07, 3.07)	0.040
Group: x ² (df)	1.39 (2)	0.500
Usual care (ref)		
YDA	-0.24 (-1.74, 1.26)	0.753
YDA + MFG	-1.08 (-2.53, 0.36)	0.142
Time (Assessment points): $\chi^2(df)$	102.07 (2)	< 0.001
Baseline (ref)		
12 months	0.06 (-0.77, 0.89)	0.886
24 months	1.61 (0.67, 2.55)	0.001
Group x time: $\chi^2(df)$	12.99 (4)	0.011
Usual care x baseline (ref)		
YDA x 12 months	0.54 (-0.60, 1.69)	0.351
YDA + MFG x 12 months	1.29 (0.19, 2.38)	0.021
YDA x 24 months	0.33 (-0.83, 1.48)	0.582
YDA + MFG x 24 months	1.58 (0.45, 2.71)	0.006
Constant	35.07 (33.94, 36.20)	< 0.001
Random effects		
School variance	0.107 (0.009 to 1.210)	
Participant variance	3.670 (2.773 to 4.856)	
School level ICC	0.007 (0.001 to 0.704)	
Participant level ICC	0.237 (0.181 to 0.303)	
Number of participants	1260	
No. of observations	1896	

Bolded values are significant at the 0.05 level

CI = confidence interval; MFG = multiple family group; YDA = youth development account; ref = Reference group; ICC = intraclass correlation coefficient

intervention. The intervention-time interaction effects were also statistically significant ($\chi^2(4) = 12.99$, p = 0.011), suggesting over time, there were statistically significant differences in self-esteem across the interventions.

To further examine the significant intervention-time interaction effects, we performed post estimations, including pairwise group comparisons at the different assessment time points (See Table 3), which showed significantly higher self-esteem in the YDA+MFG group compared to the control at time point 3 (24-months follow-up). This finding confirmed that the statistically significant intervention-time interaction was driven by the positive effect of YDA+MFG intervention on self-esteem.

When comparing the changes in self-esteem (slopes) between the three study groups at the different time

points, we found a statistically significant increase in selfesteem in the YDA + MFG group compared to the control group between baseline and 12 months; and between 12 and 24 months of follow up (See Table 4).

Effect of menstrual hygiene knowledge and cultural attitudes

As shown in Table 2, we observed a significant interaction between cultural attitudes and the study interventions. Specifically, participants who reported missing school during their menstruation period for cultural or religious reasons and received YDA + MFG intervention had significantly higher self-esteem than those in the usual care, $\beta = 1.57 (0.07, 3.07)$, p = 0.004. Table 3 Pairwise comparisons for Self-esteem between participants in the different intervention groups at each time point

Outcomes	Self esteem	
Group Comparisons Over Time	Mean difference (95% CI)	<i>p</i> -value
At baseline		
YDA vs. Usual care	0.173 (-1.453, 1.108)	0.791
YDA + MFG vs. Usual care	-0.299 (-1.713, 1.114)	0.678
At 12-months		
YDA vs. Usual care	0.372 (0.893, 1.637)	0.565
YDA + MFG vs. Usual care	0.986 (-0.495, 2.468)	0.192
At 24-months		
YDA vs. Usual care	0.153 (-0.904, 1.210)	0.777
YDA+MFG vs. Usual care	1.282 (0.084, 2.480)	0.036

Bolded values are significant at the 0.05 level

 ${\sf CI} = {\sf confidence} \ {\sf interval}; {\sf MFG} = {\sf multiple} \ {\sf family} \ {\sf group}; {\sf YDA} = {\sf youth} \ {\sf development} \ {\sf account}$

Table 4 Comparing changes in self-esteem between participants in the different intervention groups at each time point

Self-esteem	Difference in slopes		
	(95% CI)	<i>p</i> -value	
Baseline to 12-months			
YDA vs. Usual care	0.545 (-0.601, 1.690)	0.351	
YDA + MFG vs. Usual care	1.268 (0.190, 2.382)	0.021	
Twelve to 24-months			
YDA vs. Usual care	0.326 (-0.832, 1.483)	0.582	
YDA + MFG vs. Usual care	1.582 (0.455, 2.709)	0.006	

Bolded values are significant at the 0.05 level

CI = confidence interval; MFG = multiple family group; YDA = youth development account

Discussion

The present study assesses the effect of economic empowerment and family-strengthening interventions on the self-esteem of adolescent girls in Uganda. We hypothesized that participating in such interventions is associated with improved self-esteem. Additionally, we proposed that mhm knowledge and cultural attitudes would moderate the relationship. We also hypothesized an interaction effect, suggesting a combination of EE + FS, cultural attitudes, and mhm knowledge would influence self-esteem. Results revealed that our study provides evidence suggesting that interventions, particularly when combining YDAs and MFGs, are associated with a progressive improvement in the self-esteem of adolescent girls [57]. However, the improvement in self-esteem could also be linked to the natural progression in the girls' ages over time [75]. Particularly, the interventions demonstrated increased effectiveness at the 24-months follow-up point, with no significant differences evident when YDAs were applied separately. The study was conducted in a region where family ties and community support are important for adolescent development [76]; hence, the results from the combined intervention are also not surprising, indicating that leveraging existing structures to support an environment conducive to the self-esteem of adolescent girls is important. By participating in economic empowerment and family activities, the girls likely developed a stronger sense of self-efficacy, contributing to higher self-esteem. Moreover, the interventions provided tangible and intangible assets to the girls and their families. Tangible assets included financial resources, while intangible assets comprised knowledge, skills, and social support. These assets are fundamental to improving self-esteem as they provide the resources needed to overcome barriers and achieve personal goals, including self-esteem.

The results from our study reveal that the impact of the YDA+MFG intervention on the self-esteem of adolescent girls unfolds over time, indicating that the intervention has a temporal effect on the self-esteem of adolescent girls. This finding suggests that certain components of the intervention are effective in moderating self-esteem progressively, highlighting the critical nature of crafting interventions that target self-esteem due to its influence on the psychosocial health of adolescents [77]. Although the pairwise group comparison did not yield statistically significant results at the initial time points, participants in the YDA+MFG intervention arm exhibited a statistically significant improvement in self-esteem compared to the usual care. This phenomenon may be attributed to the delayed onset of some intervention effects, which might manifest more significantly over extended durations. This concept aligns with the body of research suggesting that the full effects of certain interventions may only become evident after a considerable period [78].

The findings suggest that the YDA intervention, despite including income-generating activities, did not significantly impact the self-esteem of adolescents. This may indicate that while financial savings and economic opportunities are beneficial, adolescents require more immediate and comprehensive forms of support to positively affect their self-perception. For example, the Empowerment and Livelihood for Adolescents (ELA) program conducted in Uganda incorporated not only financial literacy and vocational training but also voluntary club participation that included life skills, recreational activities, and a space for girls to socialize, privately discuss issues of concern, and develop non-cognitive skills. This more holistic approach, which combines economic empowerment with opportunities for social interaction and personal development, likely contributed to the stronger impact on adolescent well-being seen in the ELA program [79]. Similarly, the Adolescent Girls Initiative (AGI) in Kenya went beyond simple cash transfers by combining economic empowerment with life skills training and health education, resulting in more comprehensive support for adolescent girls [80]. The findings from these studies also suggest that combined interventions may be more effective among adolescent girls than single-pronged strategies. In contrast, a study conducted in Zambia found that economic empowerment interventions, when implemented in isolation, tend to result in limited improvements in well-being, especially for certain age groups, compared to combined interventions [81].

The data depicted in Fig. 2 illustrates the temporal progression of self-esteem mean scores across the three study cohorts. Initially, the YDA + MFG group exhibited the lowest self-esteem levels, followed by those receiving usual care, while the YDA-only group had marginally higher self-esteem. At the 12-month evaluation, the YDA-only group maintained their lead in self-esteem scores, with the YDA+MFG group showing a notable increase, and the usual care group's self-esteem remained consistent with their baseline measures. By the 24-month follow-up point, individuals in the YDA+MFG group demonstrated the highest self-esteem, surpassing the other groups. In the MFG sessions, adolescents were accompanied by their guardians, a strategy that may enhance outcomes by facilitating open dialogue [82]. Such an arrangement can promote candid discussions about menstrual hygiene, allowing adolescents to share their perspectives and inquire about their guardians' experiences with menstruation. This level of effective communication is instrumental in knowledge transfer and can significantly bolster the self-esteem of young individuals [83] by normalizing conversations around menstrual health. Furthermore, economic empowerment can enhance adolescents' access to education by providing them with the means to acquire essential items, such as academic supplies [84] and menstrual hygiene products. This support is instrumental in improving school attendance rates, as it addresses one of the key barriers girls often face in maintaining consistent school participation.

We observed a significant interaction between cultural attitudes and the study interventions. The familylevel engagement in the MFG intervention might have encouraged open discussions, reducing the stigma and cultural taboos associated with menstruation. Specifically, session three on puberty is instrumental in this regard. This normalization of open discussions could have fostered a more supportive environment, allowing adolescents to feel more comfortable and positive about themselves during their menstrual periods, thus enhancing self-esteem. This finding contrasts with traditional assumptions regarding the impact of cultural attitudes on menstrual hygiene management. Historical perspectives in certain areas have associated menstruation with impurity, silence, and restrictions from accessing public areas [47, 51, 85]. These norms can severely impede the development of a positive self-image and robust self-esteem in young girls. When girls internalize these negative perceptions and taboos associated with menstruation, it can contribute to feelings of shame, inadequacy, and a diminished sense of self-worth.

The analyses did not reveal a significant interaction effect between economic empowerment, cultural attitudes, and menstrual hygiene management knowledge on the self-esteem of adolescent girls. The absence of this interaction may be due to the effectiveness of the intervention, which could have diminished the moderating effects of menstrual hygiene knowledge and cultural attitudes. Additionally, the intervention was not designed to address cultural attitudes.

To bolster its effectiveness, the study incorporated a holistic intervention combining economic empowerment with family-level support. This required families to merge their financial resources, fostering savings and fulfilling unique familial needs. The interventions facilitated enhanced intra-familial communication and strengthened relationships, enabling families to collectively address and overcome many emotional, social, and financial challenges. This empowerment of families to act together has significantly contributed to the improved self-esteem of adolescent girls within these family units.

Implications

Economic empowerment and Family-strengthening strategies, particularly when combined, may contribute to improving the well-being of adolescents. By expanding entrepreneurial opportunities and providing financial and psychosocial support, these interventions could foster self-esteem and resilience among adolescent girls. While our findings indicate some positive outcomes from the combined interventions, additional research is needed to fully understand the broader and long-term effects of these strategies on adolescent well-being.

Moreover, considering the influence of cultural perceptions, it is essential to investigate the enduring impact of economic empowerment and family strengthening on adolescents' self-worth during menstruation. This investigation is particularly pertinent in settings marked by diverse cultural practices and beliefs surrounding menstruation.

The research underscores the critical role of policy frameworks integrating economic empowerment and family-strengthening initiatives within health policies targeted at adolescent girls and their families. Such integrative policies are fundamental in bolstering familial bonds and cultivating an environment that nurtures the self-esteem of adolescent girls, particularly during menstruation. Moreover, incorporating comprehensive menstrual hygiene education into school curricula is essential. This educational component is vital for dispelling persistent myths surrounding menstruation, thereby alleviating the psychological distress often associated with menstrual misconceptions and enhancing the overall well-being of the girls. Additionally, without clear recognition and consistent monitoring, Menstrual Health and Hygiene (MHH) may continue to marginalize disadvantaged adolescent girls. Linking MHH to the Sustainable Development Goals (SDGs) could elevate its importance, especially since it's not included in SDG 6.2, which addresses sanitation and hygiene for women and girls [23].

Limitations

The study presents significant improvements in selfesteem for the YDA + MFG group at 24 months. However, we don't know whether these effects will be sustained post-study. Future research should consider more extended follow-up periods to capture the full impact of the interventions and employ measures that can detect understated changes in self-esteem. Additionally, exploring other potential moderators, such as socioeconomic status or peer relationships, could provide a more comprehensive understanding of the moderating factors.

In this study, the cohort was primarily composed of in-school adolescents from rural and urban public secondary schools, ensuring a degree of uniformity in the sample's educational context and community setting. The selection criteria resulted in a homogenous group of schools with comparable socio-demographic attributes. Consequently, while the study offers valuable insights into the school-based environment, this uniformity limits the generalizability of findings to adolescents in other educational settings or regions. For instance, adolescents attending private schools, vocational schools, or those in different geographical regions such as peri-urban or remote rural areas may face different challenges and opportunities. Moreover, the study's focus on in-school students may not capture the unique challenges faced by out-of-school adolescents who could experience different economic pressures and cultural dynamics that impact self-esteem. In addition, not all eligible participants chose to participate in the study. This could introduce selection bias, potentially affecting the generalizability of our results.

It is also important to acknowledge that not all participants had commenced menstruating at baseline. This variation could influence the study's outcomes, particularly about menstrual hygiene management's impact on self-esteem. Future studies should consider stratifying analyses based on menstrual status at baseline to account for this variability. Additionally, while the quantitative approach provided significant insights, the absence of a qualitative component may have limited the depth of understanding, particularly regarding cultural beliefs and perceptions surrounding menstruation. Incorporating qualitative data, such as the voices of young adolescents and older women from their communities, could have provided a more nuanced set of findings and enriched the overall interpretation of the results. Future research should integrate qualitative methods to capture the participants' lived experiences and provide a more comprehensive understanding of the cultural contexts influencing menstrual hygiene management and self-esteem.

Conclusions

Overall, the research offers some evidence that the combination of YDAs with MFGs may contribute to improving self-esteem over time. These findings enrich the existing research on interventions aimed at bolstering self-esteem and offer a foundation for constructing selfesteem enhancement programs tailored to adolescent girls. The insights from these interventions may serve as a framework for identifying which components are most effective for developing robust self-esteem interventions.

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Author contributions

FN wrote the manuscript, VS and SK managed the study data, and led the data analysis process. FMS wrote the grant and obtained funding for the study. PN (1) contributed to the conceptualization and writing of this manuscript, FN (2) supervised the field data collection, NT, PN (2), and FMS guided the conceptualization, reviewed the manuscript for intellectual content, and made significant additions to the manuscript.

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Data availability

The dataset used for analysis in the current study is available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Written informed assent and consent was obtained from the adolescent participants and their caregivers. To prevent any compulsion, the procedures for adolescents and adult caregivers were separate. Forms for consent and assent were translated into Luganda from English. Adolescent participants spoke English, although most were more comfortable speaking Luganda. In light of the participants' English competence, the assent procedure was conducted in either English or Luganda. The research outlined in this manuscript was performed in accordance with the Declaration of Helsinki. All study procedures were approved by the Washington University in St. Louis Institutional Review Board (#201703102) and by in-country local IRBs in Uganda Virus Research Institute-Research Ethics Committee (UVRI-REC– GC/127/17/07/619), and Uganda National Council for Science and Technology (UNCST– SS4406).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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